The way we speak, the way we feel: How do language patterns reveal stress? A study on long-term human isolation

DOCTORAL DISSERTATION

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Submitted by

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To my family and my best friend Vasilisa

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Abbreviations

3	Third person
ANS	Autonomic nervous system
bpm	beats per minute
ConvA	Conversation analysis
D1	Discussion 1
D2	Discussion 2
D3	Discussion 3
D4	Discussion 4
D5	Discussion 5
F	Illocutionary force
FUT	Future tense
GAS	General Adaptation Syndrome
HBP	Human Behavior and Performance (competencies described by Mission Operations Directorate ITCB HBP Training Working Group 2008a,b)
HR	Heart rate
HRV	Heart rate variability
IA	Illocutionary act
IBMP	Institute of Biomedical Problems of the Russian Academy of Sciences
INF	Infinitive
INSTR	Instrumental case
Ipfv.	Imperfective aspect
ISS	International Space Station
L1	First language
L2	Foreign language
LF	Low-frequency power
LIWC	Linguistic Inquiry and Word Count software
MCC	Mission Control Center
NP	Noun phrase
p	Propositional content
Pfv.	Perfective aspect
PNS	Parasympathetic nervous system
POMS	Profile of Mood States
PREF	Prefix
PRF	Perfect tense
PRS	Present tense
PST	Past tense
PTCP	Participle
QCA	Qualitative content analysis
REFL	Reflexive
SA	Speech act
SG	Singular
SIRIUS	Scientific International Research In Unique terrestrial Station
SNS	Sympathetic nervous system
TCU	Turn-constructional unit

V.A. Valentina Anikushina

1. Introduction

Looking at the starry night sky has always been something that has captivated the imagination of humankind. It is possible that one of the oldest members of humankind, peering into the dark sky, wondered what were stars, the moon, or meteors. A jumble of thoughts, not yet organized by language, might have rushed through their mind, keeping them awe-struck in the face of the wild and mysterious nocturnal beauty. Later, humans attempted to explain celestial objects through religion and link their existence to ordinary human life through astrology. Astronomy was, reasonably, the first scientific approach to systemize the vast amount of knowledge and facts about the heavenly bodies. Nonetheless, it was only much later when humans succeeded in their attempt to take off from earth and become closer to what enchanted them from above since the cradle of humankind. The era of space exploration began.

However, leaving the caring cradle of Earth, space travelers encounter a hostile environment in outer space. Radiation, extreme temperatures, and low gravity are just some of the conditions that the human body must be protected against. Furthermore, the human psyche must be kept intact too. Thus, in addition to the physiological perils, there are countless concerns of a psychological nature which must also be taken into account when preparing for a space mission. The great distance from the home Earth, the dangerous and even deadly surroundings, the high level of responsibility when carrying out sophisticated and lavish scientific experiments, as well as the extent of physical and social isolation aboard a spacecraft can be named among many other psychological adversities that space travelers have to deal with[1]. The lattermost of these – isolation – is vital in the context of the present research.

To ensure that there is sufficient knowledge about the functioning of human body and psyche in challenging environments, conditions of a space flight are recreated and their effects on humans are studied on earth. Such experiments are oriented towards both technical and psychological aspects relating to space exploration. Among other things, these experiments aim to elaborate methods which mitigate possible risks associated with human factors that emerge during real space flights. Isolation, being one of the major plights that is intrinsic to space travel, is also recreated and its effects on humans are studied on earth. Furthermore, isolation during space flight is oftentimes mingled with additional aggravating factors. For instance, space travelers are required to communicate in a foreign language, e.g. at the International Space Station (ISS) – astronauts and cosmonauts have to have a high degree of competency in Russian and English that are two official working languages on the ISS. They also have to maintain high labor efficiency while being deprived of sleep, e.g. due to an emergency situation onboard a spacecraft. These additional real life stress factors can be simulated during isolation experiments as well. One such human isolation experiment, that simulated a crewed flight to the Moon and its return back to Earth, lays the foundation for the present research[2].

The central topic of the present research is connected to recently announced objectives of several national and commercial space agencies to bring humans back to the Moon and to also enable future crewed missions to Mars. Today, the need to prepare humanity for the next chapter in space exploration is of the utmost importance. Such ambitious goals inevitably challenge state-of-the-art technology – from the engineering of spaceships to life-support systems – that are mandatory for safe prolonged space travels. Furthermore, human behavior in

[1] See e.g. Kanas & Manzey (2008) for an overview of possible hurdles related to manned space missions.

[2] The present research project was enabled by the Institute of Biomedical Problems of the Russian Academy of Sciences where SIRIUS-19 (see Chapter 5) took place and the data were collected. Sincere gratitude is expressed to the Institute of Biomedical Problems of the Russian Academy of Sciences for enabling this research project.

complex and extreme environments comes to the fore, since those who undertake the space missions are humans; humans will have to operate sophisticated technology and conduct byzantine scientific experiments. Their mental and physical health is vital. Thus, only a synthesis of the latest technology with human physical and mental health can ensure safety during such a risky and dangerous undertaking as human space exploration. Psychological aspects related to human space exploration are in the center of the interest in the present dissertation. In particular, the research at hand tries to answer the question of whether spontaneous speech and communication within a small group of individuals can reveal signs of stress in speakers, since stress can negatively affect human performance and thus compromise space mission safety. The present research approaches linguistic data from two perspectives: (i) content-oriented analysis of communication and (ii) analysis of speakers' choice among available linguistic options. The goal of the present research can be broadly defined as that of elaborating a methodology to assess stress in speakers non-invasively through their communicative behavior. The analysis of communicative data is based on five group decision-making discussions of a six-person mixed-gender international (Russian and English languages) group of subjects that took part in a four-month physical and social isolation experiment. The linguistic data collected within the present research are furthermore related to physiological measures of stress (i.e. heart rate) and juxtaposed with group dynamics that were assessed by means of recurrent sociometric questionnaires.

The present dissertation is organized as follows. There are two main parts – a theoretical part and an empirical part. The theoretical part aims to outline a framework for the subsequent empirical investigation and can broadly be divided into two sections. The first section (i.e. Chapter 2) is dedicated to the concept of stress and how it is conceived in psychology and physiology. In this chapter, it is explained what factors can lead humans to experience stress (i.e. the psychological nature of stress) and how stress manifests itself somatically (i.e. the physiological nature of stress). The second section of the theoretical part (Chapter 3 – Chapter 4) addresses the idea of language as a sensitive gauge of mental states in speakers, focusing on conditions when they are under stress. Two perspectives were chosen for the analysis of linguistic data with this respect: (i) analysis of the linguistic materials, considering their content (Chapter 3) and (ii) analysis of the linguistic choices, among possible linguistic alternatives, that a speaker makes (Chapter 4). Within the former perspective, pragmatics, conversation analysis, and content analysis are discussed. Pragmatics helps to uncover the contextual meaning of utterances. Conversation analysis facilitates investigation of the structure of a conversation. Content analysis is a method to systematically analyze qualitative data, in this case discussions. In order to provide the status quo of the research on language under stress that relies on content-oriented approach, one section of Chapter 3 (i.e. section 3.4.) is dedicated to introducing a few pivotal studies of language under stress in the realm of aviation, crewed space missions, and during taxing conditions in daily life in general.

The second perspective within the analysis of linguistic data considers context-sensitive categories of language. This is discussed in Chapter 4. According to Markedness theory (section 4.1.), grammar is asymmetrical and hierarchical, meaning that certain linguistic structures require more mental resources than others. According to Givenness Hierarchy and Accessibility theory (section 4.2.), referring expressions vary in terms of the cognitive status of the referent and the degree of its mental accessibility.

The empirical part of the dissertation is built upon the above-described two approaches to the analysis of linguistic data: (i) content-oriented approach and (ii) analysis of context-sensitive linguistic categories. The material for the empirical investigation is a four-month human isolation experiment; its framework is outlined in Chapter 5. The research questions that the dissertation attends to, both within the content-oriented approach and in the analysis of context-sensitive linguistic categories, are outlined in Chapter 6. In general, the question of

whether and how stress is manifested in communicative behavior of speakers can serve as a unifying inquiry for all individual research questions. The content-oriented approach to the linguistic material opens the empirical investigation and starts by setting the frame of the analysis; in this way, Chapter 7 provides the methodology according to which the analysis is to be carried out. The content-oriented analysis proceeds on three separate levels which are delineated in three separate chapters: (i) Chapter 8 analyzes the linguistic data on the group level; (ii) Chapter 9 analyzes the linguistic data on the intra-individual level; and (iii) Chapter 10 analyzes the linguistic data on the inter-individual level. In the following chapter, Chapter 11, the analysis of the context-sensitive linguistic categories, i.e. Russian aspectual and grammatical voice systems as well as referring expressions, is conducted. Furthermore, the chapter offers an inductive analysis of speech during increased levels of psychological stress in speakers. Finally, Chapter 12 summarizes all research findings and draws conclusions.

Theoretical part

2. The concept of stress

2.1. Stress from a psychological perspective

From a psychological perspective, stress is a transactional relation between a person and their environment (Lazarus & Folkman 1984: 19; Lazarus 1966). Thus, stress is a response or a reaction to a taxing situation. In a more general sense, stress is a state of disequilibrium in one's system which activates mechanisms to regain homeostasis (Selye 1978: 12f.).

According to the transactional model of stress after the tradition of Lazarus, when encountering a potentially taxing stimulus (or a *stressor*), a person cognitively appraises the stressor by concluding whether it is (1) irrelevant, (2) benign-positive, or (3) stressful to the person's well-being. This process is called primary appraisal (Lazarus & Folkman 1984: 32). If a stressor is appraised as stressful, it can be assessed as a harm/loss, threat, or challenge. Harm/loss implies that a damaging effect to the person's welfare has already been caused (e.g. an injury), while threat implies the mere anticipation of this effect. Challenge is a kind of anticipation as well, although it is related to a positive gain that would result from the encounter (e.g. the feeling of excitement prior to an important speech, if the person is well prepared and can count on their success) (cf. ibid.: 33). An appraisal of an encounter as stressful is always accompanied by the mobilization of explicit efforts to manage the demands so it cannot be an automatic response (ibid.: 132).

If the primary appraisal provokes an experience of an encounter as stressful, the secondary appraisal takes place. During the secondary appraisal, the availability of necessary internal and external resources (be they cognitive, social, psychological) is revised and strategies (also called *coping processes* (Lazarus 1966: 25)) to deal with the stressful situation are developed (cf. ibid.: 53). For example, if a person who is standing alone and unarmed in an empty street spots a dog who is angrily barking and running towards them, the person is very likely to experience a great deal of threat and stress since the person does not have enough resources to escape the dog and its possible attack. However, should a comparable situation happen to a dog trainer in a dog school, the trainer is usually well-equipped with a knowledge of dog behavior and is already wearing a jacket that protects them against biting. Hence, the person possesses the necessary means to deal with this kind of threat and does not experience stress. To sum up, for a stressor to provoke stress in a person (both in positive, i.e. challenge, and negative, i.e. threat or harm/loss, terms), the person typically lacks the necessary resources to deal with the stressful environment. Further, it is important to notice that, despite the misleading naming of the two stages in the model, i.e. primary and secondary appraisal, it does not indicate that the former must proceed before the latter, nor that they are independent processes. It is more appropriate to speak about an "active interplay on the part of both" (Lazarus 2006: 78; cf. Lazarus & Folkman 1984: 31).

Following the transactional (dynamic and bidirectional) view on stress, reappraisal of an ongoing taxing environment proceeds constantly. Once appraised as a stressful encounter, it can cease to be stress-inducing if the affected person has gained new knowledge, expanded their

social network, or acquired other relevant resources to "withstand" the stressor (cf. Lazarus & Folkman 1984: 38). In a similar vein, it is obvious that individual characteristics of a person (e.g. character traits, previous experiences in a similar situation) define whether a stressor will be appraised as stressful or not and, if stressful, to what extent (or what is called "*the relational meaning* of threat" in Lazarus (2006: 12, italics original)). The situation itself does not imply that stress occurs:

> The important role of personality factors in producing stress reactions requires that we define stress in terms of transactions between individuals and situations, rather that of either one in isolation [...] (Lazarus 1966: 5)

However, knowing how stress emerges still does not help much with understanding its influence on human performance. Is stress good or bad? It is neither and both (cf. Lazarus & Folkman 1984: 182). A "classic" theory of the relationship between stress and performance is the Yerkes-Dodson law (Yerkes & Dodson 1908). According to this theory, performance increases with the increase of mental arousal (response to a stressor) to an optimal point at which performance reaches its maximum level; after surpassing this point, performance starts decreasing and becomes cognitively rigid (Alexander et al. 2007). This dynamic can be visualized as an inverted U-shaped curve. Hence, not only the experience of stress itself but also its extent are vital to one's performance. Similarly, the duration of the stress experience is a critical parameter when studying stress-performance reciprocity. Thus, prolonged or chronic stress, as opposed to acute stress, can cause memory deficits (Sirianni 2004: 117) and mental fatigue (Zhang & Yu 2010, see sections 2.1.1. and 2.1.2. for more on this notion). The connection of stress duration and performance is linked to the awareness of a person's limited resources and will be discussed in more detail in the next section (see section 2.2.).

The last aspect to address here is the nature of stressors. What can induce stress in humans? As it would be impossible to cover all possible reasons one could develop a stress response to, attention will be concentrated on social and cognitive motives.

2.1.1. Social factors

Humans are social beings. Building relationships, maintaining them, and affiliating with others in one's community are all basic human needs and powerful motivations (cf. e.g. Trüg 2017). Baumeister & Leary (1995) formulate this thought in their "belongingness hypothesis", which asserts that "a need to belong, that is, a need to form and maintain at least a minimum quantity of interpersonal relationships, is innately prepared (and hence nearly universal) among human beings" (ibid.: 499). Being deprived of such social contacts and bonds is therefore likely to cause stress, while maintaining them is associated with a feeling of pleasure (ibid.). Besides the psychological significance of forming social relationships, there is a biological neurochemical mechanism behind the seeking of meaningful interactions. Specifically, Baumeister & Leary (1995: 518, citing Panksepp et al. 1985) state that "[t]he formation and validation of relationships apparently stimulate opioid production, whereas the dissolution of relationships impedes it" (Baumeister & Leary 1995: 518). It is further important that personal interactions with a selected group of people, e.g. family and close friends as opposed to strangers or brief acquaintances, should be both frequent and stable to satisfy the human need to attach and belong (ibid.: 500). One of the important aspects in satisfying social relationships is mutuality. Caring for someone and being concerned about one's welfare is only beneficial when the other is able to reciprocate. Conversely, a one-sided affection is aversive for both parties, the sender and the receiver (ibid.: 514). An approach to measure interpersonal social relationships within a group is suggested by sociometry ('socius' meaning 'companion' and 'metrein' meaning 'measure'). Sociometric techniques analyze social configurations, such as conscious and unconscious social

structures (Stadler 2013a: 11), while differentiating between the surface (e.g. a school teacher) and hidden social structures (e.g. a scapegoat in a school class) (Dollase 2013: 21). The relationships on the two levels can be identical but it does not have to be so, and in the latter case social tensions and conflicts can arise (Moreno 1934). In order to reveal social networks, sociometric questionnaires are implemented. A respondent is asked to select a person (or a few persons), e.g. within a group, according to some predefined criteria (e.g. With whom would (s)he prefer to work on the next school project? or with whom would (s)he prefer to go on a school trip?). According to classical sociometry, these questions are aimed to disclose aspects of sympathy and antipathy (attraction and rejection) among group members towards each other which are not evident on the formal level of the surface structure (cf. Dollase 2013: 24). Based on the sociometric questionnaires metrics, one can evaluate a group structure (e.g. its cohesiveness) and a status of particular individuals (e.g. a group leader). Both data can be visualized by means of a sociogram or sociomatrix (cf. Schlechtriemen 2013; Stadler 2013b: 71). With regard to the belongingness hypothesis by Baumeister & Leary (1995), sociometry is able to provide instruments which characterize a group as a social body (e.g. by defining it as cohesive or not cohesive and hence by identifying which members associate themselves with the group and which do not) as well as which indicate whether a particular person potentially possesses enough social support (e.g. whether there is sufficient social support expressed as reciprocal choices between this person and others).

From a linguistic standpoint, social affiliation can be expressed by the way in which people speak with each other and what themes they discuss. The concept of stance-taking reflects this idea of how interactors can share their attitudes to each other or with specific social groups (Roth-Gordon 2020: 37f.; Johnstone 2018: 156ff.):

> […] when a person wants to identify with a certain category of women, she (or he) can adopt ways of talking that are conventionally associated with this group, so as to suggest to others what attributions to make of her (or him), and others may use a person's speech style as a way of categorizing him or her in gender terms. The same goes for styles conventionally associated with ethnicity, region, political stance, and so on. (Johnstone 2018: 170)

Furthermore, the concept of stance-taking fits into the definition of an interrelation between language and social roles comprised under the term "relational message":

> Relational messages are those verbal and nonverbal expressions that indicate how two or more people regard each other, regard their relationship, or regard themselves within the context of the relationship […] (Burgoon & Hale 1984: 193, following Burgoon & Saine 1978)

This "(linguistic) mimicry" must be non-deliberate and automatic to the greatest extent (Chartrand et al. 2005; Lakin & Chartrand 2003; Hatfield et al. 1993). Such behavior is also known as a "chameleon effect" (Chartrand & Bargh 1999) and "the typical form of the chameleon effect – behavior tendencies generated nonconsciously from the perceived behavior of one's interaction partner – is, unlike the stereotype version, largely adaptive and of high social utility" (ibid.: 907). A typical example of nonconscious linguistic alignment is known as priming and can affect, among other things, syntactic structure (e.g. Mahowald et al. 2016; Gries 2005; Levelt & Kelter 1982) or non-content speech variables (e.g. Cappella & Planalp 1981; Webb 1969). Furthermore, there are studies which indicate that the speech rate of one interlocutor can influence and cause similar patterns of speech characteristics in another (Webb 1969; Goldman-Eisler 1954). Functional speech characteristics can be transmitted in discourse according to Critical Metaphor Analysis (e.g. concerning discourse about immigrants, as in Zibin 2020). A similar phenomenon is analyzed in psychology: the nonverbal transmission of

emotions can produce a reaction which results in greater expressiveness in an interlocutor (Friedman & Riggio 1981).

In the context of the human need to socialize, isolation is a significant stress-inducing factor (Tafforin et al. 2015). As an imposed condition, isolation varies considerably and is found in many settings, e.g. in imprisonment, during winter-over in the Antarctic and Arctic, during the COVID-19 pandemic, or onboard a spaceship (see Suedfeld & Steel 2000 for a more extended overview of confined environments). Isolation often implies a combination of physical and social confinement, meaning that an affected person is not able to leave the confined environment or to choose or expand their own social network. This can severely affect the person's psychological health (Alfano et al. 2018). Isolation usually takes place in capsule environments. Suedfeld & Steel (2000: 228) suggest the following definition of such capsule environments:

> Typically, capsule environments are remote from other communities, are located in places where the physical parameters are inimical to human life, and are difficult to enter or leave. They are inhabited by artificially composed groups of people who are removed from their normal social networks and who carry out specific tasks and procedures. (ibid.)

In order to prognose the possible psychological behavior of isolated people, simulation experiments are conducted under controlled conditions. These simulations are "cheaper, easier, and safer to run" (ibid.: 229) than real field research. Due to the specifics of such capsule simulators (e.g. the strict selection criteria of participants), capsule simulator data tend to be based on small and non-random samples (ibid.).

In the realm of manned space exploration, isolation studies are a good data resource, which supplements the data collected during real spaceflights. These isolation studies help in the planning of prolonged space missions (Smith & Sandal 2017: 55; Kanas & Manzey 2008: 3f.). Among other research institutions, the Institute of Biomedical Problems (Russian Federation) (IBMP) has been conducting long-duration isolation experiments, of which Mars-500 is one of the most famous cases. The isolation chamber at IBMP is an analogue environment. Analogue environments recreate many of the stressors during real exposure in Earthly contexts (Smith & Sandal 2017: 55).

With regard to the effects of isolation, it was found that, despite some salutogenic aspects of the isolation experience (e.g. personal growth or sense of adventure (Kanas & Manzey 2008: 135; Suedfeld & Steel 2000: 229f.)), there are a number of negative consequences on the human psyche. Factors which lead to negative effects include the psycho-environmental density of isolating chambers which can express itself in an inability or violation of one's privacy, social monotony, enforced togetherness with other members in isolation as well as detachment from the outside as in the standard definition of isolation (cf. e.g. Suedfeld & Steel 2000). This can lead to conflicts (also due to cultural and language differences, as well as if an isolated group contains mixed genders (Boyd et al. 2009; Ritsher 2005; Lozano & Wong 2000)). Confinement as well as sensory and visual deprivation can result in, for example, monotony and mood changes (e.g. boredom) (Kanas 2015; Suedfeld & Steel 2000: 233ff.; Kanas & Manzey 2008: 98f.). The time spent in isolation is another important parameter. Perceived stress can accumulate with time progression, especially in prolonged missions of more than 6 weeks (Kanas & Manzey 2008: 7f.), whereas morale and performance enter into decline, particularly after the halfway point of the total duration of isolation (Suedfeld & Steel 2000: 237). Furthermore, around the third quarter of isolation, interpersonal tensions, clique formation, and loneliness are reported to increase; a decline in mood and a state of fatigue can emerge (Smith & Sandal 2014: 55ff.). In general, a three-stage adaptation to prolonged isolation and confinement is suggested: increased anxiety in the first stage turns to depressive reactions to monotony in the second stage, which then grows into emotional outbursts in the third stage

(Kanas & Manzey 2008: 34). This prognosis stands in agreement with the General Adaptation Syndrome described by Selye (ibid.) and which will be outlined in below (see section 2.2.). However, Russian scientists, based on the observations of prolonged space missions, distinguish between four stages of adaptation: first, general adjustment to the new environment (and microgravity) in space; second, by the 6th week into a mission, a person is fully adapted to the new surroundings and no longer suffers from any stressors; third, between the 6th and the 12th week major psychological changes (e.g. emotional liability, increase in irritability, emergence of asthenia, i.e. "feelings of exhaustion, hypo-activity, low motivation, low appetite, and sleep disturbances" (Kanas & Manzey 2008: 37) which can occur in a mild form after one to two months (ibid.: 146)) take place as a response to monotony and boredom[3]; and fourthly, at the time close to the mission completion, a feeling of euphoria and lack of self-control are usually documented (ibid.: 36ff.).

Having discussed stressors of social genesis, stressors based on cognitive factors will be defined in the next section.

2.1.2. Cognitive factors

Further factors which induce stress can be of a cognitive nature, for instance concerning the mental load which a person has to deal with. Any task is associated with some degree of complexity or some demands. A person who undertakes a task can perceive these demands and experience the task load associated with this task. If the demands are perceived as too high, the person is exposed to too high a task load and can thereby experience stress due to the limited capacity of the person's working memory and their ability to process novel information (cf. e.g. Rao et al. 2020; Khwaja et al. 2012: 518; Baddeley 2007). Thus, cognitive demand is an objective characteristic of a task, whereas cognitive load is its subjective perception by a person (Vizer and Sears 2017: 81; Khwaja et al. 2012). This relation can be visualized below, where cognitive load, mental load, or workload are terms which can be used synonymously:

task demand → cognitive/mental/workload → stress if cognitive/mental/workload is high

Cognitive load was originally a subject of analysis in the realm of educational psychology with regard to problem-solving and instructional design. The concept of cognitive load later spread to other scientific fields, for instance aviation psychology (e.g. concerning the workload of pilots) (cf. Ahmad et al. 2020: 2028).

An example of an increased cognitive load can be speaking a foreign language (L2) (e.g. Presbitero 2020). Speaking an L2 is associated with less automatic processing and increased difficulty which can result in increased cognitive load (cf. e.g. Keysar et al. 2012). Consequently, this can lead to anxiety and stress (e.g. Presbitero 2020; Luo 2014; Blumenthal et al. 2006: 480; Gardner et al. 1987). Foreign language anxiety (xenoglossophobia) is mostly researched in the setting of classroom language teaching (e.g. Horwitz et al. 1986). Anxiety, caused by speaking a foreign language, can arise as a result of the speaker's perception of losing one's own self-identity, which is directly connected to one's first language, or insufficient proficiency in the target language among other possible factors (cf. Hashemi 2011; also Presbitero 2020). Increased task load of speaking an L2 is evident on a physiological level. Thus, given that speaking an L2 implies greater production and planning efforts, Caldwell-

[3] In the context of spaceflights, asthenia is diagnosed and monitored by Russian scientists through, for instance, an analysis of verbal communication between crewmembers and personnel in mission control (Kanas & Manzey 2008: 146; see section 3.4.2.1. for more about verbal communication analysis in the realm of manned space missions).

Harris & Ayçiçeği-Dinn (2009) have demonstrated that reading false statements to an interlocutor, i.e. forced lying, in an L2 elicits a greater skin conductance response than lying in a first language (L1). Furthermore, semantic processing takes longer and is more error-prone among non-native speakers (cf. Hochlfeld et al. (2004) who analyzed perception of auditorily presented synonymous pairs of words in native and non-native speakers of German by recording the N400 component of the event-related potential). Fischer et al. (2019) have demonstrated that speaking an L2 (standard German for Swiss native subjects) leads to an increased cortisol stress response when performed under social stress. On the level of neural organization, L2 processing computational demands depend on the proficiency, age of acquisition, and level of exposure in the respective L2, as Perani & Abutalebi (2005) have shown. According to these authors, the additional activation of extended neural areas adjacent to those of L1 is characteristic in L2 bilinguals whose L2 proficiency is low. This effect was found to be particularly expressed in grammatical processing but less notable in lexical-semantic processing.

There are varying degrees of cognitive load while speaking an L1 as well. It is intuitively obvious and comprehensible to any native language speaker that some linguistic structures are "easier" than others (cf. Clark & Clark 1977: 337). Such skewness and asymmetry of grammar can be explained by means of the concept of linguistic markedness. Less marked linguistic elements are dealt with "more easily" by speakers and hearers than "more marked" elements (e.g. Wurzel 1998: 63; Givón 1995: 26; Clark 1973: 57) and speakers tend to use the former instead of the latter to reduce mental costs (e.g. Wurzel 2001: 398). Wurzel comments on "markedness" as follows:

> Markedness, or more precisely: the degree of markedness of a grammatical entity, is thus the relative measure for the straining of the language capacity regarding a certain parameter. (Wurzel 1998: 63)

A similar perception, albeit one which is oriented towards the mental state of a speaker, was expressed by Osgood (1966), who proposed to look more closely at the diachronic aspects of the language behavior, e.g. when individuals are experiencing effects of fatigue, drugs, or the like (ibid.: 306). It was expected that, due to the aggravation of one's mental condition, less marked linguistic structures would be triggered by "default choice in processing" (Givón 1995: 63) because "[m]arkedness is fundamentally an adaptive cognitive strategy for economy of processing" (ibid.). This is also described by Clark & Clark (1977: 523) as a hypothesis on the association between language and thought. Complex thoughts tend to be related to complex linguistic expressions while it is known that unfavorable mental states interrupt complex mental processes (cf. the Yerkes-Dodson law in section 2.1. and the concept of "integrative complexity" (Suedfeld & Tetlock 1977) in section 3.4.3.):

> *The complexity principle:* Complexity in thought tends to be reflected in complexity of expression. (Clark & Clark 1977: 523, italics original)

The concept of linguistic markedness finds support in the L2 context as well, specifically in the way that L2 learners are taught: affirmative sentences of an L2 are explained before negatives while the structure of negatives is often explained as contrasted to that of affirmatives (cf. Givón 1995: 25). In this example, affirmatives are thus "easier" than negatives. The concept of linguistic markedness in connection with the examples of grammatical voice and aspectual systems will be discussed in greater detail in section 4.1.

Lack of sleep can be a further example of a state which entails increased cognitive load. Lack of sleep negatively affects multifold neurobehavioral functions, e.g. psychomotor vigilance performance (cognition) (Griggs et al. 2022), and can lead to reduced attention and

increases in serum concentrations of stress hormones and error-proneness (Joo et al. 2012) as well as a deterioration of different types of memory (Kurinec et al. 2021; Deak & Stickgold 2010). Sleep deprivation can potentially lead to fatigue and decrease in performance (Nasrini et al. 2020; Baykaner et al. 2015; Joo et al. 2012), e.g. verbal fluency and creative thinking (Deak & Stickgold 2010: 492)[4], due to the affected regions of the prefrontal cortex (Griggs et al. 2022). According to Fostick et al. (2014), sleep deprivation also negatively affects human performance because of people's general tendency to fall asleep while executing a task or due to specific brain mechanisms, e.g. since the prefrontal cortex is generally less active during sleep deprivation (Pilcher et al. 2007). Conducting a comparison study of 24-hour sleep deprived young adults, the aging, dyslexic readers, and the control group (non-sleep deprived healthy young adults), Fostick et al. (2014) concluded that the sleep-deprived adults, dyslexic readers, and aging adults have longer temporal order judgement thresholds than the controls on a speech perception task. Phonological awareness abilities in the sleep-deprived adults, as measured by temporal order judgment thresholds, were worse with respect to a non-word reading task than in the controls. Completion of other tasks – such as Phoneme deletions, Pig Latin, Spoonerism – was not affected in the sleep-deprived subjects when compared with the controls, but they were affected in the dyslexic readers. Hence, alongside various mechanisms which prompted underlying deficiencies in linguistic ability among the compared subject groups, sleep deprivation results in specific deterioration effects on auditory and linguistic perception (ibid.). Drummond et al. (2000) have investigated the brain response to verbal learning following 35 hours of sleep deprivation. The authors found that, along with impaired free recall and no significant change in recognition memory following sleep deprivation, the discrete regions of the prefrontal cortex, bilateral parietal lobes, and two additional frontal lobe regions, both of which are associated with the execution of tasks with high working memory or cognitive load and short-term memory store, are more activated during verbal learning after sleep deprivation, whereas temporal lobes are less activated. Drummond et al. (ibid.: 656) thus concluded that the brain compensates for sleep deprivation effects and the homeostatic drive for sleep and may partially sustain intact cognitive performance in the short term, whereas it may decline in longer tasks, particularly those that require the activation of parietal lobes in a rested state, such as arithmetic tasks.

Just as an excessively high load negatively affects performance, e.g. by causing deficits in concentration, memory, reasoning, and verbal functioning (Vizer & Sears 2017: 81; see Baddeley (2007) for a detailed model of working memory), insufficient demands can also detriment the effectiveness of task execution. For instance, if pupils are asked to solve an easy riddle, they may communicate less eagerly and efficiently (due to their boredom, cf. the phenomenon "boreout", e.g. Karatepe & Kim (2020), Stock (2015); see also Kanas & Manzey (2008: 37, 221) for a discussion on the effects of decreased workload, boredom, or hypo-stimulation on the space crew's motivation and morale) than when being challenged by a moderately difficult riddle. Here again, the effect of the inverted U-shaped behavior pattern (see Yerkes-Dodson law discussed in section 2.1.) is evident. Furthermore, if the effect of a psychological stressor is too prolonged, there is a possibility that fatigue will arise:

> Mental fatigue usually refers to the effects that people may experience after or during prolonged periods of cognitive activity […] we define mental fatigue as a change in psychophysiological state due to sustained performance […]. This change in psychophysiological state has subjective and objective manifestations, which include an increased resistance against further effort, an

[4] However, compare Holding et al. (2019) who were not able to find a difference between sleep-deprived and control subjects in a word-description task regarding their verbal fluency, speech duration, speaking volume, and speaking volume consistency.

> increased propensity towards less analytic information processing, and changes in mood. (Zhang & Yu 2010: 68)

The inverted U-shaped curve is also evident in the physiological response to hazardous and demanding situations. The physiology of stress response will be briefly outlined in the next section.

2.2. Stress from a physiological perspective

The founding father of the concept of stress in physiology is the endocrinologist Hans Selye. Based on animal studies, he formulated a nonspecific body response to stress (e.g. to cold, heat, enzymes) which he referred to as a General Adaptation Syndrome (GAS) (Selye 1978)[5]. According to GAS, there are three stages of bodily reaction to stress: the alarm stage, the resistance stage, and the exhaustion stage.

During the alarm stage, the energy is mobilized from a storage site in the body (e.g. fat cells), the sympathetic-adrenal-medullary system (a quick response to a stressor, also called the "fight-or-flight" response) and the hypothalamic-pituitary-adrenal axis are both activated. As a result, among some of the physiological signs of stress response, there is an increase in the person's heart rate, blood pressure, moisture level of the skin (galvanic skin response) and breathing rate. On the other hand, digestion, reproductive function, and other parasympathetic nervous system activities ("rest-and-digest" response) become inhibited.

In the resistance stage, the body attempts to cope with the stressor and regain homeostasis.

If the stressor is too severe, prolonged, and cannot be overcome, the exhaustion stage occurs. During this stage, the body is not able to deal with the stressor since all available physiological resources are depleted. In severe cases, this stage can lead to pathologies such as illness or even the death of the affected organism.

Apart from an obvious case when such a physiological reaction is initiated by a physiological stressor (e.g. a cut which is also related to a regional response, or "local adaptation syndrome" (ibid.), such as inflammation of the surrounding tissues), a psychological stressor (e.g. an exam) is also capable of triggering GAS (cf. Sapolsky 2007: 612; Sirianni 2004: 112). Since psychological stress is inevitably linked to cognitive appraisal (see section 2.1.), the argument against the non-specificity of stress response was raised by some scientists, e.g. Mason (1971). It has also been claimed that cognition plays a highly important role in the human stress response so that GAS is too abstract (cf. e.g. Rice 2012: 26). In his later work, Selye (1978) sought to distinguish between pathological (distress) and positive (eustress) stress. To put these concepts in context, an example of a distress can be a quarrel and that of an eustress excitement before the wedding. Considering the physiological response, Selye (cited in Rice 2012: 26) stated that both distress and eustress initiate identical nonspecific physiological bodily responses (GAS), while the latter simply causes less damage. Bienertova-Vasku et al. (2020) have also claimed that the cognitive appraisal of a stressor is not so important but what really matters is the outcome of a stressful situation. To prove this hypothesis, the authors sketched out three stories in which a contradiction existed between the cognitive appraisal and the outcome on the physiological level. One of the stories is the following: a man experiences a roller-coaster ride as a pleasant event, even though it causes detrimental effects on his health, i.e. "the changes in pressure gradients in brain vasculature cause a dormant brain aneurysm to rupture, and the man dies shortly after the ride finished" (ibid.). Bienertova-Vasku et al. (ibid.) summarized their observations as below:

[5] First publication is dated to 1956.

> The most common problem with the definition of eustress stems from the fact that many authors use the term "stress" interchangeably to designate a reaction to a stressor as well as the stressor itself. The same problem affects eustress: in the original meaning, eustress is a positive reaction to a stressor, not the cause of this reaction (i.e., the stressor itself) [...] From a physiological perspective, it seems that the body does not develop two separate reactions [...] The ultimate point of debate lies in the fact that the good or bad character of the response occurs in retrospect when the reaction has led to health outcomes. This is inherently later than the event itself (whatever the event is), so at the time of the reaction, it is simply impossible to decide whether the reaction serves its purpose [...] or not [...] From the perspective of the performance-oriented theories of stress, it is impossible to draw conclusions on the actual performance achieved without the knowledge of the final outcome. (ibid.)

Based on their conclusions, Bienertova-Vasku et al. (ibid.) stated that there is no such concept as "eustress" and there is no "bad" or "good" adaptational response to a stressor.

Another interesting point regarding the physiological response to stress was raised by Saslow et al. (2014: 265), who claimed that a negative emotional reaction (or distress) is more closely linked with and is a driver of physiological reactivity, whereas positive aspects (or eustress) do not display such a strong tendency and are more independent of physiological reactivity. According to their conclusions, both distress and eustress can trigger a physiological response, but distress is assumed to be more strongly linked with this response than eustress.

There is a variety of physiological indicators of stress, e.g. increase of respiration rate, blood pressure, cortisol levels, and heart rate. The latter is particularly important for further analysis and hence will be explained in more detail. Heart rate (HR) denotes the speed of heart contractions, which is "largely under the control of the autonomic nervous system [ANS]" (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology 1996: 365; also cf. Orsila et al. 2008: 276; Appelhans & Luecken 2006: 229). The ANS, which consists of the sympathetic nervous system (excitatory function, or the "fight-or-flight" system) and the parasympathetic nervous system (inhibitory function, or the "rest-and-digest" system), governs internal body processes by instantaneously adjusting them to changing environment conditions (Sammito et al. 2014; Hottenrott 2002; Pagani et al. 1999). The physiology of a cardiovascular reactivity to stress is briefly explained below:

> During physical or psychological stress, activity of the SNS [sympathetic nervous system] becomes dominant, producing physiological arousal to aid in adapting to the challenge. An increased pulse, or heart rate, is characteristic of this state of arousal. During periods of relative safety and stability, the PNS [parasympathetic nervous system] is dominant and maintains a lower degree of physiological arousal and a decreased heart rate. (Appelhans & Luecken 2006: 229)

High task demands are also reflected in the physiological reactivity:

> Subjects react to sustained heavy task demands by an initial reaction called the defense reaction. This reaction is supposed to be caused by increased activation of the sympathetic nervous system and inhibition of the vagal system, inducing classical cardiovascular reactions: an increase in blood pressure and heart rate […] (Mandrick et al. 2016: 64)

This can also be summarized as follows:

> Heart rate has been found to increase with increased demand, and this measure may provide an index of arousal or physical effort that might accompany increased workload. (Wierwille & Eggemeier 1993: 278)

In a resting state, the normal diapason of HR lasts between 60 beats per minute (bpm) and 80 bpm for healthy adult individuals or starts from significantly below 50 bpm for well-trained athletes (Sammito et al. 2014: 4). The maximal HR is calculated using the equation: HRmax = 220 – age. For individuals older than 40 years, the equation is the following: HRmax = 207 − 0.7 × age (cf. ibid.).

Upon exposure to prolonged stress, cardiovascular response can be differentiated from the response pattern described above. Thus, the emergence of fatigue (see section 2.1.) can be associated with decreased HR (compare e.g. Patrick et al. (2017) who showed a decrease of HR post-exercise after acute sleep deprivation; cf. also Matuz et al. 2021; Schubert et al. 2009; Furlan et al. 2000). There are studies which confirm that immediately after intensive mental tasks (e.g. enduring mental arithmetic tasks) the condition of sustained mental fatigue emerges and leads to decreased HR:

> […] there is a strong link between mental fatigue and the autonomic nervous activity: performing monotonous tasks is related to the increase of the LF [low-frequency power; elevated LF is associated with increased workload and stress (Orsila et al. 2008: 276)] component in HRV [heart rate variability] […] When subject is at ease, it is modulated by sympathyovagal balance; on the contrary, the sympathetic activity is predominant when subject is fatigued, excited and nervous. Therefore, the predominant activity of autonomic nervous system of subjects turns to the sympathetic activity from parasympathetic activity after the task. However, heart rate shows the opposite course as is expected. Continuously tasking time does not lead heart rate to increase. This is in line with the course of the LF component. Lower heart rate causes more variations in heart rate and this is reflected in an increase of the LF component. (Zhang & Yu 2010: 79f.)

Even though HR is a very reliable physiological measurement, there are limitations for it with regard to HR interpretation. One must be aware that HR is an indication not only of stress but also a variety of different factors, e.g. the subject's movements, respiration, or age.

In this chapter, the brief overview was provided with relation to the concept of stress as well as selected factors that can cause it. Furthermore, it was discussed how stress can be measured with the help of physiological data, for instance, HR. In the following chapter, attention will focus on an analysis of the linguistic data with respect to establishing signs of stress in speakers. The analysis, which will be discussed in the following chapter, approaches the linguistic data based on their content.

3. Content-oriented analysis of language in use

Communication is a fundamental part of human social life. Our ability to produce speech and understand each other is as fascinating as it is complex, yet it seems to proceed with ease so that we only rarely, if at all, ask ourselves about "the mechanisms" that enable us to engage in meaningful interactions. However, questions concerning the underlying processes of our ability to communicate become paramount when one considers the crucial role that communication plays in extreme and life-threatening environments, e.g. the communication of pilots in the cockpit or that of cosmonauts and astronauts onboard a spacecraft. In such environments, one has to ensure that humans' ability to communicate is not compromised in such a way that the safety of a flight or a space mission is impacted by human errors grounded in communication problems.

One way of understanding the mechanisms behind language use is to draw one's attention to the functional dimension of communication. The present chapter is dedicated to this issue by providing an overview of the content-oriented analysis of the linguistic data. The chapter will introduce the relevant theoretical concepts for the empirical analysis. First, the term "pragmatics" and its two fundamental theories – Conversational implicatures and Speech acts – will be explicated. Then, an approach and a method which investigate the linguistic data will be outlined through Conversation analysis and Content analysis. The selected theories, the approach, and the method will all be integral to the empirical part of the present research. After this theoretical overview, a brief look at the existing studies will be given which consider the content-related aspects of communication under suppressing conditions. These studies and their findings will also be necessary for the empirical part of the present study by providing research background.

3.1. Pragmatics

The study of language systems, including their syntax, morphology and phonology, was a major focus of attention for linguists until the so-called "pragmatic turn" in the second half of the twentieth century, after which the study of language *use* became central (cf. e.g. Bublitz & Norrick 2011: 1f.; Taavitsainen & Jucker 2010: 3f.). After the "pragmatic turn", communication began to be seen as more than the mere articulation and transmission of meaningful linguistic signs between a sender (a speaker) and a receiver (a listener) (cf. Bühler's (1934) Organon model). From then on, using language was acknowledged always to imply performing an action in a given context. People are doing something (together) when they are speaking. Language use is a social action (cf. e.g. Jones 2016: 79). For instance, in asking a female passer-by about a direction to the nearest bus stop, a young man can either perform an act of simply inquiring information or he can indirectly attempt to start a conversation with a friendly-looking woman. The context (both linguistic and physical, e.g. as conveyed through intonation or gestures) is decisive for choosing between different social practices (ibid.: 78). Looking to language in its communicative functions differs crucially from the view of Saussure (2011)[6] who was interested in language system as a kind of abstract knowledge which speakers of one language share (cf. e.g. Chapman 2011: 44ff.). In his notion of "language-games", Wittgenstein (2001)[7] challenged this view by stating that there are an infinite number of possible functions which a language can perform (cf. Levinson 2013: 280) and that "utterances are only explicable in

[6] First publication is dated to 1916.
[7] First publication is dated to 1953.

relation to the activities, or **language-games**, in which they play a role" (ibid.: 227, bold original). Hence, one can generally speak about a distinction between the structural approaches to language, which disregard the communicative function of language, and the functional approaches, which emphasize them (cf. e.g. Van Valin 2008: 325). The distinction between these two approaches can be made explicit with the help of Chomskyan linguistics which distinguishes between 'competence' (meaning the possession of linguistic knowledge) and 'performance' (the actual linguistic behavior):

> Crucially, Chomsky identified competence as the appropriate focus of linguistic study. For him, language is primarily a mental structure, so true linguistic inquiry should concentrate on the nature of linguistic knowledge, rather than the distracting array of phenomena that get involved when people use language to communicate with each other. (Chapman 2011: 12)

Conversely, pragmatics highlights the communicative function of language while also "aim[ing] to model certain aspects of context in order to learn something about general rules and principles of language use" (ibid.).

> […] pragmatics deals with language *use* and *action* rather than with formal grammar or abstract discourse structures. (van Dijk 2009: 13, italics original)

Hence, the following question, related to discourse ("[…] actual instances of communicative action in the medium of language […]" (Johnstone 2018: 2; also cf. van Dijk (2009: 13ff.) for pragmatics in discourse studies)), arises: How can one correctly deduce one implied meaning among an array of different possibilities? Pragmatics, as the branch of linguistics that focuses on the language in its context and context-dependent meanings, is helpful in this regard.

> […] pragmatics includes patterns of linguistic actions, language functions, types of inferences, principles of communication, frames of knowledge, attitude and belief, as well as organisational principles of text and discourse. Pragmatics deals with meaning-in-context, which for analytical purposes can be viewed from different perspectives (that of the speaker, the recipient, the analyst, etc.). It bridges the gap between the system side of language and the use side, and relates both of them at the same time. Unlike syntax, semantics, sociolinguistics and other linguistic disciplines, pragmatics is defined by its *point of view* more than by its objects of investigation. The former precedes (actually creates) the latter […] The focal point of pragmatics (from the Greek *prãgma* 'act') is linguistic action (and inter-action) […] (Bublitz & Norrick 2010: 4, italics original)

Pragmatics studies "the relation of signs to interpreters" (Morris 1938: 6). Pragmatics is also linked to semiotics; according to Charles Morris, pragmatics is one of the three distinct branches of semiotics, along with syntactics and semantics (cf. Levinson 2013: 1ff.; see also Renkema (2004: 35f.) for more on pragmatics and its boundaries to semiotics). The closeness of the term 'pragmatics' to 'semantics' is reflected in the definition of pragmatics as "meaning minus semantics" (Levinson 2013). This means that pragmatics examines the contextual meaning of an utterance, rather than the conventional meaning of a sentence, as well as that "semantics is not autonomous with respect to [the] pragmatics, and that pragmatics provides part of the necessary input to a semantic theory" (ibid.: 35). Furthermore, pragmatics (e.g. through the analysis of spoken discourse) requires knowledge not only from linguistics but also from e.g. cognition, psychology, anthropology, sociology, and philosophy to explain the relationship between language and its functions (ibid.: 21; Gee & Handford 2012: 5; van Dijk 2009: 102; Renkema 2004: 2).

Pragmatics relies on the principles of commonsense reasoning (i.e. inference) (Kempson 2008: 401; Levinson 2013: 21) and implies "asking what conditions need to be present for a

participant in a conversation to logically conclude that a given utterance has a certain meaning (or pragmatic 'force')" (Jones 2019: 18)[8]. Two theories are fundamental to pragmatics in this regard: Gricean conversational implicatures and Speech act theory. Both theories originate from the philosophy of language. Ordinary language philosophers were interested in the "real" spoken language, in its everyday form, and in its meaning rather than its form (Bach 2006). These interests are opposed to a concern with the "ideal language", as, for example, in the tradition of Chomskyan linguistics:

> [...] philosophers would do well to pay attention to ordinary language rather than to artificial logical or technical philosophical language, because it was naturally adapted to explain and describe human being's experience and understanding of the world. (Chapman 2011: 50, referring to Austin's position on ordinary language as an object of study)

In the following, both of these theories will be described, while greater attention will be paid to Speech act theory because it will lay the foundations for the empirical part of the present research.

A good illustration of how interlocutors understand an intended meaning, often a non-literal one, was elaborated by Grice (1975) in a discussion on conversational implicatures that are based on cooperative principles and maxims. Grice (ibid.) distinguished between what is said (i.e. a literal meaning given in a language) and what is implicated (i.e. a meaning that is influenced by the circumstances of the given utterance, background knowledge about the subject of an interaction, etc.) (cf. ibid.: 44; Chapman 2011: 70). Grice claims that interlocutors are interested in cooperative interactions by default in order to achieve a "maximally effective exchange of information" (Grice 1975: 47). Hence, interlocutors adhere to certain principles and maxims:

> Make your conversational contribution such as required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged. One might label this the COOPERATIVE PRINCIPLE. (Grice 1975: 45, capitalization original)

There are four categories which define cooperative behavior in a conversation, namely:

> Category of Quantity
> 1. Make your contribution as informative as is required (for the current purpose of the exchange).
> 2. Do not make your contribution more informative than is required.
>
> Category of Quality
> 1. Do not say what you believe to be false.
> 2. Do not say that for which you lack adequate evidence.
>
> Category of Relation
> 1. Be relevant.
>
> Category of Manner
> 1. Avoid obscurity of expression.
> 2. Avoid ambiguity.
> 3. Be brief (avoid unnecessary prolixity).
> 4. Be orderly.
>
> (drawn from Grice 1975: 45f.)[9]

[8] Cf. "utterance interpretation involves *some* type of mind-reading or theory of mind" (Cummings 2015, italics original).

[9] The passages are taken individually from an exhaustive text and unified within one scheme.

Following Grice's expectations, all interlocutors in a discussion assume that these maxims are followed by everyone who is partaking in a given discussion (cf. e.g. Jones 2019: 53). Should one of the maxims be flouted by an interlocutor, others would perceive this as an intention to communicate indirectly or to implicate an indirect meaning, for example:

A: There will be an annual university party next weekend! We should go!
B: It's meant to rain on Saturday.

At first, the category "Relation" seems to be flouted by speaker B with respect to the specific communicative situation. However, what speaker B is implicating, by being seemingly uncooperative, is that he has no desire to attend the upcoming party. The maxims can be breached purposefully to implicate something (as in the example above) or if one decides to lie (Chapman 2011: 77f.). In the latter case, however, there is no conversational implicature (inferred from the maxims) because the speaker opts to disregard the maxims (in particular, the category of Quality) and the cooperative principle (ibid.).

Another significant theory in pragmatics, which originates from the philosophy of language, is Speech act (SA) theory. The core idea of SA theory is that speech is not only a means of information exchange but also a means of practicing an activity (Austin 1962; also Levinson 2013: 228f.; Chapman 2011: 58; Herrmann 2005: 27f.) "according to systems of constitutive rules" (Searle 1969: 38). SA theory was first elaborated by the philosopher of language John Langshaw Austin (1962), whose ideas were then profoundly expanded in the work of John Rogers Searle (1969). Not satisfied with a strictly formal view on language and in a bid to analyze its functional aspects, Austin (1962) categorized all utterances as either constative or performative in nature. Constatives are descriptions or reports which can be true or false, whereas performatives are inward actions (intentions) of the speaker expressed through an outward sign (utterance). The latter is constrained by specific conditions ("felicity conditions") which allow a SA to succeed. Austin determined the following felicity conditions for performatives:

(A. 1) There must exist an accepted conventional procedure having a certain conventional effect, that procedure to include the uttering of certain words by certain persons in certain circumstances, and further,
(A. 2) the particular persons and circumstances in a given case must be appropriate for the invocation of the particular procedure invoked.
(B. 1) The procedure must be executed by all participants both correctly and
(B. 2) completely.
(*Γ*. 1) Where, as often, the procedure is designed for use by persons having certain thoughts or feelings, or for the inauguration of certain consequential conduct on the part of any participant, then a person participating in and so invoking the procedure must in fact have those thoughts or feelings, and the participants must intend so to conduct themselves […] and further
(*Γ*. 2) must actually so conduct themselves subsequently.

(ibid.: 14f.)

If any of these felicity conditions is not satisfied, the utterance is a "misfire" (violation of A and B) or "abuse" (violation of *Γ*) (ibid.: 18; Levinson 2013: 230).

It is noteworthy that, towards the end of his seminal work, Austin (1962) declared that the categorization into constatives and performatives is not satisfactory and that these two categories of utterances are not clearly discrete:

> […] this [sc. the notion of the purity of performatives] was essentially based upon a belief in the dichotomy of performative and constatives, which we see has to be abandoned in favour of more general families of related and overlapping speech acts […] (ibid.: 149)

Therefore, constatives as well as performatives need to satisfy both conditions: the conditions for truth and the conditions for felicity. Hence, an utterance such as 'I warn you that the bull will charge' needs to be simultaneously true (there is a bull and it is about to charge) and to succeed in giving a warning (Levinson 2013: 234; Chapman 2011: 61f.; Austin 1962 (the example is from Austin 1962 and quoted in Levinson 2013: 234 and Chapman 2011: 61)).

After concluding that the distinction between constatives and performatives does not accurately reflect the nature of language usage, Austin (1962) decided to designate common properties of all SAs. He then suggested to discriminate between three separate acts which are inherent to a SA in general: 'locutionary act', 'illocutionary act', and 'perlocutionary act'. Each of these is defined as follows:

- A locutionary act is an "[…] act of 'saying something' in this full normal sense […] the study of locutions, or full units of speech" (ibid.: 94). It is a meaning or proposition of a sentence (ibid.: 108);
- An illocutionary act is a function or sense of the speech (ibid.: 99) conceptualized as the "performance of an act *in* saying something as opposed to [the] performance of an act *of* saying something" (ibid., italics original). It is a conventional force (F) of an utterance (ibid.: 108);
- A perlocutionary act is "the achieving of certain effects [on the hearer] by saying something" (ibid.: 120).

Austin (1962) further suggested to classify SAs in five categories which, as he acknowledged, are an intuitive guess and which, according to Searle (1969), are mostly based on verb meanings:

1. Verdicatives "are typified by the giving of a verdict, as the name implies, by a jury, arbitrator, or umpire […] they may be, for example, an estimate, reckoning, or appraisal […]" (Austin 1962: 150).
2. Exercitives "are the exercising of powers, rights, or influence. Examples are appointing, voting, ordering, urging, advising, warning, &c." (ibid.).
3. Commissives "are typified by promising or otherwise undertaking; they commit you to doing something, but include also declarations or announcements of intentions, which are not promises, and also rather vague things which we may call espousals […]" (ibid.: 150f.).
4. Behabitives "are a very miscellaneous group, and have to do with attitudes and social behavior. Examples are apologizing, congratulating, commending, condoling, cursing, and challenging." (ibid.: 151).
5. Expositives "make plain how our utterances fit into the course of an argument or conversation, how we are using words, or, in general, are expository. Examples are 'I reply', 'I argue', 'I concede', 'I illustrate', 'I assume', 'I postulate'." (ibid.).

The threefold distinction of acts (locutionary act, illocutionary act, and perlocutionary act) was adopted and carefully expounded by Searle (1976; 1969), who was a student of Austin. Searle was mainly focused on characteristics of the illocutionary act (IA). In his theory, he pays great attention to the distinction between illocutionary force (F) and propositional content (p) instead of isolating locutionary and illocutionary acts. In brief, the concept elaborated by Searle's (1976) was illustrated by means of the following symbolism:

F(p)

A proposition, which is the content of an utterance, cannot be produced without illocutionary force (function); however, the same proposition can be performed with the help of different illocutionary forces (ibid.: 29f, 125). Devices which indicate illocutionary force include word order, stress, intonation, etc. (Searle 1969: 30ff.).

Searle (1976) offers a classification of IAs by considering twelve dimensions among which three are considered the most important, namely:

- Illocutionary point refers to a basic purpose of an utterance which constitutes part of its illocutionary force, e.g. "the illocutionary point of request is the same as that of commands: both are attempts to get hearers to do something. But the illocutionary forces are clearly different" (ibid.: 3);
- Direction of fit is the relation of words (their propositional content) to the world. There are two possible directions of fit: either the words try to match the world (words-to-world) or the word tries to get the world to match it (world-to-words). Direction of fit is a consequence of an illocutionary point (ibid.: 3f.);
- The sincerity condition is an expression of a psychological state of a speaker, e.g. beliefs, hopes, attitude to a proposition (ibid.: 4).

Founded on these dimensions of IAs and by considering their syntactic and semantic properties, Searle (1976) developed a taxonomy of basic SAs. Searle exemplified the syntactic properties of the English language. They are not straightforwardly applicable to other languages. Judged in terms of semantic differences, there are five basic illocutionary acts, according to Searle (1976):

- Representatives (also known as Assertives)
- Directives
- Commissives
- Expressives
- Declarations

Representatives are utterances that commit a speaker to the truth of the propositional content. These utterances are either true or false. Their direction of fit is words-to-world because they are an objective replication of the reality, together with the speaker's sincerity condition expressed as Belief that the proposition is true or false.

Directive utterances represent the speaker's attempts to get the hearer to do something. The direction of fit is world-to-words, with the sincerity condition being Want or Desire.

By means of commissive utterances, a speaker obligates himself or herself to his or her own future actions. Hence, the direction of fit is similar to the directives – world-to-words – but the targeted agent is the speaker himself or herself. The sincerity condition is Intention.

Expressive utterances convey the psychological state of an utterer to a propositional content with no direction of fit.

Declarations are utterances that usually imply some extra-linguistic institutionalized authority which is able to engender a propositional content to the reality, e.g. pronouncing a couple man and wife (the example is from ibid.: 20). An exception is made only if declarations relate to the language use itself, e.g. while dubbing or naming something as something (cf. the examples in ibid.: 14). The direction of fit goes in both ways – words-to-world and world-to-words – because a successful performance of declarations enables a correspondence of the proposition and the world. There is no sincerity condition in declaratives.

An important contribution of Searle (1969) was also a distinction between direct and indirect SAs. SAs are either explicit and direct ('I bet', 'He promises', 'I order you to close the window!') or implicit and indirect ('It's quite chilly in the room'), so their meaning has to be retrieved from the context (cf. e.g. Johnstone 2018: 79).

This can suffice as an overview of pragmatic theories and their relationship to the analysis of language use. SA theory, and in particular its categorization of utterances according to the semantic differences of IAs, will be fundamental for the empirical part of the present research; IAs will enable a categorization of utterances which will be examined.

One can also analyze language by adhering to the approach of conversation analysis. Conversation analysis (ConvA) is a discipline which originally emerged from ethnomethodology and pays attention to the sequences of actions in a conversation (cf. e.g. Jones 2019: 17f.; Levinson 2013: 284ff.; Sacks et al. 1974: 699). Since ConvA will be important for understanding the empirical part of the present empirical research, it will be described in the next section[10].

3.2. Conversation analysis

ConvA grew out of the research of the sociologist Harvey Sacks and his associates Emanuel Schegloff and Gail Jefferson. Sacks, who was studying telephone calls to a suicide prevention center and who was not initially interested in the structure of conversations, wanted to understand the patterns which people apply to describe suicide threats. Over time he became captivated by how people engage with each other in conversations by following repeated, conventionalized rules of interaction (Jones 2016: 37; ten Have 1999: 18). Conversations appeared to proceed smoothly, with very little overlap, and were "logically managed" (Chapman 2011: 179) despite their spontaneous nature (ibid.). This led him to think about how conversations[11] are structured, which interactive sequences follow others, what enables these sequences, and so on.

ConvA approaches conversational data inductively and does not prioritize a predefined theory on what a particular conversation should look like. So, when comparing women and men's style of conversing, no theory-based assumptions on their differences should underlie ConvA; rather, the theories are to be derived from the data at hand (Person 2016: 20, the illustrative example is from ibid.; see also ten Have 1999: 31f.).

The data of ConvA are conventionally audio or video recordings of natural conversations[12]. To reproduce the natural flow of conversations, complete with its interruptions, overlapping talks, varying length of particular sounds, etc., transcriptions occupy a special place in ConvA[13]. On the one hand, it is possible to transcribe spoken speech broadly by marking the order of utterances and speakers. On the other hand, an analyst can decide in favor of a "narrow" transcription which would include a variety of fine-grained details such as overstressing of sounds, pauses, etc. (cf. Levinson 2013: 295; Chapman 2011: 180). The decision for a particular type of a transcription is aligned with the research goal in question.

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[10] The reader should be warned that an exhaustive overview of the approach will not be attempted, but only concepts which will be relevant for the upcoming empirical analysis will be outlined.

[11] Conversations are also sometimes termed "talk-in-interaction" to differentiate between the trivial and mundane senses of a conversation (cf. Schegloff 1999: 408) and in order to denote "language in use by two or more people interacting with each other" (Toerien 2014: 327).

[12] ConvA can be analyzed in an institutional setting or independently of an institution, i.e. "on the basis of data from informal, everyday conversations, in which context constraints are less explicit and systematic" (van Dijk 2009: 103). Ten Have (1999: 162ff.) suggests defining the first type as "applied CA [ConvA]" and the second type as "pure CA [ConvA]".

[13] Following Gail Jefferson, who was the first to elaborate and apply transcripts to spoken data within ConvA (cf. Sacks et al. (1974) for special symbols used in ConvA transcripts as well as O'Connell & Kowal 2008; Renkema 2004. See also ten Have (1999) for an overview of the existing transcription systems in ConvA).

ConvA does not consider the broad context to explain how conversations function but is instead focused on the context within one interaction (van Dijk 2009: 102). From this follows that interaction in itself is sufficient to provide the grounds for explaining the structure of naturally occurring casual conversations (ibid.: 107).

> What makes some utterances after a question constitute an answer is not only the nature of the utterance itself but also the fact that it occurs after a question with a particular content – 'answerhood' is a complex property composed of sequential location and topical coherence across two utterances, amongst other things; significantly, there is no proposed illocutionary force of answering. (Levinson 2013: 293)

A conversation is seen as evolving and not being planned in advance, even though it does follow some generalized mechanisms which enable interlocutors to efficiently take part in it (Chapman 2011: 179). In this regard, the concept of *turn* is pivotal for ConvA; it represents a basic form of the conversation organization (Sacks et al. 1974: 700). Turn is defined as "a stretch of speech produced by a single speaker until speaker change occurs and a different participant in the conversation becomes the speaker" (Chapman 2011: 179). By building an utterance on the utterance of a previous speaker, participants of a conversation indicate responsiveness; the interlocutors thus "have to talk singly [...] that is one at a time; and each participant's talk is inspectable, and is inspected, by co-participants to see how it stands to the one that preceded, what sort of response it has accorded the preceding turn" (Schegloff 2007: 1). Turns are not limited with regard to how long or short they can be but can vary substantially in their length (Levinson 2013: 297; Sacks et al. 1974: 709). The building blocks of turns are called *turn-constructional units* (TCUs), which, according to Schegloff (2007: 3f.), are defined by:

- grammar (e.g. clause, phrase, lexical items)
- phonetic realization (intonational "packaging")
- recognizable action in context (e.g. asking, teasing, promising).

(adapted from ibid.)[14]

There are transition relevance places in each turn which signify the fact that the current speaker has finished an utterance and the next speaker can take the floor (Sacks et al. 1974: 704). At this point in time turn-taking happens. The subsequent speaker, and all other speakers in general, (ideally) dispose of one TCU. Sometimes, the current speaker singles out a person who should take the next turn (e.g. by directing a question to a chosen person). However, there are also cases in which the current speaker does not select a subsequent speaker and one of the conversation participants pro-actively takes the floor. This conversational move is called *self-selection* (cf. ibid.: 713). If the current speaker has finished the TCU but no one claims the floor, the speaker can proceed with the next TCU or extend the current one. Hence, one turn can consist of more than one TCU (Schegloff 2007: 4; Sacks et al. 1974: 704f.). This organization of floor transfer is called *turn-allocation* (ibid.: 703). As noted previously, a TCU involves "a recognizable action in context" (Schegloff 2007: 4) which links it to SAs. Considering the relation between speech acts and speech turns, Henne (2006: 257) states that they can, but do not have to, coincide: speech acts define the modality of a communication and can be part of turns.

Consistent with the turn-allocation technique, one person speaks at a time in the majority of conversations while situations in which two or more persons talk simultaneously are rare and these periods are normally brief (Sacks et al. 1974: 706).

[14] This is a schematic summary of an exhaustive description.

Although the number of participants in a single conversation can naturally vary, if conversations include more than two parties, the third (or fourth, etc.) party can be left out during the turn-transfer and is therefore forced to self-select at a transition relevance place in order to take the floor securely (ibid.: 712). In a two-person conversation, the current non-speaker is guaranteed the next turn and the current speaker does not have to choose between interlocutors who are to be selected for the next turn (ibid.). Hence, conversations in which numerous participants take part tend to be characterized by a minimization of turn length (ibid.). This is possible because turn-taking is governed by a local management system (i.e. "on a turn-by-turn basis" (ten Have 1999: 111)) so that turn-size, as well as turn-order, can vary (Sacks et al. 1974: 725f.). In order to remain actively engaged in a conversation with many participants, interlocutors can also run more than one simultaneous discussion. Hence, in a conversation of four persons, there is a possibility of more than one simultaneous discussion (ibid.: 713).

To provide an illustration of how turns are sequentially organized, the term *adjacency pair* was elaborated. Adjacency pairs are prototypical paired utterances produced by different speakers. Their prototype examples are the pairs of question-answer, greeting-greeting, offer-acceptance, etc. (cf. Sacks et al. 1974: 716). Adjacency pairs are "a fundamental unit of conversational organization" (Levinson 2013: 304), which are enabled by a backwards confirmation of the prior turn by means of the second part of the pair, while the first part of the pair determines possible second pair parts (Schegloff 2007: 16). The second part of the adjacency pair is normally placed immediately after the first one, thereby standing to it in a relationship of "nextness" (ibid.: 14ff.). However, sometimes one adjacency pair becomes embedded within another so that insertion sequences occur and the parts of an adjacency pair stay apart and do not follow each other directly. Compare the following exchange (in which Q_I is the first question, A_I is the first answer; Q_2 is the second question and A_2 is the second answer):

Merritt, 1976 : 333

A:	May I have a bottle of Mich ?	((Q_I))
B:	Are you twenty one ?	((Q_2))
A:	No	((A_2))
B:	No	((A_I))

(from Levinson 2013: 304, italics original)

Adjacency pairs are conditionally relevant, which means that, if the first part is produced (e.g. a question), the second part is immediately relevant and expected (e.g. an answer to the raised question) (Levinson 2013: 306; Schegloff 2007: 20). The first part of the pair sets constraints on what can be the second part of the pair, since e.g. a question requires an answer (Sacks et al. 1974: 717).

Besides adjacency pairs as a technique to organize conversations, *topics* (what is being talked about, or "the 'aboutness' of a unit of discourse" (Renkema 2004: 90)) support interaction organization which is defined by a "contingent development of *courses of action*" (Schegloff 2007: 251, italics original; cf. also Schegloff 1999: 409f.). Thus, Krifka et al. (2003: 97), quoting Franke, state that a complex conversation can entail a number of "minimal dialogues". There are different types of topics according to Schegloff (2007: 169ff.), such as "topic proffering", which occurs when a speaker proposes a topic without actively developing the proposed topic. In this context other interlocutors can reject or accept the topic[15].

Levinson (2013: 313, citing Sacks 1971), remarks that topics do not occur spontaneously and should transition from the previous topics with respect to the content. A

[15] Among other topic types, there are "topic solicitation" and "unilateral topic initiation" (see Schegloff 2007: 169ff.) which will not be discussed in detail as this does not relate to the purposes of the current work.

"lousy" (Levinson 2013: 313, quoting Sacks 1971) conversation is therefore categorized by frequent marked (not topically tied) topic shifts (Levinson 2013: 313, citing Sacks 1971). New topics usually start with increased volume and pitch (Schegloff 2007: 187). To analyze a discourse topic, intuition helps to define what is being mainly spoken about in a given discourse fragment (Renkema 2004: 92). Conversation coherence is thus "constructed across turns by the collaboration of participants" (ibid.: 315; cf. Cummings 2014). Transition from topic to topic is often indicated by discourse markers, e.g. when a lecturer moves from a small talk to the lecture material with 'Okay, let's get started...' (Jones 2019: 62, the example is from ibid.).

Conversational organization, being a local management system (e.g. through turn-taking, adjacency pairs, repairs, etc.), constitutes a universal basis for world languages, whereas intermediate organizations (e.g. preference organization, pre-sequences) are more dependent on cultural aspects, e.g. what is a preferred response to a compliment (Levinson 2013: 369). Conversation context does not enjoy a decisive status[16] so that e.g. the organization of turns is context-free but at the same time context-sensitive (Jones 2019: 58; Sacks et. al. 1974: 699f.), compare:

> Conversation can accommodate a wide range of situations, interactions in which persons in varieties (or varieties of groups) of identities are operating; it can be sensitive to the various combinations; and it can be capable of dealing with a change of situation within a situation. Hence there must be some formal apparatus which is itself context-free, in such ways that it can, in local instances of its operation, be sensitive to and exhibit its sensitivity to various parameters of social reality in a local context. (Sacks et al. 1974: 699f.)

ConvA is characterized through a qualitative approach to data. Doing a ConvA involves at least the following four phases:

1. getting or making recordings of natural interaction;
2. transcribing the tapes, in whole or in part;
3. analysing selected episodes;
4. reporting the research.

(ten Have 1999: 48)

These phases are not clearly independent of each other so that the analysis can proceed in a "spiraling fashion" (ibid.).

To sum up the discussion of ConvA and build a bridge to the following empirical investigation, a conversation is structurally organized and consists of such elements as e.g. turns and topics, which have a universal basis in communication. Their realization in the data of the empirical part will be a major focus of attention.

To return to the briefly addressed question of how an analysis of qualitative linguistic data can be carried out from the methodological perspective, this is thoroughly elaborated in works dedicated to content analysis. Content analysis as a method will be introduced and outlined in the next section. This method will then be used to evaluate the data in the empirical part of the present research.

3.3. Content analysis

The origins of content analysis can be traced back to the 17th century in works of the Church which were occupied by the analysis of the non-religious nature of newspaper content (Krippendorff 2013: 10). During the first half of the 20th century, a question about how to study

[16] "[…] contexts are not studied in CA [ConvA] as "given" structures, but as being locally and interactionally constructed by the participants" (van Dijk 2009: 109).

qualitative data, such as discussions, interviews, speeches, pictures, or other forms of communication, became paramount in works by social and behavioral scientists. During the 1930s and 1940s, materials for the systematic analysis of texts were frequently related to political documents, e.g. propaganda texts (in the works of e.g. Bernard Berelson and Harold Lasswell) or were dedicated to psychological research on language as a medium to study personality and mental states[17]. An example is the works of Gordon Allport, who suggested that accurate research of personal written documents, e.g. diaries, can be applied to characterize an individual psychological construct[18].

Initially, the analysis of qualitative data of communication was performed through methods oriented towards quantitative techniques, which are very well summarized in a frequently quoted definition of content analysis:

> Content analysis is a research technique for the objective, systematic and quantitative description of the manifest content of communication. (Berelson 1971: 18)[19]

This strict quantitative approach was criticized by Kracauer (1952) who claimed that it is not axiomatic because

> 1. One-sided reliance on quantitative content analysis may lead to a neglect of qualitative explorations, thus reducing the accuracy of analysis.
> 2. The assumptions underlying quantitative analysis tend to preclude a judicious appraisal of the important role which qualitative considerations may play in communications research. Hence the need for theoretical reorientation.
> 3. The potentialities of communications research can be developed only if, as the result of such a reorientation, the emphasis is shifted from quantitative to qualitative procedures.
>
> (ibid.: 631)

To illustrate the unsatisfactory nature of quantitative approaches which aim to study qualitative data, Kracauer (ibid.: 634), citing Berelson (1952), juxtaposed manifest contents (e.g. a news story on a trail wreck) and latent contents (e.g. an obscure modern poem, both examples are originally from Berelson 1952). While the first kind of content will be understood by everyone more or less in the same manner (i.e. it is context-independent (Nießen 1977: 117)), the second will most likely lead to a multitude of interpretations and readings. On a continuum from manifest to latent contents, quantitative techniques seem justifiable only on the spectrum close to the first content type. However, quantitative techniques "fail to penetrate" (Kracauer 1952: 637) more subtle latent textual dimensions. As a result of these considerations, Kracauer coined the term *qualitative content analysis* which he explicitly set in contrast to the "mainstream" content analysis, which is principally focused on quantitative techniques (see also Nießen (1977: 110ff.) for an overview of Kracauer's statement on the weaknesses of the quantitative approach). By "defending" the qualitative approach to data analysis, Holsti (1969: 10) allocates attention to the evidence that some qualitatively based observations, e.g. a single appearance or omission of an attribute in a text, can signify much more than its relative frequency.

Nevertheless, qualitative content analysis (QCA) does not exclude quantification as such; it only makes use of a cumulative approach of quantitative and qualitative techniques (cf. e.g. ibid.: 11). Moreover, it can be assumed that the distinction into either qualitative or

[17] See Krippendorf (2013: 10ff.) for a detailed overview of the history of content analysis.
[18] See Neuendorf (2017: 274ff.); Krippendorff (2013: 32f.); Neuendorf (2002: 37ff.); and Holsti (1969: 70ff.) for more on a psychometric application of content analysis.
[19] First publication is dated to 1952.

quantitative types of content analysis is not clear and that it is simply "a matter of degree" of the analysis design (Schreier 2014a: 172; also Mayring 2008: 8f.). As Krippendorff writes:

> [...] the quantitative/qualitative distinction is a mistaken dichotomy between the two kinds of justifications of content analysis designs: the explicitness and objectivity of scientific data processing on one side and the appropriateness of the procedures used relative to a chosen context on the other. For the analysis of texts, both are indispensable. (Krippendorff 2013: 88)

Hence, Mayring (2010: 13) suggests that a better definition would be "category-led text analysis" (cf. "kategoriengeleitete Textanalyse" in ibid.). Following Mayring (ibid.: 13ff.), content analysis in general can employ three quantitative techniques:

- Frequency analysis (a count of particular elements in the text; "Häufigkeitsanalysen" or "Frequenzanalysen" in ibid.: 13);
- Valence and intensity analysis (specified elements, found in the text, are measured according to two-staged (or more) assessment scale; "Valenz- und Intensitätsanalysen" in ibid.: 15);
- Contingency analysis (an examination of co-occurrence of particular textual elements in similar contexts; "Kontingenzanalysen" in ibid.: 16).

A difference between quantitative[20] content analysis and QCA is that quantitative content analysis typically does not come back to qualitative data once the data have been coded and counted, and the content analysis does not proceed beyond the statistical findings. QCA, on the contrary, has recourse to the original communicational data in their context (Krippendorff 2013: 46f.; Mayring 2010: 21f.; Kracauer 1952: 640). Furthermore, quantitative content analysis analyzes numerous text materials to prove or reject a hypothesis, whereas QCA can be focused on an individual case without relying on a predefined hypothesis (Kuckartz 2016: 46; Mayring 2010: 20; Nießen 1977: 115). It is "an *empirically grounded method*, exploratory in process, and predictive or inferential in intent" (Krippendorff 2013: 1, italics original). QCA serves to establish (and less often to verify) a hypothesis or theory, it is implemented in pilot studies, individual cases, or describes processes of change[21], it further develops already completed studies, and it seeks to classify a datum according to some meaningful set of criteria (e.g. typology) (Mayring 2010: 22ff.). Gläser & Laudel (2010) highlight the difference in category building between (quantitative) content analysis and QCA (qualitative content analysis). Thus, QCA can form its categories based on the textual material at hand and quantitative content analysis works with predefined criteria drawn from hypotheses or previous studies. Hence, for QCA, interpretation of propositions in their context is fundamental in a way that relates it to hermeneutics (ibid.: 29ff.; Kuckartz 2019, 2016; Ritsert 1972). Nevertheless, QCA does not need to lack objectivity or reliability. A number of quality criteria can be established which comply with the standards of any legitimate scientific method.

Philipp Mayring, a German psychologist, is a crucial figure in the modern field of QCA. His research displays an attempt to elaborate and thoroughly describe QCA as a method for the social and communication sciences. In his approach Mayring (2010) relies on communication science, hermeneutics, qualitative social science, literature studies, and the psychology of text processing (ibid.: 26ff.). It is important to emphasize that QCA is a *method*, not a methodology, nor is it underpinned by a socially oriented theory as e.g. in Critical Discourse Analysis

[20] A quantitatively oriented data analysis in linguistics, that is usually implemented within corpus linguistics, can be supported by means of computer-assisted technologies (Ancarno 2020: 166ff.; Baker 2020: 124ff.; Chapman 2011: 187ff.).

[21] Consider e.g. how jobless teachers evaluate their job-related demands in a longitudinal study in Mayring (2010: 105ff.).

(Averbeck-Lietz 2019: 92f.). QCA can be implemented for any qualitative communication data, e.g. within a discourse analysis (cf. e.g. ibid.: 95; Kuckartz 2019). QCA therefore approaches a text openly (Kuckartz 2016: 46). One nevertheless has to be mindful that there is not such a thing as *one* QCA (Kuckartz 2019; Schreier 2014b), but there are rather a number of methods which systematically describe a text by means of a set of categories. Mayring (2014, 2010) defines three basic forms of a qualitative data approach:

- *Summarizing* sets the goal of reducing textual material to its most essential (core) aspects;
- *Explication* explains doubtful propositions by bringing up additional material;
- *Structuring* seeks to assess the text according to certain criteria, which are extracted from the text itself.

However, following an extensive analysis of variations of QCA analytical forms, Schreier (2014b) claims that there are two basic forms – *structuring* and *extraction* (the latter is elaborated by Gläser & Laudel (2010), see below) – while other forms are derivatives of the structuring form of QCA.

Being a scientific method, QCA is a controlled procedure of text analysis. The first basic aspect is that QCA has to be embedded into a communicative context. The goal of the analysis has to be defined, e.g. through variables of a text producer, their experiences or feelings, or the origins of a text material (Mayring 2008: 10, the examples are from ibid.).

The second foundational parameter of QCA is that it is systematic and rule-bound, i.e. it is oriented towards some predefined rules of a text analysis. The rules can vary depending on the demands of a particular qualitative data-set, but nevertheless there has to be a rule-bound procedural model ("Ablaufsmodell" in Mayring 2010). The procedural model has to define each step of analysis and each evaluation decision. Furthermore, prior to the analysis itself, content-analytical units have to be determined, namely *the coding unit* (Mayring 2014: 51; cf. "Kodiereinheit" in Mayring 2010: 59), *the context unit* (Mayring 2014: 51; cf. "Kontexteinheit" in Mayring 2010: 59), and *the recording unit* (Mayring 2014: 51; cf. "Auswertungseinheit" in Mayring 2010: 59)[22,23]:

- The **coding unit** determines the smallest component of material which can be assessed and what the minimum portion of text is which can fall within one category.
- The **context unit** determines the largest text component, which can fall within one category.
- The **recording unit** determines which text portions are confronted with one system of categories.

(Mayring 2014: 51, bold original)

A coding unit can be a proposition; a context unit can be the entire material of an analyzed case; and a recording unit can be this respective case (ibid.: 61).

These units are vital for the development of a *coding frame*[24], which is the third fundamental characteristic of QCA, or its "Herzstück" (Schreier 2014b). A synthetic category system by itself can even be considered one of the main outputs of QCA (Averbeck-Lietz 2019:

[22] Discourse analysis of speech requires that the speech patterns are transcribed, i.e. graphically represented (O'Connell & Kowal 2008: 66). Analysts are hence faced with a challenge of how to define and set boundaries to a natural flow of talk, or how to divide it into analytical chunks (Johnstone 2018: 17; cf. section 3.2.). There are no strict rules relating to this question since "analyzing human life is a matter of open-ended interpretation rather than fact-finding" (Johnstone 2018: 18).

[23] See also Krippendorff (2013: 104ff.) for the approaches to define units.

[24] Examples of coding frames will be provided by means of an overview of existing studies in section 3.4. Furthermore, a coding frame for the purposes of the research at hand will be elaborated in section 7.1.

97). There are, in general, two possibilities of categories formation: they can be derived from a theory or previous research (deductive approach), or they can be drawn from the actual conversational material (inductive approach) (cf. e.g. Mayring 2010: 83). Deductive and inductive approaches can also be combined (making a "mixed-methods" approach, on which see Mayring 2008: 9). As the first step, the category cluster can be initiated deductively and then expanded inductively (Averbeck-Lietz 2019: 87). Deductive categories can also be modified to match the specifics of the material at hand (Kuckartz 2016: 71f.). The first attempt to code the material happens in a pilot phase and succeeds in the case of 10-50% (Mayring 2008: 12) or 10-25% (Kuckartz 2016: 102) of the textual material so that changes of an inductive nature can be implemented to the general coding frame. Given that the testing phase applies to only the part of an analyzed text, Gläser & Laudel (2010: 199) consider it to be a breach of the qualitative approach, since the resulting self-contained coding frame cannot cover the nuances of the entire text. Gläser & Laudel (ibid.) plead for an absolutely open coding frame which is changeable and adjustable at every step of a text analysis. This approach is called *extraction*, and it favors the elucidation of causalities and complex information in a text (ibid.).

In general, in order to establish a coding frame, several material readings are required to tailor the categories to the material at hand (cf. "requirement for *exhaustiveness*", Schreier 2014a: 175, italics original). Establishing categories is a "spiral-shaped" process ("spiralförmig" in Averbeck-Lietz 2019: 93) which proceeds to "a point of *saturation*" when no additional categories are needed (Schreier 2014a: 176, italics original). Delineating a coding frame which is able to categorize the entire text is a prerequisite of QCA; it is not allowed to leave whitespaces uncoded (Aeverbek-Lietz 2019: 99; Kuckartz 2016: 70; see the objection by Gläser & Lausel (2010) against self-contained coding frames mentioned above). Nevertheless, one has to be cautious not to come up with too proliferated a system of (sub)categories:

> At some point they [categories] may become so narrow that most of them will be used only once or perhaps not at all; i.e., the categorized data are virtually identical with raw data. (Holsti 1969: 98)

Category clusters are frequently hierarchically structured; in this case, superordinate (main) categories are oftentimes concept-driven (i.e. deductive) and subcategories are data-driven (i.e. inductive) (Schreier 2014a: 176; Denner 2008: 243).

> Main categories are those aspects of the material about which the researcher would like more information, and subcategories specify what is said in the material with respect to these main categories. (Schreier 2014a: 174)

Once a coding frame is established, each category has to be profoundly defined and be supplemented with an illustrative prototypical example of its realization derived from the material at hand (Schreier 2014a: 177). It is important that categories are easily distinguishable from each other and mutually exclusive. This categorical distinction does not mean that, while analyzing a text material, several categories cannot be assigned to one text passage because even one sentence can contain several themes (Kuckartz 2016: 102; see section 3.2. for discussion on the interrelation between ConvA and SA). Schreier (2014a: 175) specifies this requirement as asserting that only one subcategory within one main category can define a unit of coding; however, given that there can be more than one main category, subcategories of different main categories can specify one unit of coding[25].

[25] See also Holsti (1969: 99) who argues for the requirement of mutual exclusiveness, according to which a coding unit can only be placed into one category. However, he also claims that a sentence, being a unit of coding without

> The requirement [of mutual exclusiveness] does not imply that any one unit can be coded only once – it implies that any unit can be coded *only once under one main category*. In our study, we routinely classified one and the same passage in terms of a participant's opinion about turning off the life support for Terri Schiavo, for example, and a reason for that opinion. […] In other words, the same participant may well argue that it was wrong to turn off the life support for a number of reasons, for example, both on moral and on legal grounds. And both reasons can be coded – but not for the same unit. (ibid., italics original)

Kuckartz (2019) suggests that QCA can be used in a more holistic manner, whereby the analysis is based not only on categories but also on cases. For instance, in analyzing a number of texts by means of a categories cluster, an analyst can describe not only how the categories change throughout these texts (e.g. in terms of their frequency) but also how particular texts are configured based on this cluster of categories (cf. ibid.).

QCA is a theory-guided approach. By means of this characteristic, Mayring (2010) emphasises that the theoretical arguments of the relevant research field are systematically brought into the procedure decisions. Consequently, theoretical stringency enjoys priority over technical haziness; validity is more important than reliability (ibid.: 50f.).

Quality criteria justifies QCA as a scientific method to study qualitative data. Classical quality criteria such as *objectivity*, *reliability*, and *validity* are important criteria in the field of QCA as well, but they are modified to comply with the procedural character of QCA (Kuckartz 2016: 203). Thus, *intercoder reliability*, as a form of reliability within qualitative analyses, plays a special role in QCA. Intercoder reliability is a specific form of reliability and, even more, objectivity; the latter signifies a criterion to measure the independency of analysis results which have been conducted by different coders (Mayring 2010: 117). Intercoder reliability measures whether several (minimally two (Mayring 2008: 12)) independent analysts, if equipped with the same coding frame, would code the same text material in a similar fashion. In the case of coding inconsistency, QCA should not be terminated but the passages of disagreement should try to be understood and interpreted (Kuckartz 2016: 44; Mayring 2010: 51). Interestingly, Holsti (1969: 135f.) even suggests eliminating those coders whose judges consistently deviate from other coders after a careful investigation into the roots of such deviations, so that the possibility that this coder is especially sensitive to important fine textual elements can be excluded. This testing is particularly important in the pilot phase when categories can still be modified (see above) to increase *category reliability* (Holsti 1969: 136ff.). To measure the degree of intercoder reliability, one can calculate coefficient alpha, e.g. Krippendorff's alpha (Kalpha).

Nevertheless, intercoder reliability seems problematic to many analysts. First, Ritsert (1972: 70, quoted in Mayring 2010: 117), points out that a high intercoder reliability rate is only possible if the coding frame is not finely differentiated (cf. also Holsti 1969: 137). A high coder agreement score can be a consequence of "shallow" categories, such as if a coder wants to count the frequency of foreign names mentioned in a newspaper, so that "high coding is essentially a mechanical task" (ibid.: 142). On the other hand, a more sophisticated coding frame, e.g. themes, would usually result in a lower level of reliability (ibid.). Second, it is frequently the case that only the main coder is closely familiar with the context and raw material of the textual data (e.g. (s)he was the interviewer and/or collected the data), while the other coder does not possess such profound contextual knowledge (Mayring 2008: 13). Third, the calculation of intercoder reliability coefficients is only meaningful if the textual material is segmented into identical coding units that are prepared for each coder prior to their analysis (Kuckartz 2016: 216). Otherwise, the probability of congruence between categories drastically decreases due to

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physical guides (cf. "the symbol is bounded by space, the paragraph is set off by indentation" in ibid.: 136), can entail more than one theme because the "theme is not a "natural unit" for which physical guides exist" (ibid.).

the problem of whether the coders segment the text in the same way (ibid.). Fourth, a full agreement among coders is never expected in the qualitative research, so that intercoder reliability is a doubtful criterion (Mayring 2008: 13).

Intracoder reliability is another QCA-specific quality criteria of reliability. Here, an analyst is required to re-code a text material (or part of it) after it has been coded by him or her already. However, this criterion is not usually implemented (Mayring 2010: 117).

In relation to validity, Krippendorff (2013: 44f.) insists on the possibility to compare results of content analysis with some observable evidence. He provides an example of Janis' study (1943/1965, cited in ibid.) on a mass-media content analysis and its correlation with verbal reports or the observed behaviors of audience, such as e.g. in public surveys. In Holsti (1969), a similar idea is found under the term "generality" which underscores that, first, the findings of a content analysis have to have theoretical relevance (ibid.: 5), e.g. where frequency of specific words in a subject's speech is seen as a characterization of his personality, and, second, the findings of a content analysis have to be comparable with other data – "[…] other attributes of the documents, documents produced by other sources, with characteristics of the persons who produced the documents […]" (ibid.) – to deliver meaningful conclusions. In his example, the degree of hostility in political documents was compared to the degree of violence of the respective military campaigns (ibid.: 33). The notion of validating evidence in Krippendorff and generality in Holsti overlaps with Mayring's notion of *correlative validity* ("korrelative Gültigkeit" in Mayring 2010: 119) criterion, a QCA-specific quality criterion.

With regard to objectivity, Holsti (1969: 3f.) mentions that "the research process must be carried out on the basis of explicitly formulated rules and procedures" (ibid.). This view on objectivity in qualitative research relates to Mayring's requirement that QCA should be systematic and rule-bound.

Kuckartz (2016: 217f.), who is concerned with the generalization of qualitative analysis and the transferability of its results, outlines "external quality criteria" ("externe Gütekriterien" (ibid.: 217)) which partly overlap with the QCA-specific quality criteria by Mayring (2010: 118ff.) and which include:

- *Peer debriefing*, meaning regular meetings and exchange with experts outside of one's own scientific project group (cf. "semantische Gültigkeit" in Mayring 2010: 119);
- *Member checking* means talking to the subjects who are involved in the current QCA for qualitative feedback on the analysis results (cf. "kommunikative Validierung" in ibid. 118);
- *Extended field-stay* (cf. "ausgedehnter Aufenthalt im Feld" in Kuckartuz 2016: 218) denotes a prolonged stay in the field of research in order to eschew fallacies of analysis (cf. "Nähe zum Gegenstand" in Mayring 2010: 118);
- *Triangulation or application of mixed methods* (cf. "Triangulation bzw. Einsatz von Mixed Methods" in Kuckartz 2016: 218) should enable manifold perspectives on the research object and hence increase the possibility of generalizability (cf. "Triangulation" in Mayring 2010: 118).

Other QCA-specific quality criteria discussed in Mayring (ibid. 118ff.), which are adapted from the work of Krippendorff, are *sampling validity* ("Stichprobengültigkeit" (in ibid.)) and *predictive validity* ("Vorhersagegültigkeit" (in ibid.)), among others. These types of quality criteria will not be discussed in detail since many of them are (partly) implied in the already discussed quality criteria. An interested reader can learn about the outlined definitions by consulting the works of Krippendorff (2013) and Mayring (2010).

To conclude this overview of QCA, its systematic and rule-bound procedure and the requirement to adhere to the quality criteria justify its scientific value as an appropriate method

for the analysis of qualitative data. The strengths of QCA lie in its attempt to analyze subtle and complex information communicated in a text (or speech), e.g. by considering not only what was said overtly but also what was implied. This makes its implementation suitable for the analysis of language in use according to pragmatic theories such as Conversational implicatures and SAs. Furthermore, QCA as a method satisfies ConvA which concerns the sequences of interactive actions in communication. For instance, a turn, a TCU, an adjacency pair, or a topic can be defined as a coding unit. Thus, such units can be characterized following SA, e.g. an uttered turn as relating to an expressive IA[26] (cf. Henne (2006) discussed in section 3.2. and the studies which apply such an approach in section 3.4.).

To sum up what has been discussed in this chapter so far, several ways have been illustrated in which one can analyze language in use. Two pragmatic theories which originate from the philosophy of language (Conversational implicatures and SA), as well as one approach and one method to analyze linguistic data (ConvA and QCA), were thoroughly described. Among them, SA, ConvA, and QCA are fundamental for the empirical part of the study at hand (see Chapters 8 to 10). In the next section, the outlined theoretical accounts will be put into context. Through a brief overview of the existing studies relevant to the present purposes, it can be illustrated how language, with a primary focus on its functional side, has been analyzed. The chosen studies are dedicated to the analysis of language use under stressful conditions, such as in the realm of aviation, manned space missions, or during taxing conditions in daily life in general. This thematic criterion also justifies the choice of the respective studies because language use in distress is the research interest of the present work as well.

3.4. Analysis of communication in challenging environments

The way people communicate under taxing conditions has captivated researchers' attention for a long time. More precisely, the study of language usage in suppressing conditions is vital in the research of human factors. In this section, some existing studies on the use of language in the domains of aviation, manned space missions, and in burdensome day-to-day conditions will be explored. Through an analysis of linguistic data, the studies elaborate some methods to assess non-invasively the levels of load and anxiety experienced by the speakers. In doing so, some of them also attempt to detect specific personal traits and characteristics which are disclosed in the attributes of speech.

First, some studies of cockpit communication will be summarized. Second, some studies of cosmonauts and astronauts' communication will be outlined. Third, some studies of language use in other demanding situations will be discussed. Hence, this section as a whole will provide an overview of the status quo of this particular research field. In addition, with the help of the introduced studies, it will be illustrated how the theoretical accounts of the analysis of language in use, which were discussed in the previous chapter, can be applied to real-life data. The overview of the studies will also facilitate the formulation of a coding frame for the purposes of the research at hand. Furthermore, the reviewed studies will exemplify methodologies for linguistic data analysis, such as analysis combined with sociometric data[27], which will be useful for the present research. Lastly, the overview aims at an interpretation of the obtained data.

3.4.1. Language analysis in aviation

Communication is an important and indeed integral part of the job of airline-pilots and usually takes place in the cockpit among pilots or between the tower and the cockpit. Communication helps to establish pilots' knowledge of an ongoing flight situation. For instance, if problems in

[26] This methodology will be discussed in detail in section 7.2..

[27] The sociometric analysis was conducted by the IBMP. In the present research, it is simply referred to where relevant.

the navigation of an airplane arise, the coordinated mutual actions of the pilots, oftentimes together with the tower, help to resolve them within a short timespan and with as little risk to the flight-safety as possible. For this reason, the role of language in aviation cannot be overestimated. It becomes even more pivotal in situations of increased load and danger, such as during landing, take-off, or when severe technical breakdowns emerge. In such situations, the pilots' efforts and focus are usually directed at tackling the external demands, however, a communication style is oftentimes adopted which would not facilitate a most efficient problem resolution. In the following, an overview of selected five studies on language use in aviation will be given[28].

The first study was conducted by Silberstein & Dietrich (2003). In this study, the authors analyzed cockpit-voice-recorder data from flight documentations, focusing especially on "the social dimension of communication and the psychological categories behind actual language use" (ibid.: 10) as well as "the structural properties of language itself" (ibid.: 11). Situations in which communication in the cockpit took place were classified according to varying degrees of stress and workload:

> – "Normal low workload" (N1) describes situations of normal working conditions and low cognitive workload. Typical examples are: taxi, cruise.
> – "Normal high workload" (N2) refers to situations that are characterised by high cognitive workload under normal working conditions, for instance take-off, approach, and landing.
> – "Danger 1" (D1) is marked by the occurrence of an unexpected incident, e.g. the malfunction of some minor instrument. The flight behaviour of the plane is not impaired, and there are no warning signals.
> – "Danger 2" (D2) is a much more dangerous situation. The plane is difficult to control, its flight behaviour is impaired, and there are warning signals.
> – "Danger 3" (D3) refers to highly critical situations. Vital systems of the airplane do not function any more and the plane is hardly controllable. The flight behaviour of the plane is seriously impaired, and there are several warning signals.
>
> (ibid.: 14)

A case-by-case study of 14 selected transcripts was conducted using a method of ConvA (see section 3.2.), which focused on the transcripts' formal and semantic structure. The analysis enabled those utterances and passages to be identified that were "conspicuous in some way, e.g. because of a strange structure or because of a content that does not fit into the thematic flow" (Silberstein & Dietrich 2003: 12). Nine linguistic parameters were identified as being affected by stress. The frequency of these categories was calculated within the individual transcripts by coding the pilots' speech. The frequency of the categories was assumed to reflect the extent of workload and danger on the pilots' speech.

The first linguistic category is "Information Sharing". This category evaluates the extent to which crew members produce an utterance, tell others what they observe or think, etc. "Information Sharing" can be broadly defined as "the decision whether or not to speak" (ibid.: 15), which happens "at a pre-linguistic, higher cognitive level" (ibid.). Through "Information Sharing", the crew establishes shared knowledge of a current flight situation. In order to assess this category, values [yes] and [no] were implemented.

The second category is "Initiation of Crew Resources". This category aims to analyze how teamwork is organized through linguistic means. Since a cockpit is a socially hierarchical environment (Dietrich 2003: 6), the category distinguishes between the linguistic behavior of the captain and that of the rest of the crew. Captains' speech was studied to determine whether it included communication patterns which created an open atmosphere for other crew members

[28] All five studies were published in a book "Communication in High Risk Environments" edited by Rainer Dietrich in cooperation with Tilman von Meltzer (2003).

to "seek and give suggestions" (Silberstein & Dietrich 2003: 17); the value [activate resources] signifies this type of behavior. If crew members acted due to a previous suggestion (which was not their own), these utterances were labeled as [react]. Utterances which were not open for further suggestions received the value [order]. Instances of a lack of linguistic means for organizing the teamwork were labeled as [none]. In order to assign the right value, Silberstein & Dietrich (ibid.) considered semantic (intentions of a speaker according to the SAs theory; see section 3.1.) and formal (e.g. sentence mode and tag questions) aspects.

The third linguistic category is "Receptiveness". This category assesses how crew members prioritize and solve multiple simultaneous tasks that emerge from different channels (e.g. flying the airplane, running emergency checklists, speaking to the tower). Language processing was examined in the presence of concurring information channels (e.g. cockpit crew, flight attendants, radio) as well as the amount of exchanged information. Four values were chosen to characterize this category: [broad] – all incoming information is reacted to; [focused] – crucial information is perceived; [selective] – the attention is narrowed down and reduced while the choice of channels does not work properly; [none] – there is no reaction.

The fourth category is "Responsiveness". This examines the pilots' ability to adapt to situational changes and integrate new information into the pre-existing conceptualization of a situation. This category is located at a level of higher cognitive processes and provides information on "the influence of mental scripts on spontaneous communicative behaviour" (Silberstein & Dietrich 2003: 23). If the crew members adjusted their linguistic behavior to unexpected situational changes, value [+ responsive] was applied; if not – [- responsive]. Silberstein & Dietrich (ibid.), contemplating that aviation language is prescriptive in its nature due to standardized tasks, were interested in the extent to which this prescriptiveness of professional language-use can negatively influence a crew's responsiveness to unexpected communicative demands.

The fifth category, "Relation to Task", investigates the content of an utterance, and specifically whether it contributes or not to the task of flying an airplane. In the first case, value [+ task-related] was assigned to an utterance (e.g. information about technical details, briefings), in the second case – [- task-related] (e.g. small talks, jokes, swear words).

The sixth category is "Coherence". By means of this category, the communicative dynamics were examined in a turn-to-turn manner and two values – [coherent] and [incoherent] – were used. The following rules helped to decide on the right value:

> – Do the participants work on a shared communicative task?
> – Do they answer questions directed to them by other crew members?
> – Do they complete a current communicative task before opening a new turn?
> – Do they let each other finish their utterances, or do they interrupt each other?
>
> (ibid.: 24)

The seventh linguistic category is "Information Quality". This category analyzes speech with regard to its well-formedness on the level of a single utterance (e.g. deictically unclear references or grammatical ambiguities). It was assessed through the values [+ well-formed] and [- well-formed].

The eighth linguistic category is "Register". This includes analysis of the social dimension of language in use. The informal use of language, such as calling someone by their first name, was labeled as [informal], whereas formal addresses, such as using "Sir" or strictly adhering to the standardized aviation language, were labeled as [formal].

The ninth and last category is "Emotion". This category examines the emotional components in language, e.g. intonation and choice of lexical items. Two values were elaborated to evaluate this category: [calm] and [emphatic].

On the basis of analyzing the transcripts and after considering the classification of the situations into one of the five situational types (based on their different degrees of workload and danger), the following conclusions were drawn:

- Regarding the category of "Information Sharing", all vital information was transferred in situations characterized by normal and high workload while information exchange was slightly impaired during danger conditions[29].
- "Initiation of the Crew" was highly influenced by danger. Whereas in N1, N2, and D1 the values [initiate] and [react] (as well as a significant number of [order] in N2) were most commonly observed, the frequency of the values [none] and [order] clearly increased in D2 and D3. Furthermore, D2 and D3 were characterized by very short and rudimentary utterances, the highly limited use of tag questions, polite elements, or other "linguistic ballast" (ibid.: 31), while only crucial information was exchanged. In the most critical situations (i.e. D3), no linguistic interaction was evident at all.
- "Receptiveness" was systematically impaired by the influence of workload and danger. While the category was positive in N1 and N2 (as indicated through the values [broad] and [focused]), it gradually became negative in danger conditions.
- "Responsiveness" was robust to the influence of workload and danger.
- Within the category "Relation to Task", instances of [- task-related] were most of all evident in N1 and D3. In N1, these were typically instances of gossip, jokes, and the like; in D3, [- task-related] was associated with swear words and other instances of pejorative language.
- Under normal situational conditions, the communication was coherent. However, coherence of communication decreased drastically in the danger conditions.
- "Information Quality" was less clearly associated with the analyzed situational changes: utterances were always well-formed in N1, sometimes not well-formed in N2 and D1, and slightly more often not well-formed in D2 and D3.
- According to the category "Register", cockpit communication was usually labeled as [informal] except for the case of N2[30]. The category "Register" thus remains unchanged despite the influence of workload and danger conditions.
- "Emotion" as a category was clearly affected by danger conditions. While only a few instances of emotional speech were present in N1, they were quite frequent in D2 and even more so in D3. In the latter, there were more examples of pejorative language. Elliptic structures, repetitions, imperatives, and exclamatives were frequent in danger conditions. Furthermore, there were emphatic utterances which merely expressed feelings without providing any response to the conversational goal.

The second study on language in aviation to be mentioned here was carried out by Sexton & Helmreich (2003). By analyzing flight deck communication, Sexton & Helmreich (ibid.) wanted to understand whether there are effects of personality factors on the cockpit communication under routine and abnormal working conditions. The linguistic data, which was

[29] It was also hypothesized that more instances of missing information exchange might have occurred, since not all instances of the lack of information transfer might have been noticed in the data analysis (Silberstein & Dietrich 2003: 29).

[30] Silberstein & Dietrich (2003) explained this evidence for N2 as a consequence of the crew's need to run through many checklists. This task must have led to increased usage of formal aviation language. However, following Silberstein & Dietrich (ibid.), the cultural background of the crews was judged to be decisive in the expression of register; thus, for instance, formal register is predominant in the crews from Far Eastern and Muslim cultures, even during dangerous conditions of a flight. The predominance of the informal register in the study of Silberstein & Dietrich (ibid.) was hence attributed to the large amount of data collected from American crews, for whom informal register is more characteristic (ibid.: 36).

collected through a simulator study with 26 crews of 3 persons (captains, first officers, and second officers), were transcribed and evaluated by means of Linguistic Inquiry and Word Count software (LIWC) and using a method of micro-coding technique. LIWC was elaborated at the laboratory of James Pennebaker (Pennebaker & King 1999). According to Pennebaker, every person has a unique language style, a "language-use fingerprint" (Sexton & Helmreich 2003: 59), which is robust to time and other conditions. LIWC calculates a percentage of words used in a text that relate to a set of predefined dimensions: either linguistic dimensions (such as word counts, negations, assents, etc.) or psychological in nature (such as positive or negative emotions, anger, etc.). The micro-coding technique, which was elaborated at the University of Texas, classifies utterances into action-decision sequences "which are task-related communication categories centered on events and issues requiring coordinated action among crew members" (ibid.); these action-decision sequences address threats and errors during a flight.

Among other findings, the study showed that crews communicated twice to three times more, expressed in the number of words, during abnormal flight segments than during normal ones. This was explained through multi-tasking within the flight deck management during increased workload, i.e. abnormal flight segments[31]. Furthermore, the number of spoken words was related to higher performance and lower rate of errors. Considering the findings in light of the micro-coding technique, there were more instances of problem-solving during abnormal flight segments than during routine periods.

The third study that will be outlined here was administrated by Krifka et al. (2003). The data of flight simulator sessions by commercial American airlines were studied from the point of view of analyzing language as a (structural) medium of communication and a carrier of social biases and roles (ibid.: 75f., 99). The central question which the authors addressed focused on the correlation of performance, features of communication, and task load. LIWC software was applied to the textual material (see previously in Sexton & Helmreich (2003) for the description of LIWC). Furthermore, deriving from SA theory (see section 3.1.) and considering the content features of communication (e.g. status reports or prognoses), Krifka et al. (2003: 82f.) identified 13 categories to assess pilots' communication according to SAs which are combined with content features, e.g. "Status Reports (report current state of equipment, weather, location, etc.)", "Reports of Action (speaker gives a report his own actions)", etc. (ibid.). Additionally, Krifka et al. (ibid.: 85) specified eight features of communication, such as "Explicit reference to addressee, speaker, or group" and "Correction of previous information" (ibid.).

Among other findings, Krifka et al. (2003) found that communication density (the number of contributions of each participant per minute) was higher and utterances were longer in segments of increased task load[32,33]. On the content side, "poor" crews produced more hesitations, commands as well as expressive SAs and emotion words. "Good" crews were characterized as encouraging each other, acknowledging and confirming each other's SAs as well as including politeness elements in their communication more frequently (while in high

[31] Comparing the findings by Sexton & Helmreich (2003) with the findings by Silberstein & Dietrich (2003) on the subject of the amount of produced speech, it is important to keep in mind the granularity of the situation grouping according to the degree of load. Silberstein & Dietrich (2003) differentiated between five situational types (two types of normal workload and three types of danger conditions) while Sexton & Helmreich (2003) between two (routine and abnormal).

[32] Captains talked in a more general vein (about 40% of the time), while engineers were more frequently addressed during difficult segments of flights (Krifka et al. 2003: 81).

[33] Similarly to the point made in n. 31, one has to be cognizant of the fact that Krifka et al. (2003) differentiated between two types of situational load – medium task load and high task load; this does not correspond to the situational types in Silberstein & Dietrich (2003), but it does (partially) correspond to the study design in Sexton & Helmreich (2003).

task load situations, such politeness elements were less common in "good" crews than in "poor" crews).

When thinking about the possible improvements which can be made to future studies on language in aviation, Krifka et al. (ibid.) advocated a more fine-grained system of SA types, together with smaller "thought units" (ibid.) which would enable unambiguous coding based on SAs (cf. *coding unit* in section 3.3.). Krifka et al. (2003) also suggested to supplement this SA-oriented approach with an independent method of ConvA (see sections 3.1. and 3.2.). The authors further aimed to develop types of single SAs based on longer dialogue sequences in order to classify them (cf. the hierarchical organization of categories in content analysis, see section 3.3.). Furthermore, by considering a dialogue to consist of a number of "minimal dialogues" (Krifka et al. 2003: 97; cf. *topics* discussed in section 3.2.), Krifka et al. (2003: 97) proposed to "test how often crew members initiate dialogues, how often they give up their [communicative] goals in a dialogue, how often they respond with a counter-initiative speech act, and how often (and perhaps also how quickly) they do (or do not) finish a dialogue, that is, constitute a minimal dialogue" (ibid.)[34].

The fourth study was based on authentic data obtained from communication in the operating room and the cockpit. Dietrich & Grommes (2003) were interested in how speakers and hearers produce coherent conversations under varying conditions of workload, i.e. standard procedure vs. unexpected disturbances. Communication was assumed to be coherent where there are relations between referents within a text (cf. ibid.: 109; also see section 4.2.). Following the theory of discourse structure formulated by Klein & von Stutterheim (1989), a text is an answer to a question (i.e. "quaestio") which imposes constraints on the well-formedness of a discourse and thereby enables a speaker to achieve a communicative goal, i.e. to answer the text question. Extending this model onto the conversational organization, Dietrich & Grommes (2003: 110ff.) differentiate between two possible types of answers to a quaestio, or two possible types of a talk:

a. Quaestio-maintenance occurs in a talk and confirms a previous quaestio, but it does not initiate a new quaestio. The quaestio therefore remains what it was before.
b. Quaestio-shift takes place in a talk when a previous quaestio is confirmed and the new quaestio is also initiated that connects to the previous one.

Coherence in a conversation is linked to the cognitive planning of conversational messages which are contextually related and adhere to the constraints of the quaestio (cf. the Gricean maxim of Relevance in section 3.1.). Coherence is therefore upheld through both quaestio-shift and quaestio-maintenance (Dietrich & Grommes 2003: 112).

In their study, Dietrich & Grommes (2003) concluded that, with an increase of task load, the capacity to organize communication by means of quaestio-shifts gradually decreases and is replaced by an increase in quaestio-maintenances until the point of extreme task load, during which no communication takes place (ibid.: 120)[35].

The last study on language in aviation that will be discussed in this section consolidates methods from linguistics and organizational psychology. Grote et al. (2003) investigated

[34] Cf. the notion of poorly organized conversations with frequent marked topic shifts (Levinson 2013: 313, citing Sacks 1971; discussed in section 3.2.) and the notion of "quaestio-movements" in the study of Dietrich & Grommes (2003) (as well as the quaestio-theory by Klein & von Stutterheim (1989), which will be introduced below).

[35] For situations of high task load in an operating room, Dietrich & Grommes (2003: 122) concluded that the shared attentional field (surgeons and other assisting doctors are focused on one exercise – the operating table) supports coherence. However, it is different for cockpit communication where pilots are responsible for different tasks during a flight and thus have a divided focus of attention. In the latter case, coherently organized communication was assessed as crucial for interlocutors to enable common knowledge about an ongoing situation (ibid.).

whether and how standardization influences coordination processes in the cockpit[36]. The exercise of coordinating the team was divided into explicit and implicit forms:

> Explicit coordination is considered necessary when an agreement must be arrived at about how an action should be organised. It occurs typically during new tasks and new situations or when a new group of people make up a team to accomplish a job. People have to devote extra resources (very often communication) to organize the activities. Implicit coordination occurs when every one in a team knows his/her job, the actions harmonise with each other based on some kind of understanding [...] and therefore little noticeable effort for coordination is required. (ibid.: 132)

According to Grote et al. (ibid.: 132f.), explicit coordination is necessary *before* situations with increased load occur in order to decrease coordination costs during a challenging situation. The reduction of efforts for explicit coordination was assumed to help with the handling challenging tasks because team members share mental models of the current task and the team as such[37]. *Explicit* coordination contributes to the task load because team members have to simultaneously exercise the task and coordinate the team. An indication of *implicit* coordination can be the unsolicited exchange of critical information.

Grote et al. (2003) developed a systematic approach to assess communication, which involved a set of mutually exclusive categories that characterize information flow on a general level and discern between explicit and implicit coordination elements. For instance, examples of explicit coordination are "Provide information", "Request information", etc. (see ibid.: 141). Categories that describe implicit coordination are "Provide unsolicited information", "Offer assistance", etc. (ibid.: 142). Another set of categories was based on the concept of "heedful interrelating" (ibid.: 133, quoting Weick & Roberts 1993) and consisted of deliberate efforts by interlocutors "to (re)-consider the effects of their own actions in relation to the goals and actions of others" (Grote et al. 2003: 133)[38]. Examples of these were "Considering others", "Correcting the behavior of others", etc. (ibid.: 143).

In one of the sessions, a phase which was dedicated to problem solving indicated significant differences in the amount of speech between the conversation participants. For this reason, this phase was analyzed more closely with help of the aforementioned criteria and by considering quaestio-movements ("behavioral categories" and "linguistic categories" in Grote et al. 2003). With respect to the latter, Grote et al. (ibid.) differentiated between three subsegments: quaestio-new (a speaker initiates a new communicative task; cf. *topic* in section 3.2.), quaestio-shift, and quaestio-maintenance (see Dietrich & Grommes (2003) for the explanation of the quaestio-theory by Klein & von Stutterheim (1989)). Even though both quaestio-shift and quaestio-maintenance utterances form a coherent conversation (Dietrich & Grommes 2003: 112), Grote et al. (2003: 149) arrived at the conclusion that quaestio-shifts are linked to effective and quaestio-maintenances with an ineffective communication[39].

To conclude the overview of the five selected studies on language analysis in aviation, a few points need to be highlighted. First and foremost, communication patterns change under the influence of load; for instance, the amount of speech tends to increase with an increase of

[36] Grote et al. (2003) also considered analyzing low standardization of language use in emergency rooms, but this analysis was not carried out at the time when the outlined study was published.

[37] It is noteworthy that 73% of accidents in commercial aviation happen on the very first day of a crew pairing (Sexton & Helmreich 2003: 63).

[38] There was one more set of categories which aimed to assess leadership since it was assumed to be closely linked to coordination and the effects of standardization, i.e. "depersonalised leadership" (Grote et al. 2003: 142). The categories were "Making plans", "Assessing task", etc. (cf. ibid.).

[39] As an illustration of this assumption, it was concluded that, since the captain spoke most of the time and did not indicate effective leadership style, the co-pilot responded passively by maintaining the quaestio initiated by the captain (Grote et al. 2003: 145, 149).

load (Krifka et al. 2003; Sexton & Helmreich 2003) until the load is too high, i.e. in the danger conditions (Silberstein & Dietrich 2003). Furthermore, this change is not chaotic but reflects the degree of load experienced by a speaker. The change in language patterns is both evident with respect to the quantitative aspects, i.e. the amount of speech, as well as from the content-side, i.e. what is communicated. Nevertheless, one has to be conscious that the reviewed studies have their limitations. For example, Silberstein & Dietrich (2003) mentioned that the cockpit-voice-recordings never exceeded 30 minutes and were mainly performed when a problem occurred, and that for many crews there were no data on speech during normal flight conditions. For the purposes of the following empirical part, the study by Silberstein & Dietrich (2003) is of particular relevance because it will lay the ground for the coding frame (see section 7.1.). Additionally, the choice to analyze linguistic data used by Grote et al. (2003), namely by evaluating the linguistic data by means of behavioral (i.e. content categories) and linguistic (types of quaestio-movements) categories, will be followed in the empirical part of the present study. Furthermore, the approaches and categories used in all five studies will be taken into account while either establishing the coding frame or later on during the interpretation of the obtained data.

In the following, the discussion of language analysis in stress-inducing environments will be continued. Attention will fall especially on the use of language in the context of manned space missions.

3.4.2. Language analysis in manned space missions

In the context of manned space missions, the assessment of a person's mood, level of anxiety, and degree of adaptation to new conditions associated with a spaceflight (see section 2.1.1.), as well as the dynamics of a small group (i.e. the crew; see section 2.1.1.), is oftentimes measured by means of an analysis of linguistic material. A substantial contribution to this research field has been carried out by IBMP, who study interactions between cosmonauts and Russian Mission Control during real spaceflights as well as in the framework of isolation studies (see section 2.1.1.)[40]. Furthermore, "the right use" of language is considered one of the aspects that can and should be trained in astronauts and cosmonauts as part of the curriculum prior to their assignment to an international space mission; this will be illustrated with the help of a manual that has been jointly elaborated by space agencies. In the following, the focal points in the linguistic research will be addressed by referring to a number of selected studies.

3.4.2.1. Language analysis during real spaceflights and in simulation studies

On the body of a 520-day isolation study Mars-500, Tafforin et al. (2015) analyzed the group dynamics of a six-person crew using an ethnomethodological approach. The authors correlated the results of a sociometric analysis (see section 2.1.1.), Luscher's color choice test, as well as a Personal Self-Perception and Attitudes test with their observations on the verbal and non-verbal behavior of the crew. Group discussions were video- and audio-recorded and evaluated based on two criteria: "interpersonal communications in Russian" and "interpersonal communications in English". It was found that interpersonal communication was negatively correlated with anxiety levels; subjects with high sociometric popularity and status (see section 2.1.1.) participated in interpersonal communications more frequently and entailed lower levels of anxiety as well as higher facial expressivity. Tafforin et al. (2015) considered this correlation to be an indicator of "group membership as a source for satisfying the need in affiliation, as well as the need related to the area of human communications" (ibid.: 27; cf. "the need to belong" hypothesis in section 2.1.1.). A comparable study was conducted by Kuznetsova et al.

[40] For a historical overview of this approach see Gushin et al. (2016).

(2016). This study was performed on the same crew during the period of the crew's greatest autonomy, when they did not possess any communication with the outside personnel. The authors confirmed the findings of Tafforin et al. (2015) regarding the correlation of anxiety levels and sociometric status. Furthermore, Kuznetsova et al. (2016) found that less popular crew members more often initiated interactions than more popular crew members did. The authors interpreted these findings as an attempt of less popular and more anxious crew members to alleviate social frustration, caused by isolation and confinement, and satisfy their need for affiliation and empathy by approaching more popular and relaxed colleagues.

There is another approach to the analysis of communication material in the realm of manned space missions. Patterns of authentic communication between crew members and Mission Control Center (MCC) may be examined to monitor the behavioral health of the former. For example, Kanas et al. (2008) discussed whether features of individual communicative style reflect a speaker's personality traits and their psychological emotional status as estimated by Profile of Mood States (POMS). To undertake this inquiry, the communication of six astronauts with the MCC was coded using content analysis (see section 3.3.); content analysis has been elaborated by IBMP since 1971 to evaluate communication between cosmonauts and MCC (Gushin et al. 2016). The criteria of communicational functions were based on the framework developed by Lomonov (1981, referred to in Kanas et al. 2008: 823):

> (1) Informative function, which includes primary demands for information, clarifying (secondary) demands for information, informing after a demand, informing without a demand, requests, professional slang, and ignoring a demand. (2) Socio-regulatory function: rational consent, rational discord, operational complaint, socially directed complaint, calls by name, and refusal to cooperate. (3) Affective (emotional) function: encouragement, sympathy, gratitude, emotional consent, emotional discord, satire, acidity, humor, and jokes. (ibid.)

Kanas et al. (2008) found similarities in communication patterns of crew members with similar POMS profiles. Furthermore, a POMS questionnaire and content analysis were found to be appropriate for monitoring negative changes in the psycho-emotional state of the astronauts.

The next study on language use in the field of manned spaceflights continues the investigation into cosmonauts' unique communicative style[41]. Yusupova et al. (2021) examined the routine communication between 15 cosmonauts and the Russian MCC. The authors formulated asset of categories defined for a content analysis according to four communicative styles in Satir (quoted in ibid.). Among these four types were "Computing", which is characterized by precision and emotionlessness, and "Blaming", which displays itself as a psychological defense against guilt and a refusal to collaborate along with a quick situation analysis. Following the content analysis of transcripts, the communicative styles were matched with the content analysis categories, e.g. "Computing" style was defined through such content analysis categories as "Informing", "Planning", "Initiative", etc.[42].

In the next study to be mentioned here, Yusupova et al. (2019) implemented a similar approach by using content analysis to study "rapid remote assessment of the psychophysiological state of astronauts as well as in-group and intergroup (crew-MCC) interactions" (ibid.: 710). Yusupova et al. (ibid.) implemented content analysis on the communication of five astronauts with the MCC on the topic of routine and challenging situations during a one-year long space flight. In accordance with the transactional model of

[41] Cf. also the notion of "language-use fingerprint" mentioned in Sexton and Helmreich (2003: 59), following Pennebaker & King (1999), in section 3.4.1..

[42] For the present purposes, the methodology of the study is of greatest interest. Therefore, the summary of the respective results will be kept to a minimum.

stress by Lazarus (see section 2.1.), the authors regarded communication "as a form of behavioral manifestation of astronauts' coping strategies of dealing with problematic situations emerging during space flights" (Yusupova et al. 2019: 711). Yusupova et al. (ibid.) assumed that astronauts, being exposed to problematic and stressful situations, would habitually make use of behavioral styles which had been learned during their lifetimes; this assumption is pursuant to Satir's view on the manifestation of typical communicative reactions of humans under stress (ibid.). According to the results of the study conducted by Yusupova et al. (2019), a number of statements that indicated a greater attention to work planning, claims to the ground (such as demands and requests), desire to shift the responsibility for the problem, and humor increased during the final phase of the space flight which is associated with particular difficulty for the crew (see section 2.1.1.).

Another study conducted by IBMP was based on the experiment SIRIUS-19 (a 120-day isolation study; see section 5.1.)[43]. Supolkina et al. (2021) analyzed the manifestation of increased autonomy among isolated crews during a period of extended confinement. Specifically, the researchers were interested in the phenomenon of psychological "detachment" as "caused by the progressive increase in crew autonomy with loss of the visual image of their home planet that could negatively influence the mood, morale, and overall activity of the crew and induce groupthinking" (ibid.). Daily communication of the crews with the outside personnel, together with other video messages produced by the crew, were analyzed using the method of content analysis (cf. Gushchin et al. 2016). Acoustic features were also studied, e.g. fundamental frequency (F0) and signal intensity (loudness). Among other findings, it was found that external communication decreased[44] and the crew expressed fewer problems, needs, or asks towards support personnel as the end of isolation approached. This was interpreted as an indicator of either the crew's better adaptation to long-term isolation or autonomization and asthenization (see section 2.1.1.)[45]. Notably, from the second isolation month, the researchers reported a difference between the morning (lower) and evening (higher) F0 in all crew members. This finding was interpreted as a sign of increasing fatigue. In general, communication styles within the crew smoothed out near the end of the isolation, as indicated by communication volume, emotionality, and certain acoustic features such as vocal (glottal) pulses, as well as an increase in group cohesion and its consolidation (Supolkina et al. 2021).

Thus, in the field of manned space missions, linguistic data are used to assess the psycho-emotional health of space travelers, as well as their sociometric status, and to understand group dynamics within the crew and between the crew and the MCC. Furthermore, features of communicative style help to reveal speakers' personal traits and can be equated to the concept of coping strategies upon stress (see section 2.1.).

To complete the overview of the array of approaches and methodologies used in the analysis of linguistic data within the framework of manned space flights, the next section is dedicated to language-related competencies which space travelers are required to possess prior to their assignment to a mission on the International Space Station. These competencies are not based on a scientific analysis but are studied after gathering years of experience in space agencies. Therefore, due to their authenticity and closeness to the research field, they are important for consideration in the present research.

[43] SIRIUS-19 experiment is the testbed for the present investigation as well, see the Empirical Part.

[44] However there was a single increase during a simulated Moon landing (Supolkina et al. 2021; see for the detailed SIRIUS-19 scenario description in sections 5.1. and 5.3.).

[45] Another possible interpretation of the communication data was given by referring to the "third quarter" phenomenon (Supolkina et al. 2021; see section 2.1.1.).

3.4.2.2. Training of language-related competencies

The training of behavioral competencies is an important part of the curriculum for astronauts and cosmonauts. Space travelers are expected to possess soft skills, which supplement their technical competencies, in order to be assigned for an international space mission. Hence, the International Space Station Human Behavior & Performance Competency Model (Mission Operations Directorate ITCB HBP Training Working Group 2008a and 2008b) was elaborated to facilitate such trainings in soft skills. The Human Behavior and Performance competencies (HBP) are further recommended to be considered during cosmonauts and astronauts' selection phase. HBP are reinforced either during technical or HBP-specific training sessions.

The HBP document consists of eight categories which are further specified by means of behavioral markers which, in turn, are explained through details and examples as well as supplemented via cognitive and affective teaching points, such as "Knowledge" and "Attitudes". The eight categories are:

- "Self-Care and Self Management"
- "Communication"
- "Cross Cultural"
- "Teamwork and Group Living"
- "Leadership"
- "Conflict Management"
- "Situational Awareness"
- "Decision Making and Problem Solving"

As it is not possible to investigate all the listed categories in the framework of the present study, attention will be given to the categories "Communication" and "Cross Cultural" because they are both (partially) dedicated to the use of language. In the following, the scope of these two categories will be explicated through their respective competencies. In the empirical part, relevant behavioral markers of the selected competencies will be outlined (see section 7.1.2.). All other details will be left out because they are not relevant to the purposes of the present research. An interested reader can consult the HBP documents (Mission Operations Directorate ITCB HBP Training Working Group 2008a and 2008b), which are publicly available online, to learn more about the manual.

The category "Communication" consists of two competencies: "Optimize communication" and "Ensure understanding" (Mission Operations Directorate ITCB HBP Training Working Group 2008b: 2-10ff.).

The category "Cross Cultural" contains five competencies: "Demonstrate respect towards other cultures [national, organizational, professional]", "Understand culture and cultural differences [national, organizational and professional]", "Build and maintain social and working relationships", "Intercultural communication and language skills", and "Commitment to multicultural work" (ibid.: 2-17ff.).

Unlike the previously described approaches to communication analysis during spaceflights, the HBP does not deliver data on changing language patterns. The HBP is rather a set of recommendations given by and for international space agencies on the soft skills which cosmonauts and astronauts should possess and reinforce. Therefore, the main strength of the HBP lies in its closeness to the field of applied psychology in the realm of manned space exploration (see also Kanas & Manzey (2008: 180ff.) for an overview of the HBP). The two outlined categories – "Communication" and "Cross Cultural" – will be important to establish deductively categories within the coding frame in the present study (see section 7.1.2.).

In the next section, the overview of the use of linguistic data in stress-inducing environments will be continued. Accordingly, it will be reviewed how linguistic data are

approached to evaluate the mental states of speakers in stressful conditions that are not associated with aviation or manned space exploration.

3.4.3. Language analysis in other stress-inducing environments

Analysis of language use under demanding conditions can be attempted not only to achieve some practice-oriented goals, e.g. to assess the psycho-emotional state of pilots or cosmonauts/astronauts, but also because of scientific curiosity in general. With this in mind, two approaches for examining speech patterns during stress in "more ordinary" settings than those which have been discussed in the previous sections will be introduced below. The first study is concerned with language use during an emotionally stressful story-telling task. The second approach is related to the speech characteristics of defendants who have been charged with a criminal offense and their victims in trial court. Even though there are a great number of approaches to language analysis (e.g. by considering its acoustic features, as in Lieberman et al. 2005), the overview of the existing literature on language characteristics during stress will be concluded with these two studies because they will be important in the empirical part of the research.

A study by Saslow et al. (2014) was based on three independent studies, but only the first one of these is of interest for the present purposes because of its independent parameter – HR data. In the first study, the question was raised whether physiological reactivity to a conversation about a recent stressful event is related to the cognitive complexity of speech. The subjects (N = 136 undergraduates) were asked to tell other subjects in same-gender dyads about a recent emotionally painful event that occurred to them; the listener and the speaker then changed their roles once the initial speaker finished his or her story.

In order to assess linguistic cognitive complexity, Saslow et al. (2014) applied LIWC (Pennebaker & King 1999; cf. also Sexton & Helmreich (2003) in section 3.4.1.) to samples of the participants' speech. The categories used for measuring linguistic cognitive complexity were based on previous research (cf. Slatcher et al. 2007; Pennebaker & King 1999) and were as follows:

- Distinctions or qualifications, exclusive words (e.g. *but, except*), tentative words (e.g. *maybe, perhaps*), negations (e.g. *never, neither*), discrepancies (e.g. *should, would*). The proportion of these words was assumed to increase with the increase of linguistic cognitive complexity.
- Words linked to grouping ideas together as well as inclusive words (e.g. *with, also*), on the other hand, were assumed to decrease with the increase of linguistic cognitive complexity.

(cf. Saslow et al. 2014: 258)

Saslow et al. (2014) stated that the concept of linguistic cognitive complexity is similar to the concept of "integrative complexity" in psychology and the political sciences (Suedfeld & Tetlock 1977)[46]:

> This [integrative complexity] is a dimension of information processing characterized at one pole by simple responses, gross distinctions, rigidity, and restricted information usage, and at the other by complexity, fine distinctions, flexibility, and extensive information search and usage. (ibid.: 169)

[46] Analyzing negotiations of national leaders during crises between the years 1914 and 1962, Suedfeld & Tetlock (1977) concluded that those crises which were characterized by lower levels of communicative complexity resulted in wars (ibid.: 182). Thus, it does not seem far-fetched to assume that the complexity of information processing can indeed be related to – or even expressed in – the linguistic complexity of speech.

To interpret and correlate the frequency of the aforementioned categories in subjects' speech, Saslow et al. (2014) collected data on three additional measures:

- Trait emotional stress reactivity questionnaire (a unidimensional 7-item scale used to evaluate how one tends to respond to stressful events; this varies from high reactive to nonreactive items).
- State emotional stress questionnaire (a questionnaire on the current emotional state of a speaker that was conducted at baseline and following each discussion).
- HR (the data were obtained at a baseline, i.e. 5 minutes of electrocardiogram data, while the subjects were filling in the questionnaires, and an average of the first 5 minutes in the story-telling task).

The results of the study revealed that linguistic cognitive complexity was strongly linked with physiological reactivity *during* the story-telling task but was *not* linked to the increase in HR from the baseline. In other words, an average HR during the story-telling task was a more important indicator of lower linguistic cognitive complexity in all subjects generally than the subjects' individual increase in HR during the task relative to the baseline:

> We conducted a regression analysis with the heart rate at baseline and during the discussion, baseline, and after stressed emotions, as well as the self-reported tendency to react strongly to stress, all entered simultaneously. Greater heart rate reactivity (heart rate during the discussion now controlling for all other measures in the model, including baseline heart rate) continued to be related to lower linguistic complexity ($\beta = -.20$, $p = .043$). Neither stressed emotions ($\beta = .12$, $p = .265$) nor the self-reported tendency to react strongly to stress ($\beta = -.08$, $p = .428$) continued to be related to linguistic complexity. (ibid.: 260)

Furthermore, the HR threshold of around 94 bpm was related to the lowest level of linguistic cognitive complexity:

> The mean heart rate in the conversation was 93.46 bpi [sic] in participants who spoke with the lowest cognitive complexity (lowest tertile), 89.71 bpm in participants who spoke with a medium level of cognitive complexity (middle tertile), and 87.14 bpm in participants who spoke with the highest cognitive complexity (highest tertile). (ibid.)

In conclusion, Saslow et al. (ibid.) stated that the experience of emotional stress, as measured through HR, has an influence on language cognitive complexity.

In a study on Russian defendants charged with a criminal offense and their victims in a trial court, Zhabin (2009) analyzed changes in formal characteristics of speech such as speech tempo, rhythm, pauses, or slips of the tongue. Following a psychiatric experiment on types of psychological accentuation[47] and an auditory assessment made by Russian native speakers on the recorded trials to detect periods of emotional distress in the subjects' speech, Zhabin (ibid.) concluded that in all subjects, when one disregards their psychological accentuation, speech amount increased together with distress degree when compared to the medium degree of distress[48]. A dramatic decline in the amount of speech was observed in those subjects in states of the highest distress[49]. Furthermore, in the state of medium degree of distress, speech of all subjects contained hesitations, false starts, and pauses. Based on these and further findings (e.g.

[47] That is psychasthenic, emotional-liable, schizoid, hysteroid, asthenic, and explosive types of accentuation (Zhabin 2009: 76).
[48] In the study by Zhabin (2009), four degrees of tension in speech were differentiated, which indicated either no tension (indicated as "0") or three degrees of tension distinguished by their intensity ("+", "++", and "+++").
[49] Cf. the Yerkes-Dodson law in section 2.1..

phonetic features), Zhabin (ibid.) claimed that it is possible to detect an emotional state of a (Russian) speaker through the characteristics of their speech.

Thus, also in areas that are not related to aviation and manned space exploration, speech is analyzed on the basis of its change as a response to demanding conditions, i.e. emotional distress. The study by Saslow et al. (2014) was able to detect that HR beyond 93.46 bpm is associated with decreased linguistic cognitive complexity; furthermore, this threshold was found to be universal in the examined subjects, i.e. disregarding their baseline HR. Zhabin (2009) identified that, in particular, the amount of speech is universally affected in speakers by the degree of experienced stress, which relates his study to the studies discussed in the section dedicated to the language analysis in aviation (see section 3.4.1.). The study by Saslow et al. (2014) will be crucial for the design of the empirical study based on context-sensitive parameters (see Chapter 4 for discussion of the context-sensitive categories and Chapter 11 for the empirical investigation). The findings from the study by Zhabin (2009) will be important for the interpretation of the obtained data according to QCA (see Chapter 8) and as one of the initial guides during the inductive approach in this dissertation (see section 11.3.).

In section 3.4., a few selected studies dedicated to the analysis of language in use under taxing conditions were reported. The overview was divided according to the research context within which they were carried out, i.e. aviation, manned space missions, and general scientific inquiries on language in distress. Three approaches (Silberstein & Dietrich (2003; see section 3.4.1.), HBP (2008a,b; see section 3.4.2.2.), and Saslow et al. (2014; see section 3.4.3.)) will be especially fundamental for the establishment of the coding frame (i.e. Silberstein & Dietrich 2003; HBP 2008a,b; see section 7.1.) and design (i.e. Saslow et al. 2014; see Chapter 11) in the empirical part of the present work. Furthermore, the majority of the studies that were outlined in this section will be necessary for elaborating on the coding frame for the QCA (see section 7.1.). The findings of all mentioned studies will be considered during the interpretation of the obtained data in the empirical part of the research.

This concludes the discussion on content-oriented approaches to language material. This chapter has provided a theoretical overview of the pragmatic theories, ethnomethodological approaches, and methods used in conducting a content-oriented analysis of text. After a general introduction, a number of studies on the analysis of language in aviation, manned space missions, and other demanding situations were outlined. In the next chapter, the attention will shift to a different view on the analysis of language in use as an indicator of complexity, which focuses on the choice that a speaker makes among several context-sensitive linguistic alternatives available in the language.

4. Context-sensitive categories of language in use

Language in use can be analyzed not only on the basis of the content of an utterance, but also by considering the choice a speaker makes when (s)he is confronted with certain linguistic options that are available in language. However, what counts as a "certain linguistic option"? Consider a situation in which a school director asks a teacher about what a group of students were doing in class. Here, the teacher can either respond with *They solved a difficult riddle* or *They were solving a difficult riddle*. In this case, the choice depends on the teacher's subjective view on the event as it unfolds and his or her communicative intent, e.g. whether or not the teacher wants to highlight that the students completed the task or that the task had taken them quite a long time.

Another example of such linguistic options can be illustrated through the following pair of utterances: *Ms. White has three sons* or *She has three sons*. What defines the choice between this pair of utterances? One explanation is that the choice between these two options is dependent on the speaker's assumptions regarding the knowledge which he or she shares with the listener. Has Ms. White been mentioned in the previous discourse? Is Ms. White walking down the street and is the speaker pointing at her? For the message to be understood correctly, the speaker has to evaluate whether the hearer is able to safely recognize his or her intention (Stojnić 2021: 3; also Gagarina & Bohnacker 2022: 172).

What these examples have in common is that the choice between the linguistic options is dependent, first, on the speaker's intention and, second, on the cognitive resources that are required from the speaker or the hearer. In both examples, one of the linguistic alternatives is cognitively "easier" to process than the other. This use of language will be discussed in detail in the present chapter.

Furthermore, whereas in the former example the two linguistic options, *They solved a difficult riddle* vs. *They were solving a difficult riddle*, feature some semantic differences (see section 4.1.1.), the latter example, *Ms. White has three sons* vs. *She has three sons*, consists of two semantically synonymous alternatives. The linguistic differences in the second case can be characterized by the term 'information structure' (or also 'information packaging' in Chafe 1976):

> The term *information structure* is meant to capture the different dimensions at which linguistic messages can be structured in accordance with requirements imposed by the linguistic and extralinguistic context as well as the communicative intentions of the speaker. (Hinterwimmer 2019: 340, italics original)

Among factors of linguistic context, one should include semantic, pragmatic, syntactic, morphological, and prosodical properties of utterances (Féry & Ishihara 2016: 1). Among factors of extralinguistic context that help to determine the structure of a linguistic message, one can mention the interlocutor's perception of the world (ibid.), the role of the addressee, as well as factors of higher-order cognitive processing, e.g. attention, memory, and inferencing (ibid.: 13; Bornkessel-Schlesewsky & Schumacher 2016).

To sum up, the selection between linguistic alternatives depends not only on a speaker's intentions but is also constrained by extralinguistic factors, e.g. cognitive resources (e.g. van Deemter et al. 2016; Givón 1995). The speaking process is thus to some extent reliant on the extralinguistic *context*. This notion will be central for the present chapter.

The chapter consists of two sections. In the first section, the so-called Markedness theory, according to which certain alternatives within a grammatical category require varying degrees of cognitive resources, will be discussed. In other words, according to this theory, grammar is asymmetrical and hierarchical. The aspectual and grammatical voice systems of Russian will exemplify such grammatical asymmetries. In the second section, attention will be given to referring expressions, such as noun phrases (NPs) and pronouns. According to the Givenness Hierarchy and the Accessibility theory, the choice of a referring expression is dependent on the cognitive status of the referent, e.g. its identifiability, and the degree of its mental accessibility.

Both the Markedness theory and the Accessibility theory, as well as the Givenness Hierarchy, can be related to the role of cognitive resources in the communication process. Hence, grammatical categories and referring expressions are sensitive to the working memory's limitations which can be strained by external demands (see section 2.1.2. for the influence of external demands on working memory). This is assumed to affect the speaker's choice of a particular linguistic structure, whereby the speaker tends to choose a cognitively less demanding linguistic structure when exposed to a great amount of external demands. In the process of language production, a speaker will therefore select structures which are computatively less demanding, in particular in relation to external stress. This assumption will be empirically addressed in Chapter 11 while the present chapter is dedicated to build the theoretical framework for it.

4.1. The concept of linguistic markedness

In linguistics, the term 'markedness' is ambiguously defined, being either based on structure or on processing costs. The former approaches markedness with the help of the notion of 'featuredness' (the existence of a particular feature or its absence), whereas the latter considers markedness to be an expression of the cognitive resources that are required to produce and comprehend language. In the following, these two approaches to markedness and their differences will be explicated.

The concept of linguistic markedness was coined in the Prague school. Markedness was first discussed in the field of phonology in the works of Trubetzkoy (1939) (cf. Greenberg 2005: 11; Waugh 1982), who differentiated between 'marked' and 'unmarked' categories that, however, can be better explicated through a notion of 'featuredness' (Wurzel 1998: 54). According to the Prague school, some phonemes which belong the same category have, and others do not have, a particular feature (e.g. voice). The 'marked' member can thus be described as possessing an additional feature and the 'unmarked' counterpart as lacking it:

> [...] the marked feature is a positive something, e.g. nasality, aspiration, while the unmarked feature is merely its lack. (Greenberg 2005: 14)

Having traced the concept of markedness to phonology, it was then extended by Jakobson (1939) to include grammatical categories and semantics (cf. Greenberg 2005: 11). Since then, the notion of markedness has been discussed in all domains of language (Kean 1984: 5f.; Mayerthaler 1981: 173). For instance, in lexical semantics, it is claimed that semantically marked words are more specific than unmarked ones, e.g. in the opposition *nurse* (unmarked) vs. *male nurse* (marked), where the unmarked form *nurse* is conventionally used to denote both female and male personnel (cf. Greenberg 2005: 66, the example is from ibid.). An unmarked member can also characterize a generic category, e.g. *man* as synonymous with *human being*, as well as being a specific counterpart to the marked member, e.g. *man* vs. *woman* (ibid.: 25f., the example is from ibid.). Consistent with the Pollyanna Hypothesis, negatively evaluated words are marked and ones with more positive or pleasant meanings are unmarked, e.g. *pretty*

(unmarked) vs. *ugly* (marked) (Boucher & Osgood 1969, the example is from ibid.; cf. also Ingram et al. (2016) for more on the Pollyanna Hypothesis). According to Givón (1995: 63ff.), people generally prefer using positive adjectives due to the fact that a positive adjective among such antonymous pairs entails a quality which covers the entire scale of the adjectival meaning and thus is perceptually more salient. On the contrary, a "negative" adjective can only cover the extremes of this scale[50]:

How long is it? – Very long / very short
vs.
How short is it? – *Very long / very short
(the examples are from ibid.: 63)

As was stated in the introduction to this section, the term 'markedness' encompasses divergent interpretations (Wurzel 1998). On the one hand, one speaks about 'featuredness' (*Merkmalhaftigkeit* in German) to denote an existence or absence of one particular linguistic feature (e.g. *-s* in English plural). This was illustrated in the aforementioned examples.

The key idea behind this concept of markedness lies in "the fact of asymmetrical or unequal grammatical properties of otherwise equal linguistic elements – inflections, words in word classes and even syntactic constructions" (Croft 1990: 64). The notion of markedness exists not only as a binary opposition but oftentimes forms a scale or hierarchy, e.g. in the category of number: *singular* < *plural* < *dual* < *trial*/*paucal* (ibid.: 66, 95ff.). Here, *singular* is the least and *trial*/*paucal* the most marked element within the case of grammatical hierarchy (cf. ibid.: 66). Markedness is therefore a quantitative concept, rather than a binary scale (Haspelmath 2005: XV; cf. also Greenberg 2005: 31).

On the other hand, markedness (*Markiertheit* in German) contrasts with 'naturalness' (Mayerthaler 1981) and implies that more marked grammatical entities are more difficult for humans to process. This second understanding of the term 'markedness' is the focus of the present research. Hence, the subsequent discussion will be dedicated to the conceptualization of this use of the term 'markedness'.

There are several criteria (or "dimensions" in Haspelmath (2006: 38)) which differentiate marked and unmarked linguistic elements within a grammatical category. Croft (1990), for instance, mentions the following ones:

- Structure: the marked value has at least the same number of morphemes as the unmarked, e.g. plural tends to have more morphemes than singular (cf. ibid.: 72ff.);
- Behavior: paradigmatically, unmarked elements vary more than marked ones. For example, there is a distinction in grammatical gender in the English singular as an unmarked category – *he, she, it* – but not in the plural, which is the marked category – *they* (cf. ibid.: 77ff.);
- Frequency: unmarked values are usually more frequent, or at least not less frequent, than marked ones (cf. ibid.: 84ff.);
- Neutral value: in neutralized contexts, only unmarked forms appear (cf. ibid.: 89ff.). For example, German word-final devoicing leads to the fact that *Bund* ('bundle') is pronounced the same as *bunt* ('colourful') – [bʊnt] (ibid.: 89). German obstruents are neutralized in terms of voice when in a final position and are always unvoiced (Haspelmath 2006: 55; Greenberg 2005: 13f., 63f.).

[50] Cf. Givón (1995: 63); Clark (1973: 55) on the acquisition of a positive opposition member prior to the negative one in antonymous pairs.

In attempting to explain such linguistic asymmetries through external factors, functional grammarians regard language as a "complex, biologically-based system of knowledge representation and communication" (Givón 1995: 9; cf. also Levinson 2013: 40). Functionalists aim to provide underlying reasons as to *why* some structures are marked and others are unmarked. Among such reasons, Givón (1995: 26) mentions communicative, socio-cultural, and neuro-biological factors. Understanding markedness as a "biologically-supported structure[]" (ibid.), such substantive reasons explain markedness as "adaptively motivated" (ibid.; cf. also Givón 2018: 11):

> Describing structures independently of the multiple adaptive contexts that constrain both their use and their evolution is a luxury not available to functionalists. Functionalists are burdened with having to explain the facts of structure by reference to some surrounding adaptive context. (Givón 1995: 26)

It is assumed that marked linguistic structures require greater mental effort, attention, and processing time than unmarked ones. For example, passive clauses are found to be processed with more difficulty and be acquired later by children when compared to active clauses (Givón 1995: 45; see also section 4.1.2.). Givón (1995: 28) defines this under the criterion *cognitive complexity* (compare the notion of "load" described in section 2.1.2.).

From the perspective of functional grammarians, frequent and recurrent information is processed automatically and categorically by modular channels, while less frequent information requires greater conscious attention and tends to depend a lot on the given context (ibid.: 13). Therefore, more frequent unmarked elements are easier to process than less frequent ones[51].

Various criteria that characterize a linguistic element as marked or unmarked tend to coincide in language. Thus, a marked member is usually less frequent and varies less paradigmatically while it is more complex structurally and cognitively than its unmarked counterpart. There are three aspects of markedness where this becomes evident: (i) in language acquisition (both L1 and L2), (ii) in structure, and (iii) in considering the required computational load. This correlation between the dimensions of markedness is called *iconicity*. Mayerthaler (1981: 25) defines *constructional iconicity* as that according to which "which is 'more' semantically should also be 'more' constructionally" (ibid.; cf. also Haspelmath 2006: 58). This criterion is in accordance with Clark & Clark's (1977) idea of "two interrelated sources of complexity" (ibid.: 337), which mark an important phase of children's language acquisition: (i) cognitive complexity ("the complexity of the child's ideas being mapped onto language" (ibid.)) and (ii) formal complexity ("the complexity of linguistic devices available in each language" (ibid.)), cf.:

> The simpler an idea is, the earlier children are able to map it onto language and so talk about it. More complex ideas take much longer to get mapped onto language. (ibid. with respect to cognitive complexity)

They also write:

> It seems reasonable to suppose that the more complex a linguistic device is, the longer children will take to learn it. (ibid.: 338 with respect to formal complexity)

Context plays an essential role in an analysis of markedness (e.g. Givón 1995). Some marked forms, such as passive sentences, can be used more often in marked discourse types (e.g. Ludwig 2001: 410), i.e. in written-formal texts, than in unmarked oral-informal discourses

[51] With respect to the formal complexity of linguistic elements, it is a central criterion that the markedness status is judged from the functionalists' view as well (cf. e.g. Givón 1995: 28).

(Croft 1990: 87). Hence, the passive voice can be unmarked in technical instructions or written texts (Renkema 2004: 65). Haspelmath, in his preface to Greenberg (2005: XV), summarizes the role of context in the study of markedness by explaining that "markedness is not an absolute property but is often relative to a given context". Hence, with the respect to the aspect of context-sensitivity, one can speak of a tendency of more frequent occurrences of marked linguistic elements in more marked contexts (Givón 1995: 27), e.g. technical writings. In this case, one speaks about *local* types of markedness in opposition to *absolute* types of markedness, which are based on universal principles of human cognition (cf. Christiansen & Chater 2008). The latter stands in the center of the present research.

A quite skeptical attitude to the term 'markedness' was expressed by Haspelmath in his article, with its provocative title "Against markedness (and what to replace it with)" (2006). He recognizes that the term 'markedness' is "superfluous [...] as a metagrammatical or explanatory concept" (ibid.: 43). Instead, he proposes to operate with less technical linguistic terms such as uncommon/common, abnormal/normal, unusual/usual, and unexpected/expected (ibid.: 63). The skepticism regarding the necessity of the separate term 'markedness' was also expressed by Fenk-Oczlon (1991); she considers frequency to be the key predictor of any dimension associated with markedness (e.g. structural and cognitive complexity). Taking into account these arguments against the term 'markedness', it is nevertheless important to acknowledge the asymmetry within linguistic categories. The nature of this skewness can indeed be unclear, so it does not compromise the empirical evidence for the existence of the discussed asymmetries in language. Thus, in the empirical part of this research, it will be assumed that a higher cognitive load leads to less frequent use of marked linguistic structures. In other words, a more frequent occurrence of marked linguistic structures is expected in less marked extralinguistic contexts, i.e. where there is a lower degree of experienced load. In testing this hypothesis, the characteristics of *absolute* linguistic marked structures will be pointed out, which are constrained by the limitations and capacity of human cognition and hence vary in terms of the processing costs required on the production side (cf. Christiansen & Chater 2008).

To investigate this question, attention will be paid to two grammatical systems in Russian: aspect and grammatical voice. They will be discussed in the next sections and then analyzed in the empirical part.

4.1.1. Russian aspectual system

Aspect is a grammatical category that describes the internal temporal constitution of a situation (Comrie 1976: 52). There are two aspectual categories in Russian: the Imperfective (Ipfv.) and the Perfective (Pfv.). The third type of aspect – the Perfect – is not present in the Russian active voice and can only be found in the passive, e.g. *okna otkryty* (Perfect) which means 'the windows have been opened' vs. *okna byli otkryty* (non-Perfect) which signifies 'the windows were open' (cf. ibid.: 54, 84f.). Since Pfv. and Ipfv. are present in the active as well as the passive voice in Russian, attention will be focused on this binary opposition.

Russian verbs almost always exist in aspectual pairs: the Ipfv. and the Pfv. (e.g. Tauscher & Kirschbaum 1987: 263; Forsyth 1970: 2). However, on the one hand, some verbs only have a Pfv. (*perfectiva tantum*) or an Ipfv. (*imperfectiva tantum*) form, for instance *zasmejat'sja* (perfectiva tantum; 'to start laughing') and *besedovat'* (imperfectiva tantum; 'to have a conversation'). On the other hand, some verbs can be biaspectual, for example, *obešat'* ('to promise'). As to the usage of aspect, it is a speaker's choice how to describe the action (e.g. Forsyth 1970: 7f.; Klein 2009). The use of aspect is thus sensitive to context (see in the introduction to Chapter 4).

Comrie (1976) considers the meaning of the Pfv. as that aspect which "looks at the situation from outside, without necessarily distinguishing any of the internal structure of the situation" (ibid.: 4). The Pfv. can reflect a series of repeated actions considered as one event,

e.g. *on obernylsja neskol'ko raz* ('he turned round several times') (the example is quoted from Forsyth 1970: 12). The Pfv. verbs are usually telic (Bar-Shalom 2002: 324); telic verbs describe events that have an endpoint or goal (Becker et al. 2013: 213).

Conversely, the Ipfv. "looks at the situation from inside, and as such is crucially concerned with the internal structure of the situation, since it can both look backwards towards the start of the situation, and look forwards to the end of the situation, and indeed is equally appropriate if the situation is one that lasts through all time, without even beginning and without any end" (Comrie 1976: 4). Ipfv. verbs can be both telic and atelic (Bar-Shalom 2002: 324); atelic verbs do not signify any intrinsic endpoints (Becker et al. 2013: 213).

The meaning of infinitive verbs depends, along with the meaning of the aspect itself, on the words with which they are adjacent, and primarily with their lexical meaning (Rassudova 1968: 52). Verbs in an infinitive form have a secondary function; they express modality (ibid.: 54). For instance, when an event occurs once, then the Pfv. form of an infinitive is usually used[52], as when it is used after such words as *nado* ('[it is] needed') or *khotet'* ('to want') to signify an action in its completeness. In these cases, infinitive forms of Ipfv. verbs have an additional modal meaning, since they signify a beginning of an action:

- *Mozno mne **primerit'*** (Pfv.) *kostjum?* – 'Can I **try** the suit on?'
- *Primeročnaja osvobodilas', mozete **primerjat'*** (Ipfv.)*!* – 'The dressing room is not occupied, you can (start to) **try** it on!'

(the examples are from ibid.: 57f.)

Apart from the semantic factors, the Russian aspectual forms are characterized by a formal morphosyntactic device. From a morphological perspective, the Pfv. is often formed from the Ipfv. by means of prefixation with a slight modification of the verb meaning (Comrie 1976: 89), e.g. *delat'* (Ipfv.; 'to do') – ***s**delat'* (Pfv.; 'to accomplish'). The secondary Ipfv. can be a suffixal derivative from the Pfv. (ibid.: 90), e.g. *sbrosit'* (Pfv.; 'to throw') – *sbraš**yv**at'* (Ipfv.; 'to be throwing') (see also Isačenko 1982: 365ff.). Prefixes that modify a verb meaning are called prefixes with a lexical meaning; prefixes that do not change the lexical meaning of a verb are called prefixes with a grammatical meaning (Vinogradov 1952: 312; cf. also Klein 1995: 671).

The aspectual system is not to be confused with the tense system. Following Comrie (1976), "[t]ense relates the time of the situation referred to to some other time […]" (ibid.: 1f.). There are three tenses in Russian: present, past, and future. Tense is a deictic category (ibid.: 5; Levinson 2013: 56f.), while aspect is a non-deictic category (Beedham 1982: 84). The table below provides an overview of the use of the two aspectual categories, Pfv. and Ipfv., in different tenses:

[52] Pfv. can be used to describe a repeated action where one is highlighting a single event ("nagljadno-primeročnoje značenije" (Rassudova 1968: 69)), cf. *on ljubit **pokazat'*** (Pfv.) *svojo prevoskhodstvo* – 'he likes **to show** his superiority' (ibid., the example is from ibid.).

	Perfective	Imperfective
Past	*On pro-čita-l roman.* 3SG PREF-read-PST novel he till end-read-PST novel 'He read a novel.'	*On čita-l roman.* 3SG read-PST novel he read-PST novel 'He was reading a novel.'
Present		*On čita-et roman.* 3SG read-PRS novel he read-PRS novel 'He is reading (reads) a novel.'
Future	*On pro-čita-et roman.* 3SG PREF-read-PRS novel he till end-read-PRS novel 'He will have read a novel.'	*On bud-et čit-at' roman.* 3SG will-3SG read-INF novel he will-3SG read-INF novel 'He will read / be reading a novel.'

Table 1: The use of the Russian aspectual forms in different tenses with example-sentences.

A further important category is the category of *Aktionsart* (or "event types", "lexical aspect", "situation aspect")[53]. According to Klein (1995; 2009), *Aktionsart* denotes "a subdivision of verb types according to the temporal properties of the situations which they describe" (Klein 2009). For instance, the verb *pisat'* ('to write'; as in *On pišet pis'mo* – 'He is writing/writes a letter') describes a state, while the verb *perepisat'* ('to copy'; as in *On perepisyvaet pis'mo* – 'He is copying/copies a letter') describes an event (ibid., the examples are adopted from ibid.). The lexical content of the former expresses one state and the latter two states (a source state and a target state)[54,55]. A different view on *Aktionsart* is suggested by Vendler (1967), who distinguishes between four "time schemata": states (e.g. "to stand"), activities (e.g. "to run"), accomplishments (e.g. "to paint a picture"), and achievements (e.g. "to find a solution") (cf. Klein 2009, the examples are from ibid.).

Having described the Russian aspectual system, it can now be characterized according to the concept of markedness. In considering the binary opposition of the Pfv. and the Ipfv., one can see that the Pfv. bears the marked status (e.g. Durst-Andersen 2018: 58; Klein 1995: 690; Isačenko 1982: 347; Comrie 1976: 112ff.). For instance, structurally speaking, Ipfv. verbs are simplex verbs in Russian with two exceptions: there are about 30 Pfv. verbs that are simplex and some simplex verbs are ambiguous between the Ipfv. and Pfv. (Klein 1995: 670).

Furthermore, Comrie (1976: 115) points to the fact that certain forms tend to be missing in the paradigm of a marked form. Accordingly, in the Russian aspectual system, three tenses are distinguished in the Ipfv. (Past/Present/Future) but only two in the Pfv. (Past/Future) (cf. Table 1).

In considering the acquisition of the aspectual system by Russian children, Bar-Shalom (2002) has come to a conclusion that the Pfv. as well as the Ipfv. are produced early and correctly by monolingual Russian children (from 1;6 to 2;11). Cejtlin (2000: 150) has stated that the acquisition of aspect can be characterized by only rare deviations from the adult language forms. Cejtlin has further argued that Ipfv. verbs appear slightly earlier than Pfv. verbs in children's speech; speaking about an ongoing event is the natural first stage in children's language (cognitive) development (ibid.: 148f.). Hence, the acquisition of the Russian aspect interrelates with the acquisition of the *Aktionsart*. The Ipfv. is initially used by Russian children in the present tense, while the Pfv. is mainly used with past inflections (Gagarina 2000; cf. also Stoll 2005; Pupynin 1996). Thus, the Ipfv. reflects an unmarked, cognitively less difficult, aspect as a description of ongoing events that are central to a child's early development (cf. Pupynin 1996: 93). This is supported by the study of Gagarina (2000) which has revealed that,

[53] See Stoll (2005) and Gagarina (2000) for *Aktionsarten* in Russian.

[54] Klein considers 0-state contents (atemporal contents; as in e.g. "Seven is a prime number" (Klein 1995: 682, the example is from ibid.)), which describe a situation as unlimited in time, as not "directly relevant to the problem of Russian aspect" (ibid.).

[55] Following Klein (1995: 689), Pfv. verbs are 2-state verbs and Ipfv. verbs are 1-state verbs.

among the twenty-four earliest verbs, the Ipfv. tended to be more frequent than the Pfv. in the speech of six Russian children who were younger than 23 months (ibid.: 239).

However, the Pfv. is used more often than the Ipfv. in Past and Future tenses and in all communication styles (Comrie 1976: 117). Comrie explains such discrepancy in the marked status of Pfv. and its high frequency in Russian by pointing to the prevailing role of the meaning that a speaker intends to express when describing an event. A speaker "chooses" an aspect depending on what (s)he intends to say, i.e. whether an event is completed, habitual, etc. The use of aspect is generally driven by the speaker's subjective view on how to express a proposition (Tauscher & Kirschbaum 1987: 250; cf. the notion of context-sensitivity explained in the introduction to Chapter 4).

Furthermore, the unmarked Ipfv. cannot always replace the marked Pfv., a point which contradicts the notion of neutralization of marked members with unmarked ones (Comrie 1976: 112):

Na etot raz my rešili (Pfv.) / **rešali (Ipfv.) zadaču za pjat' minut*
'This time we solved the task in five minutes.'

(the example is from ibid.: 113)

The decisive argument in light of these contradictory observations is offered by the fact that, when the Ipfv. and the Pfv. are purposefully contrasted within the same context, their meanings differ. Thus, the Pfv. implies the successful accomplishment of an action, whereas the Ipfv. simply does not exclude it (ibid.)[56]:

- *Vy čitali* (Ipfv.) *'Vojnu i mir'?* – 'Have you read 'War and Peace'?'
- *Vy pročitali* (Pfv.) *'Vojnu i mir'?* – 'Have you finished 'War and Peace'?'

(the examples are from ibid.)

Hence, context (pragmatic reasoning) plays a decisive role in the possible readings of the Ipfv. (Sonnenhauser 2008: 2079).

To sum up the above arguments, the Pfv. is a marked category in the binary opposition in the Russian aspectual system. Even though the Pfv. is used more frequently, the Ipfv. has a broader meaning, is acquired slightly earlier than the Pfv. by monolingual Russian children, and is, with a few exceptions, a simplex verb form in Russian. The marked status of the Pfv. will be examined in the empirical part of the research, where it will be expected that the extralinguistic context, i.e. normal and increased stress levels, is a decisive reason for the proportion of Ipfv. and Pfv. verbs in spontaneous L1 speech, such that there are more Ipfv. verbs, which are unmarked, under the condition of increased stress.

In the next section, the discussion of the asymmetry within the Russian grammatical categories will be continued. The Russian voice system will be described and then characterized according to the concept of linguistic markedness.

4.1.2. Russian grammatical voice system

There are usually several possibilities of how to describe an event from a linguistic point of view (Arnold et al. 2013). There are grammatical structures that can be perceived as, at least partially, synonymous in terms of referential content, e.g. active and passive voice. This apparent synonymy makes such structures particularly interesting for a psycholinguistic

[56] Cf. also Klein (1995), who states that "[…] PERF encompasses the entire lexical content, whereas IMPERF places the assertion time, as it were, in the midst of the action. No assertion is made about whether the target state is reached or not, since the target state does not overlap with the assertion time." (ibid.: 692, capitalization original).

analysis due to their fine functional differences (Tannenbaum & Williams 1968: 246). The choice among such structures can be characterized by the term "information structure" (see the introduction to this chapter).

The Russian grammatical voice system (or diathesis) is based on a morphological category of a verb and describes a relation between semantic roles and syntactic function (see Babby & Brecht 1975: 364f.):

> […] Voice is the relationship between a verb's subcategorization feature and the realization of this feature in the surface structure of the sentence. (ibid.: 364)

There are two views on the diathesis of the Russian verb (for a detailed discussion of the diathesis in Russian, see e.g. Evseeva et al. 2007). The first group of linguists (e.g. Isačenko) considers all verbs (including intransitive ones) to be either active or passive. The second group (e.g. Vinogradov) considers only transitive verbs and distinguishes between active, passive, and middle voice. Since intransitive verbs cannot be passivized in Russian, the latter school is central for the present purposes because it enables an analysis of the context-sensitive use of active and passive clauses when both are possible (cf. Abraham (2006: 13) and Isačenko (1982: 451) who state that there is no impersonal passive in Russian).

According to the second group of linguists, not only do intransitive verbs not indicate the grammatical voice, but so do

- verbs that are not used without the clitic –sja (e.g. *nadeet**sja*** – 'to hope');
- reflexive verbs derived from intransitives (e.g. *plakat'sja* – 'to cry to someone'); and
- verbs that have impersonal meaning (e.g. *temnet´* - 'to become dark').

(cf. Evseeva et al. 2007: 351[57])

In the active voice, the grammatical subject corresponds to the agent and performs the action upon the object:

Mama kupi-l-a tort.
mother buy-PST-3SG cake
'Mother bought a cake.'

In the passive voice, the grammatical subject is equivalent to the patient of this clause so that the agent is not accentuated and can be marked with the instrumental case (cf. Babby & Brecht 1975: 343). In such sentences, the attention is directed away from the agent (cf. Beedham 1982: 4; Isačenko 1982: 448) so that "the agent of the corresponding active is radically de-topicalized, and another argument becomes, by default, the topical argument" (Givón 2018: 15). Tannenbaum & Williams (1968: 246) explain this variation in terms of conceptual focus.

Tort by-l kupl-en mam-oi.
cake be-PST buy-PTCP mother-INSTR
'The cake was bought by the mother.'

The middle voice – or the middle verb form (Alexiadou & Doron 2012: 1) – has no corresponding active form (Babby & Brecht 1975: 345). Verbs in the middle voice are intransitive verbs which have been built from transitive ones, e.g. *koška kusaetsja* (Ipfv.) – 'the cat bites.'

[57] V.A.'s translation from Russian.

Since Russian does not possess a distinct paradigm for the passive voice (Isačenko 1982: 449), an important characteristic of the Russian voice becomes its interrelationship with the grammatical aspect (see section 4.1.1.). Whereas aspect plays no role in the middle voice, such that Ipfv. as well as Pfv. verbs acquire a clitic –SJA (Babby 1975: 300), it is vital to differentiate between both aspects in the passive and active voice. The passive of Ipfv. verbs tends to be realized by an addition of a reflexive clitic –SJA (also expressed as –S') to a finite verb. The passive of Pfv. verbs is periphrastic and is usually realized by a passive past participle marked by a suffix –EN– (further realized as –N– or –T–) and a copula verb *byt'* ('to be') (Beedham 1982: 47; Veyrenc 1978: 58; Babby & Brecht 1975: 342, 361). Therefore, one can say that the Russian passive tends to establish a syntactic paradigm for each aspect (Babby & Brecht 1975: 363):

	Perfective	**Imperfective**
Past	*Roman by-l pro-čit-an.* novel be-PST PREF-read-PTCP novel be-PST till end-read-PTCP 'A novel was read.'	*Roman čit-al-sja.* novel read-PST-REFL novel read-PST-REFL 'A novel was being read.'
Present	*Roman pro-čit-an*[58]. novel PREF-read-PTCP novel till end-read-PTCP 'A novel is/has been read.'	*Roman čit-et-sja.* novel read-PRS-REFL novel read-PRS-REFL 'A novel is being read.'
Future	*Roman bud-et pro-čit-an.* novel will-SG PREF-read-PTCP novel will-SG till end-read-PTCP 'A novel will be read.'	*Roman bud-et čit-at'-sja.* novel will-SG read-PRS-REFL novel will-SG read-PRS-REFL 'A novel will be being read.'

Table 2: Paradigm of the Russian passive voice with example-sentences.

With respect to the concept of markedness, the passive voice is a marked case in the voice system of many languages, including Russian (cf. e.g. Greenberg 2005: 45; Givón 1995: 44ff.; Klenbort & Anisfeld 1974: 190 for a universal marked status of passive constructions; Myachykov & Tomlin 2008: 37; Kasatkin et al. 1991: 206; Babby & Brecht 1975: 354 for the non-canonical status of the passive voice in Russian). According to the criteria of structural complexity, the passive voice of Russian is more complex than the active voice[59].

Following the criteria of L1 acquisition, the acquisition of syntactically more difficult passives, in comparison to actives, is sometimes not finished by the age of seven or eight years in Russian monolingual children; consequently, they tend to rely on semantics but not on syntax-based strategies of thematic role assignment when comprehending passive sentences (Kruchinina et al. 2022). Furthermore, the ongoing process of grammar acquisition and processing of the syntactically complex passive voice is reflected in the functional maturity of the brain, specifically the frontocentral and the left temporoparietal structures and their connections (ibid.).

[58] Even though Pfv. verbs are not used in the present tense in the active voice (see section 4.1.1.), there is a passive form of Pfv. verbs in the present tense which have a Perfect form (cf. e.g. Babby & Brecht 1975: 344).

[59] According to the criteria of language acquisition, Russian children up to the age of 3;9 lack the formation of mature (subject; object) A-chain accounts (Babyonyshev & Brun 2004: 30):

> According to the standard analysis of the passive constructions, the nominal argument of a passive predicate is base-generated in the direct object position and then moves into the canonical subject position. The subject and object positions are connected by a (subject;object) A-chain. (ibid.: 19)

Therefore, Russian children tend to use passive-like sentences in their adjectival function and not as "real" passives, e.g. *Dom stroilsya* (*Vanej*) *dva goda* ('The house was being built (by Vanya) for two years'; verbal passive) vs. *Kofta byla vyazanaja* (*mamoj) ('The cardigan was knitted (*by mom)'; adjectival passive) (ibid.: 18, the examples are from ibid.).

Considering the criteria of frequency, the passive voice is usually used in written language while active verb forms are the most frequent voice form in an oral discourse (Rachmanova & Suzdal'ceva 1997: 435). Moreover, there is a tendency to avoid the passive in the Russian language which is facilitated by the flexible word order in Russian (Myachykov & Tomlin 2008: 37f.). Therefore, "word order variations support[…] thematization or topicalization instead of voice" (ibid.: 37), cf.:

- SVO (canonical word order in Russian)[60]
  Papa *vidit* *košku*
  Dad SUBJECT is seeing/sees cat OBJECT
  'Dad sees/is seeing a/the cat.'

- OVS (marked word order in Russian)
  Košku *vidit* *papa*
  Cat OBJECT is seeing/sees dad SUBJECT
  *'The cat is seeing/sees dad.'

Taking into consideration all the above-mentioned arguments, the passive voice is a marked form in the Russian voice system. The marked status of the passive will be examined in the empirical part of this research, where it will be expected that the extralinguistic context, i.e. normal and increased stress levels, is decisive for the proportion of active and passive clauses in spontaneous L1 speech, with more active clauses being expected under the condition of increased stress.

To sum up the discussions based on the Markedness theory, a few points need to be emphasized. First, the Markedness theory claims that linguistic markedness is "adaptively motivated" (Givón 1995: 26) like any "biologically-supported structure[]" (ibid.) and therefore it highlights the dependency of speech processing on the speaker's cognitive resources. Second, two grammatical categories of Russian were introduced in this section to outline the theoretical assumptions based on the Markedness theory: the Russian aspectual and grammatical voice systems. It was stated that the Pfv. and passive voice are marked, i.e. cognitively more difficult, members of the respective grammatical oppositions. This assumption will be tested in the empirical part of this research (see Chapter 11).

In the following, attention will be focused on another context-sensitive category: referring expressions. As in the section dedicated to the Markedness theory, the general theoretical framework of the term 'referring expressions' will be given first, followed by the grounds on which they are considered context-sensitive. Subsequently, the Russian pronominal system, which will be the focus of the empirical investigation in this research, will be outlined.

4.2. Referring expressions

Higher cognitive functions, e.g. working memory, are susceptible to changing external demands (see section 2.1.2.). These cognitive functions are fundamental to language use, regarding both comprehension and production, and therefore have a direct influence on it. This can be illustrated with the help of not only the Markedness theory, but also *referring expressions* which are important during discourse construction. Halliday & Hasan (2013) characterize 'reference' within the term 'cohesion':

> What characterizes this particular type of cohesion, that which we are calling REFERENCE, is the specific nature of the information that is signaled for retrieval. In the case of reference the

[60] E.g. Bailyn 2001.

> information to be retrieved is the referential meaning, the identity of the particular thing or class of things that is being referred to; and the cohesion lies in the continuity of reference, whereby the same thing enters into the discourse a second time. (ibid.: 31, capitalization original)

One type of referring expressions are nominal expressions, e.g. proper nouns and pronouns (Salazar-Orvig et al. 2021: 3; Krifka 2006). Explaining why a speaker uses one referring expression instead of another in a discourse (cf. the notion of "information structure" in the introduction to Chapter 4) is attempted by the Givenness Hierarchy and the Accessibility theory (cf. Scott 2020). According to the Givenness Hierarchy (Gundel et al. 1993), a speaker constantly acknowledges a cognitive status ("information about location in memory and attention state" in ibid.: 274) of a respective referent in the hearer, e.g. whether the referred entity is the focus of attention and is therefore easily identifiable by the hearer or is unknown to the hearer. There are six cognitive statuses in natural language discourses that are reflected in different linguistic forms of referring expressions. The highest status is "in focus" (e.g. '*it*' in English) and the lowest status is "type identifiable" (e.g. '*a(n)* X' in English) (cf. ibid.: 275). The cognitive status helps the hearer "to restrict the set of possible referents" (ibid.).

The Accessibility theory is cognitively motivated. There are extralinguistic inferences which can be drawn between linguistic forms and proper contexts (Ariel 2001: 53). Following the Accessibility theory, a reference requires the activation of memory nodes. The amount of necessary processing costs is defined by the mental accessibility of a referent at the current discoursal stage: the less mentally accessible is the referent, the more elaborate is the respective linguistic marker (e.g. a personal pronoun indicates a higher degree of mental accessibility than a demonstrative pronoun) (ibid.: 29). The degree of accessibility is determined by the physical context of the speech situation, e.g. concerning the use of animate or non-animate referents, and the discourse world, e.g. the use of relevant and irrelevant discourse topics (ibid.: 31). The Accessibility theory rests on a form-function correlation which is determined by three overlapping criteria: informativity ("the amount of lexical information" (ibid.: 32)), rigidity ("the ability to pick a unique referent, based on the form" (ibid.)), and attenuation ("phonological size" (ibid.)). Thus, the lower degree of accessibility of mental representations is characterized as being more informative, rigid, and unattenuated, e.g. as when the referent of a full NP is assumed by a speaker to be mentally less accessible in comparison to a pronoun (cf. ibid.: 31).

The role of cognitive representation in referring expressions has been studied empirically. Given the limited capacity of working memory which is simultaneously required for storage and the processing of information, the production of anaphors in healthy speakers is explained by the fact that "[e]stablishing reference to a highly accessible entity only requires a low-cost referring expression [e.g. pronouns], whereas establishing reference to an entity that is not highly accessible requires a referring expression with a higher cost [e.g. definite noun-phrase anaphors]" (Almor 1999: 748f.). This relation between the referring expression and the processing load is assumed to be due to the function of anaphoric expressions; they reactivate information stored in one's working memory and establish coherence in a discourse (ibid.: 750). Further support for the role of working memory in language usage was provided in a study on patients with Alzheimer's disease (Almor et al. 1999). It was found that, due to working memory deficits, patients with Alzheimer's disease experience difficulties in producing and comprehending referring expressions. Despite the high frequency of pronouns in speech, patients with Alzheimer's disease are impaired in their ability to comprehend pronouns which are semantically less informative than full NPs; conversely, full NPs, which contain more informative referring expressions than pronouns, provoke greater activation of reference processing which is beneficial for the patients with Alzheimer's disease to sustain effective communication (ibid.). Hence, the overspecification (whereby more information is produced than required) and underspecification (whereby less information is produced than required) of

referring expressions, as well as their misunderstanding, are related to individual variations of working memory capacity and, therefore, processing speed (van Deemter et al. 2016; cf. also Bos et al. 2014).

From the discussion above, the class of pronouns can be taken to be particularly suitable for studying the relation of higher-cognitive functions, such as working memory, and actual language use because "they [sc. pronouns] encode an instruction to the hearer that he should look for a conceptual file containing a token feature" (Scott 2020: 94). In other words, the hearer is requested to decode the concept expressed with a pronoun. Therefore, pronouns, unlike noun phrases, entail "procedural guidance" (ibid.) which can be compromised by deficiency in one's working memory, e.g. due to stress (see section 2.1.2.). In the following, the pronominal system of Russian will be outlined in order to investigate the influence of increased demand on their use in spontaneous L1 speech (see Chapter 11).

In Russian, pronouns are grouped into nine categories based on their meaning (cf. Tauscher & Kirschbaum 1987: 217ff.):

Personal pronouns	*ja* ('I'); *ty* ('you' 2nd person singular); *my* ('we'); *vy* ('you' 2nd person plural); *on* ('he'), *ona* ('she'), *ono* ('it'), *oni* ('they')
Reflexive pronouns	*sebja* ('self')
Possessive pronouns	*moj* ('my'), *tvoj* ('your' 2nd person singular); *naš* ('our'), *vaš* ('your' 2nd person plural); *svoj* ('one's own'); *ego* ('his', 'its'), *ejo* ('her'), *ikh* ('their')
Demonstrative pronouns	*etot* ('this'), *tot* ('that'); *takoj* (*takovoj*) ('such', full form), *takov* ('such', short form)
Interrogative pronouns	*kto?* ('who?'), *što?* ('what?'); *kotoryi?* ('which?'), *kakoj?* ('what?'), *kakov?* ('what kind?'); *čej?* ('which?')
Relative pronouns	*kotoryi* ('which'), *kto* ('who'), *što* ('what'), *kakoj* ('what'), *kakov* (*čej*) ('what kind' ('whose'))
Determinative pronouns	*ves'* ('entire'); *sam* ('self'), *samyi* ('most'); *vsjakij* ('each'), *kazdij* ('every')
Negative pronouns	*nikto* ('nobody'), *ništo* ('nothing'); *nikakoj* ('none'), *ničej* ('nobody's'); *nekogo* ('of no one'), *nečego* ('nothing')
Indefinite pronouns	*nekto* ('someone'), *nečto* ('something'), *nekotoryi* (*nekij*) ('some'); *koje-kto* ('someone'), *koje-što* ('something'), *koje-kakoj* ('some'); *kto-to* ('someone'), *što-to* ('something'), *kakoj-to* ('some'); *kto-nibud'* ('somebody', 'anybody'), *što-nibud'* ('something', 'anything'), *kakoj-nibud'* ('anyone'); *kto-libo* ('anybody'), *što-libo* ('anything'), *kakoj-libo* ('any')

Table 3: Nine categories of the Russian pronouns based on their meaning following Tauscher & Kirschbaum (1987: 217).

Russian pronouns do not only substitute nouns but also possess deictic and syntactic – either substantive (e.g. *ja* ('I'), *ty* ('you')) or adjective (*moj* ('my'), *kakoj* ('what')) – functions (Isačenko 1982: 469, 478).

Apart from these nine semantic categories, Russian also has the option "*pro*-drop" which depends on discourse conditions (Pekelis 2018: 67), e.g. a pronoun can be oftentimes omitted in a utterance which is a response (*Ty što delaeš'? – Ø Pišu knigu* ('What are you doing? – Ø Writing a book')). For this reason, Russian can be seen as a non-canonical *pro*-drop language (McShane 2009: 103; Timberlake 2004: 223). Ellipses are more typical in Russian oral discourse than written language (McShane 2009: 107f.). Furthermore, an ellipsis of a subject can be obligatory:

> In Russian, the baseline choice for subject realization is "realize overtly", and the main goal of the current model – and challenge for an intelligent agent – is to determine when to elide, since not eliding in the appropriate contexts can lead to ungrammaticality or stylistic infractions. (ibid.: 118)

For instance, 1st and 2nd personal pronouns are widely elided in the Russian spoken discourse because of their high givenness status in the discourse (ibid.: 126). Furthermore, not only subjects but also direct and indirect objects can be elided in Russian (e.g. Lindseth 1998: 45), even though less often (Timberlake 2004: 224, 226).

In Russian, referential devices are divided into full NPs and semantically reduced NPs; the latter encompass personal pronouns, zeros, demonstratives, and other minor types of pronouns (Kibrik 2011: 398). The most frequent kind of pronouns is the third person pronoun *on* ('he') (also *ona* ('she') in feminine form, *ono* ('it') in neuter form, and *oni* ('they') in plural form); the demonstrative pronoun *tot* ('that') (also *ta* in feminine form, *to* in neuter form, and *te* in plural form) is less frequent than the third person pronoun (ibid.: 398f.). According to Gundel et al. (1993: 284, 292), the Russian hierarchy of referring expressions can be summarized in the following way (disregarding other minor types of pronouns, as noted in Kibrik 2011):

Full NPs > Demonstrative pronouns > Personal pronouns > Ø

In the empirical part (see Chapter 11), the distribution of the Russian pronouns (including zero pronouns) will be examined by the subjects' L1 spontaneous speech under varying degrees of cognitive load. This investigation will be based on the two aforementioned statements. First, pronouns entail a procedural guidance from the speaker to the listener which is followed by the hearer's decoding of the reference according to its degree of accessibility and cognitive status. Second, usage of pronouns has been found to depend on the speaker's working memory capacity. Thus, working memory capacity, e.g. its depletion due to increased environmental demands, is expected to influence the speaker's choice of pronouns during speech.

This concludes the theoretical background of the current research. In this theoretical part, the nature of stress was outlined according to psychological and physiological perspectives. Further, it was discussed how an analysis of the linguistic data can be useful to determine signs of stress in speakers. For this investigation, it was suggested to consider a content-oriented approach to the linguistic data as well as review context-sensitive categories of language in use. With respect to the former, pragmatics (Speech act theory in particular), conversation analysis, and (qualitative) content analysis were introduced and delineated. In addition, studies on the analysis of language in use in the realm of aviation, manned space exploration, and burdensome day-to-day conditions were defined to report the status quo in the relevant research field. With respect to the context-sensitive categories of language which were proposed to be analyzed due to their susceptibility to extralinguistic demands, such as stress, the Markedness theory, Givenness Hierarchy, and Accessibility theory served as theoretical accounts. According to the Markedness theory, two grammatical categories of Russian (aspectual and voice systems) were assumed to require unequal cognitive resources from the speaker – Pfv. was assumed to be cognitively "more demanding" than Ipfv., while passive voice was assumed to be cognitively "more demanding" than active voice. Following Givenness Hierarchy and Accessibility theory, Russian semantic classes of pronouns and instances of pro-drop were suggested to involve varying amounts of cognitive resources. In the following chapters, both the theoretically grounded concepts used in the analysis of the linguistic data, i.e. the content-oriented approach and context-sensitive categories, will be addressed empirically.

Empirical part

5. SIRIUS-19

5.1. About the study

The present study was conducted in the framework of a four-month (120-day) human isolation experiment SIRIUS (Scientific International Research In Unique terrestrial Station)-19. SIRIUS-19 was part of a series of human isolation experiments and simulated a piloted mission of a six-person crew to the Moon and its return to Earth. SIRIUS-19 was organized by IBMP (the Russian Federation) together with the National Aeronautics and Space Administration's Human Research Program (the United States of America), as well as in cooperation with other scientific and business partners[61]. There are four separate isolation experiments that last from seventeen to 360 days. The isolation experiments are being conducted between the years 2017 and 2025.

SIRIUS-19 took place in Moscow, Russia, from the 19th of March until the 17th of July 2019. The isolation project was aimed at studying psychological and physiological processes that occur in an isolated crew during long-duration confinement; the confinement was designed to be similar to that during real spaceflights (see section 2.1.1.). The facility where the experiment took place was a closed habitat composed of five separate modules (see section 2.1.1. for more on capsule environments and isolation studies). Four modules jointly combined to make a 550 square-meter habitation module. The fifth module is a 1200 square-meter imitation of the lunar surface. The isolation complex is a hermetic construction equipped with life-support systems, i.e. an air conditioning system, a purification of the atmosphere system, a water supply and sewage system, a video surveillance system, a power supply and lighting of the medico-technical complex system, an information provision and communication system, a control system, an information system of the medico-technical complex, a gas supply and maintenance of the atmosphere system, etc.[62].

5.2. Subjects

The crew of SIRIUS-19 was a mixed-gender six-person group of Russians and Americans. The crew consisted of three women and three men. The crew included a crew commander, a flight engineer, a flight surgeon, and three researchers. The mean age was 34.3 years of age (SD 5.7 years). There was one native speaker of English, four native speakers of Russian, and one bilingual subject in English and Russian. Hence, all subjects were competent in the English and Russian languages to a varying degree.

[61] For more information see https://www.nasa.gov/sites/default/files/atoms/files/sirius_19_booklet.pdf (last accessed 06.07.2024) and http://sirius.imbp.ru/completed/index19.html (in Russian; last accessed 06.07.2024).
[62] For more information see http://mars500.imbp.ru/nek_lss.html (in Russian; last accessed 06.07.2024) and http://mars500.imbp.ru/en/nek.html (last accessed 06.07.2024).

5.3. Experiment scenario

The experiment scenario reproduced the key characteristics of a real flight to the Moon, including landing on its surface and returning to Earth. The milestones of the four-month experiment were as follows[63]:

1. Launch of the spacecraft and docking with the station in the lunar orbit.
2. During the first two months, the crew explores the lunar surface and lays out a landing plan; the crew also carries out a series of dockings with transport vehicles.
3. Four crew members land on the Moon and two of them perform a number of egresses while wearing lunar spacesuits. At the same time, the vehicle keeps orbiting and the other two crew members consult the crew members on the Moon on technical issues and assist them.
4. Departure from the lunar surface and docking with the orbiter.
5. Orbiting the Moon for a few weeks, while the crew remotely operates lunar rovers (as preparation for building a moon base) and carries out a series of dockings with transport vehicles.
6. Return to Earth.

During these 120 days, five in-group decision-making tasks were conducted. These discussions represent the data of the present research. Hence, they will be thoroughly described in the next section.

5.4. Data

Five discussions, which take the form of decision-making tasks, took place during the entire period of the isolation experiment. Four of them were organized by IBMP[64] and one by the University of Muenster[65]. During the discussions, the crew had to find mutual agreement on how to rank several options, e.g. several craters, based on their priority for a successful task resolution (see below for an overview of the tasks).

For the group decision-making tasks organized by IBMP, sixty minutes were allocated for the crew to complete the task, of which twenty minutes of the total task duration were dedicated to group discussions. The discussion, which was organized by the University of Muenster, was part of a Design thinking session (see below for the explanation of the Design thinking methodology); 120 minutes were allocated to complete the entire session. Fifteen minutes of the group discussion was assigned to the part of the methodology which laid the foundation for the linguistic analysis (see below for the selection criterion). All discussions were video- and audio-recorded.

The first discussion (D1) took place on the 17th day of isolation. It started at 7:07:43 PM and was completed by 7:21:20 PM Moscow local time[66]. During this discussion, the crew had to decide on which of the three craters they would land as the first, the second, and the third option.

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[63] This is a brief and slightly modified summary of the SIRIUS-19 scenario following the information published on http://sirius.imbp.info/completed/index19.html (in Russian; last accessed 06.02.2023) and https://www.nasa.gov/sites/default/files/atoms/files/sirius_19_booklet.pdf (last accessed 06.07.2024).

[64] Some of the discussion tasks, namely D1, D2 and D4, were developed and provided by DePaul University (Chicago, USA) and Northwestern University (Evanston, USA) (cf. Anikushina et al. 2022; see also n. 73 for the difference in the discussions numbering in the paper (i.e. Anikushina et al. 2022) and in the present dissertation).

[65] Heidelberg University and the University of Muenster cooperated within the framework of SIRIUS-19.

[66] The time slots given here reflect the actual duration of the discussions as part of the decision-making task.

The second discussion (D2) was conducted on the 48th day of isolation, from 5:15:03 PM to 5:22:51 PM Moscow local time. A ranking was established with respect to three planets that the crew would visit and explore.

The third discussion (D3) took place on the 76th isolation day and was part of the Design thinking session. The crew had to develop a software which would support their daily operations. There were six methodological phases the crew had to adhere to[67]:

1. Understanding – the crew had to explore what needs they have as a team.
2. Research – the crew had to research and extend their understanding of the most essential problems which confronted them as a team.
3. Synthesis & point of view – the crew had to focus on the identified problem to formulate a question which would straightforwardly address it.
4. Ideation – the crew had to generate ideas about the solution to the problem and choose one of the ideas suggested.
5. Prototyping – the crew had to create a tangible prototype.
6. Testing – the crew had to test the prototype[68].

The linguistic analysis was conducted within the fourth phase, i.e. while the crew had to choose one of the ideas. This phase was similar to the other discussions in isolation; the crew was asked to vote for the proposed ideas based on the defined and weighted selection criteria. Then it had to agree on one proposed idea which would be elaborated in further steps according to the Design thinking methodology. Furthermore, the crew was asked to conduct the fourth phase, which was selected for the linguistic analysis, in the English language which was an L2 for the majority of the subjects (see section 5.2.). Hence, D3 was a discussion with higher load for the majority of the group (see section 2.1.2.)[69]. D3 started at 6:44:47 PM and was completed by 6:52:37 PM Moscow local time.

The fourth discussion (D4) took place on the 101st day of isolation and from 6:27:58 PM to 6:40:19 PM Moscow local time. The crew was asked to agree upon a ranking of three asteroids, which were approaching and dangerous to Earth and which they had to destroy.

The last discussion (D5) was conducted during sleep deprivation at night on the 114th isolation day, from 11:54:29 PM to 00:02:01 AM Moscow local time. Thus, D5 was the second discussion with an additionally designed demanding condition (see section 2.1.2.). Apart from sleep deprivation as a stressor, the task was similar to other "normal" discussions. The crew members had to agree on a ranking priority of three modules that they would need to repair onboard the ISS.

5.5. Study design

In the figure below, the landmarks of the experiment scenario (see section 5.3.) and the five discussion tasks (see section 5.4.) are represented jointly:

[67] For more on the methodology of Design thinking, see e.g. Plattner et al. (2018); Lewrick et al. (2018); Leifer & Steinert (2011).

[68] This is a slightly modified summary of the methodology description in Taratukhin (2019).

[69] For the non-bilingual native speaker of English, all other discussions, i.e. except for D3, can be considered as demanding. However, in favor of a unified approach towards the analysis of the presently available data, this independent variable will not be considered.

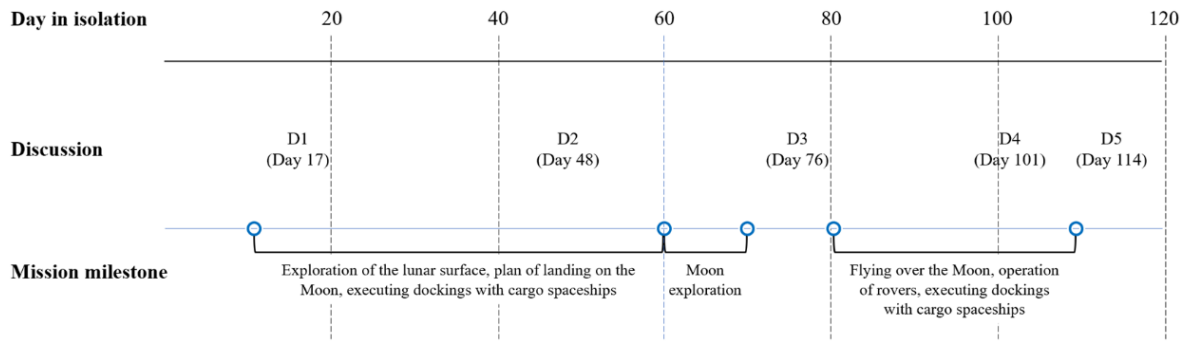

Figure 1: Scenario of SIRIUS-19 isolation experiment with an overview of the key milestones and group discussions. There were five discussions during a simulated flight to the Moon, a landing on the Moon surface, and a return to Earth.

During the five group discussions, the subjects were sitting at a table while wearing an HR monitor chest strap Polar, either H7 or H10 model, as well as ActiGraph wGT3X-BT bracelets. The subjects' HR was recorded with a one-second interval.

5.6. Methodology

In terms of preparation for the psycholinguistic study and prior to isolation, the crew was instructed by V.A. to consult a methodology of the present study that they would need to follow during the group discussions in isolation. In isolation, a subject who was assigned as responsible for the methodology had to ensure that the technique proceeded according to the given instructions. In D3, this role was voluntarily taken over by another subject.

According to the psycholinguistic methodology, the following steps needed to be followed by the crew:

1. Verification that a computer with the installed ActiLife desktop software by ActiGraph precisely indicates the local time:
   a. The responsible crew member had to open the computer settings on which the ActiLife desktop software was installed.
   b. The responsible crew member had to adjust the time on the computer according to the time on the digital clock in the isolation chamber[70]. To do this, it had to be ensured that the time indicated on the computer and the digital clock are synchronous to the second – the crew member had to click on the "save" button after entering the adjusted time on the computer when the digital clock was at exactly 00 seconds, e.g. 1:46:00 PM.
2. Activation of ActiGraph wGT3X-BT bracelets with the starting time plus 3 minutes and recording frequency 1 second without stop timer.
3. Verification that the ActiGraph wGT3X-BT bracelets and HR monitor chest strap sensors are tied around the subjects' chests as well as that the electrodes are moisturized.
4. The responsible crew member loudly states the exact time displayed on the computer with the installed ActiLife desktop software to one of the cameras in the chamber when the time was exactly at 00 seconds, e.g. 1:47:00 PM.
5. The crew starts with the decision-making task.

[70] Given that the isolation chamber was a hermetic construction, the crew was not able to rely on the natural indicators of time, e.g. sunlight. The digital clock was a more reliable source of the actual time outside the isolation chamber than the computer. Therefore, it was decided to adjust the time indicated by the computer to that of the digital clock.

6. Once the crew agrees on a solution, the responsible crew member loudly states the exact time (including seconds) displayed on the computer with the installed ActiLife desktop software to one of the cameras in the chamber.
7. The crew takes off the bracelets and the chest straps.
8. The responsible crew member transfers the data obtained from the bracelets to the computer with the installed ActiLife desktop software.
9. The responsible crew member sends the HR data to the IBMP support personnel via an email.

Time synchronization indicated on the computer which generated the HR data with the video recordings of the discussions in the cameras was a crucial requirement. It was initially assumed that the digital clock in the isolation chamber would be visible in the video recordings to synchronize the time on the digital clock with the time on the computer. However, this turned out not to be the case[71]. Nevertheless, since the video recordings also indicated time with a second interval (in the left upper corner of the recordings), it was possible to synchronize the time indicated on the computer – this was always announced by the responsible crew member before and at the end of each discussion (see steps 4 and 6 in the study methodology) – with the time indicated in the video recordings.

A sociometric analysis on group structure and cohesion as well as individual sociometric status (see section 2.1.1.) was conducted by psychologists at IBMP during the entire isolation period (Gushin & Vinokhodova 2020). A recurrent sociometric questionnaire was administered by IBMP approximately every two weeks. The sociometric questionnaire consisted of two questions:

1. With whom of the crew would you participate with again in a similar isolation?
2. With whom of the crew would you depart onto an uninhabited island?

For each question, the subjects had to choose three crew members. Based on these choices, the relationships in the group, its status structure, and the level of group cohesion with respect to the work-related situation (question one) and leisure-related situation (question two) were measured (cf. Anikushina et al. (2022: 61) for the methodology description). The group cohesion was assessed by considering only mutual choices, i.e. if crew members selected each other simultaneously (ibid.). The choices of individual subjects were not visible to other crew members (following personal communication with IBMP).

[71] Similarly, it was initially assumed that it would be possible to distinguish the time indicated on the computer display in the video recordings; however, this was not the case. Hence, the responsible crewmember was required to bring the computer display close to one of the cameras immediately before and after the group discussions.

6. Research questions

The empirical part of the present research consists of two parts: analysis of the linguistic material according to the method of QCA (see Chapter 3) and analysis of the linguistic material based on the context-sensitive categories (see Chapter 4). Within the QCA, the linguistic data will be approached on three separate levels: group level, subjects' intra-individual level, and inter-individual level. Each research level addresses the following series of questions:

I. **Group level**: How did the communicative behavior of the crew, as a coherent body, change across the entire isolation period, under the "normal" isolation conditions[72] and during the discussions with the additionally designed stressors?
II. **Intra-individual level**: Did the communicative behavior of individual subjects change across the entire isolation period under the "normal" isolation conditions and during the discussions with the additionally designed stressors? How common were these individual types of communicative behavior among the subjects? Does one's communicative behavior correlate with the character of his / her HR?
III. **Inter-individual level**: Were there any similarities in the patterns of communicative behavior among the subjects? Can such similarities in the patterns of communicative behavior be considered a consequence of sympathy and affinity between the crew members?

The analysis on the group level is based on the evidence that speaking an L2 (in D3) and speaking during sleep deprivation (in D5) signify increased demands in comparison to speaking under the "normal" isolation conditions (see section 2.1.2.). Hence, the characteristics of communicative behavior, according to the categories outlined below (see section 7.1.), are expected to indicate an increased cognitive load experienced by the crew during D3 and D5. Discussions which are not associated with additional demanding conditions – D1, D2, and D4 – are expected to reflect a gradual and linear dynamic evolution of the formal-linguistic and pragmatic categories, according to their measurement principle (see sections 7.1.3. and 7.1.4.); this evolvement reflects an adaptation to isolation progression (cf. sections 2.1.1. and 3.4.2.1. and the concept of coping in psychology in general, which was introduced in section 2.1.). In the case of non-linearity, an influence of unexpected stressors is assumed, for instance one rooted in group dynamics[73]. The analysis on the group level is inspired by the study by Silberstein & Dietrich (2003; see in section 3.4.1.), who holistically studied characteristics of communication in the cockpit, but not the communication of individual subjects, in order to find correlations between the characteristics of communication and the degrees of workload and danger. Similarly, the present analysis on the group level aims to characterize the behavior of the crew as a coherent body whose members cooperatively construct a discourse which changes as a response to changing environmental conditions. The sociometric findings on the cohesion of group structure (see section 2.1.1.) will be introduced to provide an additional point of view on the linguistic data and validation of their interpretation.

[72] The "normal" isolation conditions are considered discussions without additionally designed stressors, i.e. D1, D2, and D4 (see section 5.4.).
[73] The analysis on the group level became part of a paper (Anikushina et al. 2022) which further includes an analysis of the crew's communication with MCC, physical activity, sociometric research, and a Design Thinking study. However, in the paper (ibid.), only discussions without extra stressors were considered, i.e. D1, D2, and D4. Aiming at the consistency in the methodology description in the paper, D4 was named D3.

The investigation into the intra-individual level is based on existing studies in linguistics and psychology (see section 3.4.). The subjects are assumed to adjust their communicative behavior to the changing environment, i.e. stressors, such as, for instance, sleep deprivation or isolation progression, by maintaining attributes that are characteristic of their individual linguistic style (cf. the concept of "communication as a form of behavioral manifestations of astronauts' coping strategies" in Yusupova et al. (2019: 711), see section 3.4.2.1., and the concept of "language-use fingerprint" in Sexton & Helmreich (2003: 59), see section 3.4.1.). It will be further analyzed whether and in what ways some of these individual preferences in communicative behavior were more common than others among the subjects.

The inter-individual analysis is based on the evidence that humans tend to elaborate definite linguistic strategies to cope with demanding environments (cf. Satir's view on the manifestation of typical communicative reactions of humans under stress in Yusupova et al. 2019, see section 3.4.2.1., and the intra-individual analysis of the present research) and that these strategies can be explained by the sociometric status of an individual (cf. Kuznetsova et al. 2016; Tafforin et al. 2015; see section 3.4.2.1.). The role of social relations is also evidenced in language according to the concept of "relational messages" (see section 2.1.1.). Hence, communicative behavior is considered as a window into one's social preferences or aversions. The findings from the sociometric research on the group structure according to the subjects' mutual choices will be introduced to testify the interpretation of the linguistic data.

The empirical part based on the QCA will proceed in the order outlined above. The analysis on the group level will lay the foundations for the subsequent analyses on more granular levels, i.e. the intra-individual and inter-individual levels. The coding frame according to which the linguistic data will be examined is provided in Chapter 7.

With regard to the analysis based on the **context-sensitive categories** (see Chapter 4), this is based on the assumption that one's language behavior is diachronic as a response to varying mental states (cf. Osgood 1966; see section 2.1.2.). It is hypothesized that an increase in a subject's mental load, expressed through an increase in his / her cardiovascular response (cf. Saslow et al. (2014) outlined in section 3.4.3.), will result in the subject's "preference" of cognitively easier and more accessible linguistic structures. This hypothesis is consistent with "a cognitive strategy for economy of processing" (Givón 1995: 63). Hence, it is hypothesized that, in order to keep the balance between increasing extralinguistic demands and the necessity (or keenness) of continuing with the speaking process, the subjects would tend to avoid cognitively difficult linguistic structures.

Finally, an inductive analysis of the linguistic data under increased levels of stress will be given. The linguistic data which were collected when subjects' HR was equal to or above 94 bpm (cf. the study by Saslow et al. (2014) and which was reviewed in section 3.4.3.) will be analyzed with regard to repetitive statements, self-repairs, and instances of irregular word order (cf. e.g. Zhabin 2009: 78f.; Bock 1996: 402ff.).

7. Content-oriented analysis

7.1. Coding frame

The categories for the present QCA are of a deductive-inductive nature. The deductive approach is based on existing studies on the analysis of linguistic data in challenging environments (see section 3.4.). As was noted previously (see section 3.4.3.), particular interest is related to the study of Silberstein & Dietrich (2003; see section 3.4.1.) and the HBP documents (2008a,b; see section 3.4.2.2.). Some of the categories, which are elaborated in these studies, are adjusted to meet the necessary requirements of the present study. Furthermore, some new categories are elaborated. These inductively developed categories are required to ensure that an analysis of the text corpus succeeds without uncoded whitespaces (cf. section 3.3.).

There are two types of categories: pragmatic categories and formal-linguistic categories (cf. Grote et al. (2003) in section 3.4.1.)[74]. The pragmatic categories are grouped according to the SA theory (cf. Krifka et al. (2003) in section 3.4.1.), i.e. they are classified as adhering to the basic IAs (see section 3.1.). Hence, the categories are hierarchically structured, with the main categories being concept-driven (IAs) and the subcategories being data-driven (deductive-inductive categories) (cf. section 3.3.).

In the following, the applied categories will be explained. Their description will start with a discussion of the categories following the study by Silberstein & Dietrich (2003). This will be followed by an overview of the categories following the HBP (2008a,b).

7.1.1. Categories based on Silberstein & Dietrich (2003)

Six categories described by Silberstein & Dietrich (2003) are defined as satisfying the requirements of the present isolation study. These are: “Information Sharing”, “Initiation of Crew Resources”, “Receptiveness”, “Responsiveness”, “Relation to Task”, and “Coherence”. The remaining three categories, i.e. “Emotion”, “Register”, and “Information Quality”, are omitted from the present research for reasons that are described in the following. The category “Emotion” is integrated within the category “Relation to Task”, since speaking about topics not related to the conversational goal can oftentimes be assumed to be an expression of emotions, e.g. jokes and gossiping (cf. sections 3.4.1. and 3.4.2.1.)[75].

Another category which is excluded from the present QCA is “Register”. This is considered not relevant in the present study, since the crew’s communication style was always observed as informal.

The category “Information Quality”, which focuses on the structure of single utterances, will be partially addressed within the analysis based on the context-sensitive categories and the inductive analysis of language characteristics under increased levels of load (see Chapter 11).

The six categories elaborated by Silberstein & Dietrich (2003) which are included in the present QCA, will be reviewed individually in the following paragraphs.

<u>Information Sharing</u>

Two values – [yes] and [no] – were suggested by Silberstein & Dietrich (ibid.) to evaluate the “Information Sharing” category. In their study, communication in the cockpit was evaluated

[74] The categories for the content-oriented analysis are briefly outlined in Anikushina et al. (2022).

[75] Furthermore, levels of an emotional reaction, i.e. stress, will be monitored by means of the physiological data and juxtaposed with the linguistic data in Chapter 11.

without specifying the extent of verbal activity of individual subjects. The present research, however, also aims to obtain information on individual communicative behavior. Thus, the evaluation principle of the category "Information Sharing" needs to be modified. To do this, produced TCUs (see section 3.2.) and single words will be counted for each subject.

In terms of the evaluation of this communicative behavior, the number of all TCUs (henceforth, *turns*) and all words will be calculated in each discussion for the group level analysis. For the intra-individual and inter-individual level analyses, the number of turns and words in a discussion in the speech produced by a subject will be compared to the total number of all words and turns produced by all subjects in this discussion (i.e. a percentage of the total in this discussion). This approach provides an overview of how actively the subjects shared information among themselves; thus, this represents a quantitative approach. Instances of subjects who failed to communicate information will not be tracked since it was problematic to state whether the information was indeed withheld, even though it was available to the speaker, or whether the speaker simply did not possess information to be shared (cf. a similar problem mentioned in Silberstein & Dietrich (2003: 29)). The category "Information Sharing" will henceforth only report on the [yes] value as defined by Silberstein & Dietrich (2003).

A closer look at the qualitative side of "Information Sharing" is possible by adding two pragmatic values. First, the willingness of the subjects to provide background information related to the conversational goal (e.g. updates on the status of the group decision), while not expressing one's own opinion on the conversational goal, will be labeled as **[adding information]**[76]. Second, a subject's utterances that serve to openly state his or her opinion on the conversational goal, when not being explicitly and directly asked to do so, will be labeled as **[own opinion]**[77].

In terms of the evaluation procedure, (i) the number of instances of the analyzed pragmatic value in a discussion will be compared to the total number of instances of all pragmatic values in this discussion (i.e. a percentage of the total in this discussion, here and hereafter) (the group level analysis) and (ii) the number of instances of the analyzed pragmatic value produced by a subject in a discussion will be compared to the total number of instances of all pragmatic values in this discussion in the speech of this subject (i.e. a percentage of the total in this subject, here and hereafter) (the intra-individual and inter-individual analyses)[78].

Initiation of Crew Resources

In the present study, the category "Initiation of Crew Resources" will be almost entirely adopted according to its original definition in Silberstein & Dietrich (2003). These authors studied how teamwork is organized through linguistic means by investigating whether, for instance, captains' speech included communication patterns which created an open atmosphere for other crew members to "seek and give suggestions" (ibid.: 17). However, in the present research, no differentiation will be drawn between the captain's and subordinates' roles because the crew demonstrated an informal communication style. Thus, [activate resources] can be assigned to any crew member's utterance regardless of their hierarchical status within the group. Additionally, the [activate resources] value is further subdivided to address two further aspects:

1. addressing a particular crew member (e.g. calling him or her by his or her name)

[76] Cf. "Provide information" and "Information containing a summary of a state of affairs or a process" in Grote et al. (2003: 141).
[77] This kind of verbal activity is understood as "informing without a demand" by Kanas et al. (2008) (see section 3.4.2.1.). Cf. also the notion "implicit coordination" in Grote et al. (2003: 133), such as "Provide unsolicited information" (ibid.: 142; see section 3.4.2.1.).
[78] See examples of all the pragmatic values in section 7.1.3..

2. seeking information from the crew without addressing any specific crew member (e.g. generally asking the crew for more information).

The first value retains the label **[activate resources]**[79]. The second value is named **[seeking information]**[80,81]. The difference between these two values can be partially described as the difference between a 'request' and 'question':

> For a request to be satisfied, the hearer has to perform the required action. If I ask you to open the door and someone else opens the door then I got what I wanted but my request was not fulfilled. By contrast, if I ask you whether the door is open and someone else says 'yes', then my question was answered even though you didn't answer it. Requests can be satisfied only by the person to whom the request is given. Questions aren't like that. The answer to a question can come from anywhere, even if the question is addressed to a specific person. (Hanks 2018: 135)

The values **[react]** and **[order]** do not diverge from their original definitions in Silberstein & Dietrich (2003). Hence, the value [react] denotes one's verbal response to a directed request made by other crew members, i.e. by means of [activate resources][82]. In comparison to the values [adding information] and [own opinion], this value does not display a self-initiated act of information sharing[83]. The value [order] describes the verbal attempt to take control over others or the crew teamwork in general[84].

The value [none] will not be applied. However, failures to optimize teamwork through communicative means can be – to some degree – indirectly assessed by a comparison of utterances labeled as [react] vs. those labeled as [activate resources]. For instance, if in a discussion there were 30 utterances labeled as [activate resources], which require an addressee to respond, while there were only 24 utterances labeled as [react], then one can infer that the teamwork was not optimized in the given discussion in the case of at least 6 instances. Nevertheless, it is important to mention that an utterance labelled as [react] could also be a response to other directed requests, e.g. [verifying] (see section 7.1.2. for the definition of the value [verifying]).

In terms of the evaluation procedure, (i) the number of instances of the analyzed pragmatic value in a discussion will be compared to the total number of instances of all pragmatic values in this discussion (the group level analysis) and (ii) the number of instances of the analyzed pragmatic value produced by a subject in a discussion will be compared to the total number of instances of all pragmatic values in this discussion in the speech of this subject (the intra-individual and inter-individual analyses).

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[79] Cf. "calls by name" by Kanas et al. (2008) in section 3.4.2.1. and the selection of next speaker in ConvA in section 3.2..

[80] Cf. "demands for information" by Kanas et al (2008) and the notion of "explicit coordination" in Grote et al. (2003), such as "Request information" (ibid.: 141).

[81] The value [seeking information] is also a behavioral marker described in the HBP ([seeks answers in proactive manner] in Mission Operations Directorate ITCB HBP Training Working Group 2008b: 2-15, see section 3.4.2.2.), where it refers to the following behavior characteristic:

> [Crew member] Asks questions before the need for the information is urgent, for situational awareness, to anticipate problems, etc. (Mission Operations Directorate ITCB HBP Training Working Group 2008b: 2-15)

[82] This kind of behavior is labeled as "informing after a demand" in Kanas et al. (2008, see section 3.4.2.1.).

[83] Cf. "self-selection" (Sacks et al. 1974: 703) which is also discussed in section 3.2..

[84] Cf. "Commands (request an action by addressee)" in Krifka et al. (2003) and "Giving order" in Grote et al. (2003: 141), see section 3.4.1., as well as "primary demands for information" and "clarifying (secondary) demands for information" in Kanas et al. (2008), see section 3.4.2.1..

Receptiveness

Given that there were no simultaneous tasks set via concurrent information channels (while in the cockpit, the pilots have to fly the airplane, run emergency checklists, speak to the tower, the isolated crew was "simply" asked to complete a decision-making task), the crew's ability to distribute their attentional resources between the two languages that were used inside the isolation chamber, English and Russian, will be examined. The subjects' ability to concentrate equally using both languages is considered vital to form a common ground, "a body of information that is presumed to be shared by the parties of a discourse" (Stalnaker 2014: 2; cf. also Renkema 2004: 41f.).

This common ground is vital to enable safety in the context of international flight assignments, as formulated by Vieira et al. (2014):

> […] when you bring in a person who cannot read the manual, you raise the risk. When you bring in a person who does not understand the verbal instructions from a co-worker to his supervisor, you raise the risk. (ibid.: 129)

The necessity to mitigate language-related challenges during international space mission assignments is also emphasized by Alexander Gerst, a German ESA astronaut:

> The most difficult part of my preparations to the space? It was to learn Russian in three months! If I need to memorize a circuit or off-nominal procedures, then, at least, I know the time I am prepared. With a language, it is always something [more] to come. You cannot reach the end of it. (Gerst & Abromeit 2017: 31)[85]

In order to describe the evolution of the communicative behavior assessed by the category "Receptiveness", the proportion of subjects' usage of their respective L2 to that of the L1 will be calculated. To do this, the number of turns which were in L2 will be compared to the number of all turns. In the case that both L1 and L2 appear within one turn, this turn will be assessed as half in L1 and half in L2, regardless of the actual length of the passages in L1 or L2. On the group level analysis, the calculation will be carried out with a summarized number of turns in L2, i.e. produced by all six subjects, in a discussion compared to the total number of all turns in this discussion (i.e. a percentage of the total in this discussion). On the intra-individual and inter-individual level analyses, the category evolution will be calculated based on the number of L2 turns produced by an individual subject in a discussion compared to the total number of all turns produced by this subject in this discussion (i.e. a percentage of the total in this subject).

Responsiveness

Unlike in the cockpit, there were no unexpected situational changes which would emerge in parallel to the isolated crew taking part in the group discussions. Prior to the decision-making task, hypothetical situations in which the crew had to make a decision (see section 5.4.) were introduced to the crew. The task description, after being provided to the crew members, was exhaustive so that there were no parts of it which could have been introduced to the crew later on when the discussion had already started. Nevertheless, the descriptions of these hypothetical situations were designed to be slightly varying among the crew members, presumably to stimulate more energetic conversations. Taking this set-up into account, it was decided to make use of the quaestio theory (see section 3.4.1.) to assess the linguistic data on the category "Responsiveness".

Following Klein & von Stutterheim (1987), quaestio is an implicit or explicit question – as well as one which is evident from the general context (Klein & von Stutterheim 1989) – to

[85] V.A.'s translation from German.

which a text (text quaestio) or a linguistic utterance (utterance quaestio) responds (Klein & von Stutterheim 1987: 163). The latter is restricted by the former and constitutes a part of it, as the following account describes:

> The quaestio of an utterance can be resulted from a superior quaestio which is addressed by the text to which the former quaestio belongs. It is therefore necessary to differentiate between a question of a text ("a question of the text") and that of separate utterances. Oftentimes, the latter result from the former […] A question [at the level of a text] cannot be answered by one sentence: the answer is distributed between a series of utterances which are connected to each other in a certain way. (ibid.: 165)[86]

If one compares a discussion with a (narrative) text, one can assume that the main question of a discussion, or "conversational goal" (Dietrich & Grommes 2003: 113; Grommes & Dietrich 2002: 198), can be seen as a text quaestio:

> [...] the role that the conversational goal plays in the control of coherence in a conversation is similar to the role that the quaestio plays in the coherence control on monological talk. (Dietrich & Grommes 2003: 113)

Consequently, single utterances (i.e. turns)[87] within a conversation can be seen as a response to the conversational goal (see ibid.: 122). Single utterances also form a hierarchy within themselves (cf. Klein & von Stutterheim 1987). There are utterances which coordinate and organize the discussion (cf. Grote et al. 2003: 127f., 148f.; see section 3.4.1.). They can be called s*ubordinate quaestiones to the superior conversational goal*; other utterances expound on the already introduced subordinate quaestiones in a discourse (cf. Dietrich & Grommes 2003: 111ff., 122; Grote et al. 2003: 148; Grommes & Dietrich 2002: 202f.; Klein & von Stutterheim 1989: 43; Klein & von Stutterheim 1987: 165ff.). Further, all utterances can be differentiated according to the novelty of the information they provide to the current discoursal status, as is reflected with the term "quaestio-movement" (Dietrich & Grommes 2003; Grote et al. 2003; Grommes & Dietrich 2002): quaestio-shift (an utterance moves a discourse forward by means of the new information it carries) and quaestio-maintenance (an utterance does not move a discourse forward since it expresses no new information) (cf. Grote et al. (2003) in section 3.4.1.; also Dietrich & Grommes 2003; Grommes & Dietrich 2002; Klein & von Stutterheim 1989). To avoid possible confusion based on this terminology, quaestio-movements will be named *information-movement*; hence, a differentiation will be drawn between *information-shift* and *information-maintenance*[88].

To summarize the above observations on the quaestio theory for the research at hand, the model below is provided:

[86] V.A.'s translation from German.

[87] 'Utterance' and 'Turn' are used synonymously in the present methodology. 'Utterance', however, implies a stronger pragmatic reading than 'Turn'.

[88] Cf. the concept of 'information newness' in Dowell et al. (2019):

> *Given* information includes words, concepts, and ideas that have already been mentioned in the discourse; *new* information involves words, concepts, and ideas that have not yet been mentioned, which builds on the given information or launches a new thread of ideas. (ibid.: 1012, italics original)

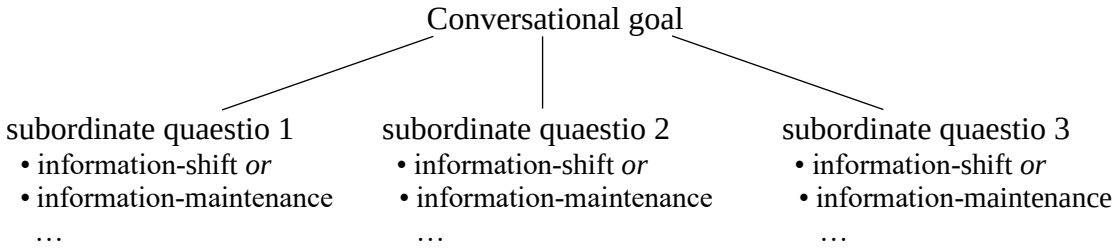

Figure 2: Quaestio approach in the study. A conversation is organized by means of its conversational goal which governs the coherence of the respective conversation; single utterances within a conversation can be responses to a conversational goal (Dietrich and Grommes 2003: 113). Such single utterances, i.e. subordinate quaestios to the superior conversational goal, form a hierarchy within themselves (cf. Klein & von Stutterheim 1987) and organize the conversational flow (cf. Grote et al. 2003: 127f., 148f.). Other utterances expound on the already introduced subordinate quaestiones in a conversation by either introducing new information to the conversation with regard to the conversational goal (i.e. information-shift) or reiterating the already available information / not contributing to the resolution of the conversational goal (i.e. information-maintenance) (cf. Grote et al. 2003; also Dietrich & Grommes 2003, as well as Grommes & Dietrich 2002).

To analyze the evolution of the category "Responsiveness", each new subordinate quaestio will be considered as a situational change (cf. the similar approach by Grote et al. 2003)[89]. When a subject reacts to a new subordinate quaestio by means of at least one utterance, disregarding the information-movement type, that subordinate quaestio will be assigned as 'responded to' for the subject. For the category evaluation, the number of quaestiones that a subject (the intra-individual and inter-individual analyses) responded to in a discussion will be compared to the total number of all quaestiones in this discussion (i.e. a percentage of the total in this discussion). On the group level analysis, the category is measured by means of an average of the subjects' performance; otherwise, the category would always be assessed as 100% because at least one subject always responses to (or simply initiates) a new quaestio.

Relation to Task

By means of the category "Relation to Task", an overview of utterances that do not directly aim to resolve the conversational goal (e.g. jokes, swear words etc.) will be provided. Whereas Silberstein & Dietrich (2003: 23) described this category with the help of the values [+ task-related] and [- task-related], the present study will focus only on **[- task-related]** cases[90]. Moreover, by an additional value **[comment]**, such utterances will be marked that are neither jokes nor swear words but rather convey an emotional reaction to what was said by others or the task itself and instances of thinking aloud[91].

In terms of the evaluation procedure, (i) the number of instances of the analyzed pragmatic value in a discussion will be compared to the total number of instances of all pragmatic values in this discussion (the group level analysis) and (ii) the number of instances of the analyzed pragmatic value produced by a subject in a discussion will be compared to the total number of instances of all pragmatic values in this discussion in the speech of this subject (the intra-individual and inter-individual analyses).

Coherence

To determine whether a discussion is coherent, Silberstein & Dietrich (2003) suggested the following criteria:

[89] In Grote et al. (2003), Dietrich & Grommes (2003), and Grommes & Dietrich (2002), the researchers described utterances of a conversation by coding them according to the linguistic categories originated from the quaestio theory (see section 3.4.2.1. for the first two studies).

[90] Cf. "Expressives (express an emotional state of the hearer [sic. speaker])" in Krifka et al. (2003: 83).

[91] Cf. Vygotsky´s (1934/1986) differentiation of speech functions into that for others and for oneself, i.e. "social speech", "private speech", and "inner speech" (cf. e.g. Jones 2009: 167, 169).

- Do the participants work on a shared communicative task?
- Do they answer questions directed to them by other crew members?
- Do they complete a current communicative task before opening a new turn?
- Do they let each other finish their utterances, or do they interrupt each other?

(ibid.: 24)

To identify which of these criteria can be meaningfully implemented in the present study and in what form, each of them will be discussed more closely:

1. *Do the participants work on a shared communicative task?*
   To examine this criterion, the number of turns associated with the participation in parallel discussions (cf. section 3.2.) will be compared to the number of all turns in the respective discussion.
2. *Do they answer questions directed to them?*
   This criterion will not be considered since there were only few instances of a question directed to a crew member which was not responded to[92].
3. *Do they complete a current communicative task before opening a new turn?*
   To assess this type of communicative behavior, the number of initiated subordinate quaestiones (see the category "Responsiveness") will be documented. A subordinate quaestio will be regarded as an example of an incoherent communicative behavior; following an introduction of a new communicative (sub)task, the previous one would be left unattended in the majority of cases[93].
4. *Do they let each other finish their utterances, or do they interrupt each other?*
   As mentioned previously, the register of the discussions was informal and the interruptions were not uncommon. For this reason, an analysis of this criterion does not seem informative in the present research because of the high frequency of interruptions. Nonetheless, instances of parallel discussions will be examined.

Furthermore, via an examination of the frequency of information-movements (i.e. information-shift vs. information-maintenance utterances; see the category "Responsiveness"), the *efficiency* of communication (cf. Grote et al. 2003: 149) will be assessed. Even though both information-movement types contribute to discourse coherence, information-maintenance utterances were found to be less effective in resolving the conversational goal than information-shift utterances (ibid.: 148f. and that was also discussed in section 3.4.1.)[94].

In favor of a systematic approach, subordinate quaestiones will be classified following theoretical considerations (e.g. Graesser et al. 2018) and inductive reasoning. Thus, a distinction will be drawn between three types of subordinate quaestiones:

1. A new quaestio is initiated by a speaker to emphasize his or her opinion that is clearly related to the conversational goal – "own opinion"[95].

[92] See also the category "Initiation of Crew Resources" where a quantitative comparison of utterances labeled as [react] vs. those labeled as [activate resources] was suggested to report instances of a lack of responses to requests.
[93] Cf. the notion of a "lousy" (Levinson 2013: 313, quoting Sacks 1971) conversation in section 3.2..
[94] Grote et al. (2003: 148f.) consider quaestio-maintenance utterances as ineffective linguistic behavior to resolve a problem which leads to inefficiency in a conversation. In the present analysis, however, it is decided not to judge information-maintenance utterances as necessarily ineffective but rather as only inefficient; it might be possible that, despite the fact that such utterances do not introduce new information to resolve a conversational goal, they can still be helpful, for instance, to allocate the interlocutors' attention to crucial information that has been previously mentioned.
[95] This is vital for "[i]nternalized team knowledge" (Graesser et al. 2018: 68) which is "the knowledge held by each individual team member that forms the bases for shared cognition" (ibid.).

2. A quaestio is initiated in order to organize or control the teamwork – "coordination"[96].
3. A new quaestio does not contribute directly to the conversational goal and likely serves for in-group tension displacement (cf. Kanas 2015: 46) or similar functions – "side structure"[97].

To summarize the above-mentioned arguments, the following parameters will help to evaluate the subjects' communicative behavior according to the category "Coherence":

1. The number of turns associated with the participation in parallel discussions compared to the total number of all turns.
2. The number and type of initiated subordinate quaestiones[98].

An increase in the frequency of parallel discussions and the number of initiated quaestiones indicate negative dynamics in coherence. Further, to assess the efficiency of communication, (i) the number of information-shift utterances (i.e. turns) in a discussion is compared to the total number of all utterances in this discussion (the group level analysis) or (ii) the number of information-shift utterances in a discussion produced by an individual subject is compared to the total number of all utterances produced by this subject in this discussion (the intra-individual and inter-individual analyses).

To conclude the elaboration of the coding categories based on the study by Silberstein & Dietrich (2003), it has to be stated that many of the originally defined categories were modified to meet the requirements of the isolation experiment at hand. This was achieved by introducing other studies on language use in demanding conditions (see sections 3.4.1. and 3.4.2.1.) or taking into consideration the present linguistic data. In the following, the coding frame, which has already been introduced and elaborated, will be complemented by means of the categories based on the HBP documents (2008a,b; see section 3.4.2.2.).

7.1.2. Categories based on Human Behavior and Performance Competency Model (2008)

As was discussed in section 3.4.2.2., two out of eight categories mentioned in the HBP (2008a,b) are relevant for the present study, i.e. "Communication" and "Cross Cultural". Each of them will be discussed in more detail below.

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[96] Cf. "coordination [which is one of the features required for the optimization of Collaborative Problem Solving performance outcomes according to O'Neil et al. (2003), cited in Graesser et al. (2018)] which includes the synchronization and integration of group activities to accomplish a task in a timely fashion" (Graesser et al. 2018: 67).

[97] Cf. "Nebenstruktur" in Klein & von Stutterheim (1987: 167) and "side structure" in Klein & von Stutterheim (1989), as well as "['irrelevant' topics that] might be considered 'off-task' for the corresponding collaborative activity […]" in Dowell et al. (2019). Dowell et al. (ibid.) also note that these contributions are relevant for social aspects of communication (citing Stahl (2000)).

[98] Subordinate quaestiones can be understood as a sign that a crew member feels compelled to explicitly guide the conversation (cf. section 3.4.1.):

> Many, even most conversations involve only partial alignment in interlocutors' interests, either in ultimate goals or in which information they prefer to share […] In all such contexts, an actual or epistemically possible conflict motivates at least one interlocutor to be *strategic* about their conversational contributions, by minimizing their overall commitments and/or by directing the conversation toward some contents and away from others. (Camp 2018: 41, italics original)

Communication

The category "Communication" consists of two competencies: "Optimize Communication" and "Ensure Understanding".

The competency "Optimize Communication" comprises nine behavioral markers, of which three will be examined, i.e. "Shares information", "Provides constructive feedback", and "Communicates concerns; persists until acknowledged". The former behavioral marker is similar to that which was discussed in section 7.1.1. ("Information Sharing"). Hence, it will not be reviewed twice.

According to the HPB (2008b), the behavioral marker "Provides constructive feedback" is defined as follows:

- Points out both positive and negative impacts of others' behaviors and ideas in a tactful way
- Checks to see if other person is open to feedback
- Communicates in a respectful manner
- Makes suggestions for improvement
- Identifies positive aspects in others

(ibid.: 2-12)

Considering the character of the interactions in the isolation study, the scope of the analysis is limited to the first, the fourth, and the last objectives. For this reason, the value **[providing feedback]** will refer to the behavior pattern of repudiating others' statements on the conversational goal or any relevant information to the discussion in general which rectifies these statements[99]. Agreeing with somebody by providing grounds for their point is replicated in the value **[supporting]**. Should a subject solely express agreement on what was said by others without justifying their point of view, the value **[agreeing]** will be applied[100].

A further behavioral marker in the category "Optimize Communication" is "Communicates concerns; persists until acknowledged". This is described as follows:

- Communicates concerns in a way that team members can understand; verifies understanding
- Assertively states concerns when they have impact on safety. Is not discouraged by hierarchy

(ibid.: 2-13)

Such behavior patterns will be understood under the value **[raising concerns]** in the present analysis and will include verbal actions such as disagreeing with the reason given for thinking or doing something. Similar to the value [agreeing], the value **[disagreeing]** denotes that a subject is objecting to someone's statement without explaining the rationale behind the disagreement[101]. Moreover, an explicit value **[persisting]** will be assigned to such verbal behavior whereby a subject repeatedly communicates concerns, misunderstanding, and the like with respect to one issue.

The second competency within the category "Communication" is "Ensure Understanding". It includes six behavioral markers. Four of these will be elaborated and then subsequently implemented into the analysis: "Listens «actively»", "Seeks answers in proactive manner", "Verifies information", and "Acknowledges confusion or misunderstanding". To understand whether these behavioral markers shall be modified to meet the requirements of the research at hand, each of them will be reviewed with the exception of the behavioral marker

[99] Cf. "Correction of previous information" in Krifka et al. (2003: 85) and "Questioning decision" in Grote et al. (2003: 142).

[100] A similar approach to describe the two kinds of accord is suggested by Kanas et al. (2008), namely "rational consent" and "emotional consent"; see section 3.4.2.1..

[101] Parallels can be drawn between the present approach and that suggested by Kanas et al. (2008; see section 3.4.2.1.), who differentiate between "rational discord" and "emotional discord".

"Seeks answers in proactive manner", since this behavioral marker is identical to the pragmatic value [seeking information], which was reviewed in section 7.1.1..

According to the HBP (2008b), the behavioral marker "Listens «actively»" is defined as follows:

- Restates what others have said individually or in a group
- Attends to non-verbal cues
- During important conversations, maintains attentive posture, eye contact, paraphrases what is heard, clarifies phrases, and summarizes
- Waits until other person has finished talking before responding (i.e., does not interrupt)

(ibid.: 2-14)

In the present study, the value **[listening "actively"]** will be applied when subjects restate what was said by others or encourage a crew member to keep on speaking, e.g. by uttering "hm" or "yes"[102]. The decision to limit the scope of the original behavioral marker is based on the fact that the video recordings, which were the material for the QCA (see section 5.4.), did not allow for a profound analysis of nonverbal communication.

The next behavioral marker is "Verifies information". This is interpreted as follows:

- Reads back information in order to verify accuracy
- Records complex information

(ibid.: 2-15)

The value **[verifying]** is assigned to those utterances by means of which the subjects validate their comprehension of task requirements or of other colleagues' point of view.

The last behavioral marker within the category "Communication" to be elaborated is "Acknowledges confusion or misunderstanding". Following the HBP, it is defined as follows:

- Receiver communicates to sender of information own confusion or lack of understanding
- Admits when a message has not been understood
- Calls attention to the ambiguity by asking questions to clarify meaning of the message, including non-verbal behavior

(ibid.: 2-16)

In other words, the value **[acknowledging confusion]** will be implemented in the case of those utterances when a subject admits his or her misapprehension of either what was said (or done) by others or the task-related information in general.

In terms of the evaluation procedure, (i) the number of instances of the analyzed pragmatic value in a discussion will be compared to the total number of instances of all pragmatic values in this discussion (the group level analysis) and (ii) the number of instances of the analyzed pragmatic value produced by a subject in a discussion will be compared to the total number of instances of all pragmatic values in this discussion in the speech of this subject (the intra-individual and inter-individual analyses).

[102] Cf. "Reports of Report (rephrase information expressed before)" and "Rephrases (acknowledge and rephrase preceding speech act)" in Krifka et al. (2003: 82f.), as well as "Reassurance (e.g. feedback about comprehension of a communication)" in Grote et al. (2003: 141) concerning the first part of the value meaning; cf. "aktives Zuhören" in Rogers (2015: 53f.), "backchannels" in Peters & Wong (2015), "encouragement" in Kanas et al. (2008); "minimal encouragers" in Blonna & Watter (2005: 62), and "Acknowledgments (express that the proceeding speech act was understood)" in Krifka et al. (2003: 83) concerning the second part of the value meaning.

Cross Cultural

The category "Cross Cultural" incorporates five competencies which are defined by ten behavioral markers. Because many of them are either overlapping or they cannot be analyzed by means of a mere linguistic analysis, only one behavioral marker will be considered in the present study, namely the behavioral marker "Acknowledges the impact of cultural dominance on crew interaction" within the competency "Understand culture and cultural differences [national, organizational and professional]". This behavioral marker is specified as follows:

- Recognizes when a culture becomes dominant by representation
- Identifies the impact of cultural dominance on group interaction
- Acknowledges that the dominant culture does not render invalid the other cultural views
- Does not consider one's own culture superior

(ibid.: 2-19)

Since these characteristics are difficult to assess without an additional analysis based on the subjects' self-reflection and due to the complex definition of the term 'culture', the possible implications drawn from this behavioral marker should reconsidered. Hence, explicitly calling attention to the linguistic barrier in the group will be reflected in the value **[acknowledging linguistic dominance]**.

Given the fact that the crew was multilingual (Russian and English), an additional value to capture the willingness of the subjects to establish shared common ground will be introduced, i.e. **[interpreting]**. The direction of interpretation, from or into L1/L2, is disregarded. Any utterance which aims at interpreting in either of the languages will be labeled by means of this value [interpreting]. This action is one example of implicit coordination and heedful interrelating which is beneficial for the team's situation awareness and the effectiveness of teamwork (cf. Grote et al. 2003: 133f.; see section 3.4.1.)[103].

In terms of the evaluation procedure, (i) the number of instances of the analyzed pragmatic value in a discussion will be compared to the total number of instances of all pragmatic values in this discussion (the group level analysis) and (ii) the number of instances of the analyzed pragmatic value produced by a subject in a discussion will be compared to the total number of instances of all pragmatic values in this discussion in the speech of this subject (the intra-individual and inter-individual analyses).

This overview completes the formulation of the categories. In the next section, all categories will be compiled and explanations regarding when and what category is to be applied will be provided. Illustrative examples that are derived from the study materials with occasional slight alterations for the visualization of the prototypical meaning of each pragmatic value will also be provided.

7.1.3. Synopsis of all categories

Having introduced a number of different categories, their synopsis and classification can next be given to clarify their implementation. Thus, in the table below, all categories are presented together with their descriptions. The values are differentiated according to their assessment principle: pragmatic (relying on the content which is expressed in an utterance) or formal-

[103] Cf. in particular the category "Considering others" in Grote et al. (2003: 143).

linguistic[104] (based on an assessment of formal content-related criteria)[105,106]. Each pragmatic value is indicated by square brackets, following Silberstein & Dietrich (2003), and accompanied by an illustrative example.

[104] Formal-linguistic categories can also be classified as those related to the concept of information structure (see Chapter 4 for a brief outline of this concept).

[105] A similar approach was carried out by Grote et al. (2003; see section 3.4.1.). These authors categorized utterances according to behavioral (pragmatic values in the present study) and linguistic (based on quaestio-movements) categories.

[106] For better readability and unification of the methodology, formal-linguistic subcategories and types of subordinate quaestiones will be defined as 'values' and listed under the respective column, even though they are not marked by square brackets (cf. Silberstein & Dietrich 2003).

Categories	Pragmatic values	Formal-linguistic values
Integration of the categories following Silberstein & Dietrich (2003)		
Information Sharing	**[adding information]** – Providing background information that is related to the conversational goal (e.g. to update on the status of the group decision, to answer questions about the task description) while not expressing one's opinion and decision regarding the conversational goal. **Example:** **A:** *Alright, now we are having a group discussion. Well, what do we have?* **B:** *Two against two.* **[adding information]**	The number of turns produced in a discussion (group-level analysis). The number of turns produced by a subject in a discussion compared to the total number of all turns in this discussion (intra-individual and inter-individual levels).
	[own opinion] – Openly stating one's opinion on the conversational goal without being explicitly asked to do so. **Example:** **A:** *They never mention a risk of a fatal error.* **B:** *But I have selected X because the spaceship will certainly be damaged.* **[own opinion]**	The number of words produced in a discussion (group-level analysis). The number of words produced by a subject in a discussion compared to the total number of all words in this discussion (intra-individual and inter-individual levels).
Initiation of Crew Resources	**[activate resources]** – Addressing a particular crew member (e.g. by calling him / her by name) to learn about his / her opinion on the main topic of the discussion. **Example:** **A:** *And what do you think* (name of B)*?* **[activate resources]** **B:** *I have chosen…*	
	[seeking information] – Asking for general information that is related to the conversational goal without specifying the addressee. **Example:** **A:** *Okay, who does not agree?* **[seeking information]** **B:** *Well, I have chosen a different option.*	
	[react] – Responding to a direct request to share a personal opinion that is related to the conversational goal; it is not self-initiated information sharing. **Example:** **A:** *What is your* (to B) *least favorable crater?* **B:** *It is crater X.* **[react]**	

	[order] – An attempt to take control over the actions of colleagues, for instance to coordinate the team. **Example:** **A:** *Let's assign X as the least favorable option.* **[order]** **B:** *Well but…*	
Receptiveness		Number of L2 turns produced by all subjects in a discussion compared to the total number of all turns in this discussion (group level). Number of L2 turns produced by a subject in a discussion compared to the total number of all turns produced by this subject in this discussion (intra-individual and inter-individual levels). In case that both L1 and L2 appear within one turn, this turn will be assessed as half in L1 and half in L2, regardless of the actual length of the passages in L1 or L2.
Responsiveness		Number of quaestiones to which it was responded to by a subject in a discussion compared to the total number of all quaestiones in this discussion (intra-individual and inter-individual levels). The average of the subjects' individual metrics on the category "Reponsiveness" in each discussion (group level).
Relation to task	**[- task-related]** – Utterances which are not primarily related to the conversational goal, e.g. jokes, swearing, speaking about irrelevant topics. **Example:** **A:** *Why does this guy know that the landing on Mars is similar to six minutes in hell?* **B:** *He died and went to hell.* **[- task-related]**	

	[comment] – A reaction to what was said (or done) by others or the task itself and which does not directly contribute to the conversational goal, for instance, thinking aloud. **Example:** **A:** *They mention here that in case of an earth shake, the flying vehicle gets damaged.* **B:** *Well yeah, they both* (craters) *are somewhat dangerous.* **[comment]**	
Coherence	Type of initiated subordinate quaestiones: "coordination", "own opinion", or "side structure".	The number of each subordinate quaestio produced in a discussion (group-level analysis). The number of all subordinate quaestiones produced by a subject in a discussion compared to the total number of all subordinate quaestiones in this discussion (intra-individual and inter-individual levels).
		Number of turns produced by all subjects in a discussion that are associated with engagement in parallel discussions compared to the number of all turns in this discussion (group-level analysis). Number of turns produced by a subject in a discussion that are associated with engagement in parallel discussions compared to the number of all turns produced by this subject in this discussion (intra-individual and inter-individual levels).
Efficiency of communication[107]		Number of information-shift turns in a discussion compared to the total of all information-movements, i.e. information-shift plus information-maintenance turns, in this discussion (group level). Number of information-shift turns produced by a subject in a discussion compared to the total of all information-movements, i.e. information-shift plus information-maintenance turns, produced by this subject in this

[107] This category originates from the approach in Grote et al. (2003; see section 7.1.1. on the category "Coherence").

		discussion (intra-individual and inter-individual levels).
Integration of the categories following the International Space Station Human Behavior and Performance Competency Model (Mission Operations Directorate ITCB HBP Training Working Group 2008a,b)		
Category 'Communication'	**[providing feedback]** – Repudiating statements of others with regard to the conversational goal or any relevant information in general which rectifies these statements. **Example:** **A:** *We have two people against two people.* **B:** *Why two against two? We have all selected the same.* **[providing feedback]**	
	[supporting] – Agreeing with others while explaining the reason for doing so. **Example:** **A:** *If we land at X, we have more chances than if we land at Y. This is the reason why I have chosen X.* **B:** *Yes, they indeed mention here that there is by far less room for failure in case of landing at X.* **[supporting]**	
	[agreeing] – Agreeing with others without justification. **Example:** **A:** *Do you agree?* (to everyone) **B:** *Yes.* **[agreeing]**	
	[raising concerns] – Disagreeing with others while explaining the reason for thinking differently. **Example:** **A:** *Let's assign X as the least favorable option.* **B:** *Well, but Y is the only crater with the possibility of human toll.* **[raising concerns]**	
	[disagreeing] – Disagreeing with others without justification. **Examples:** **A:** *Well, let's choose X as the third option.* **B:** *No.* **[disagreeing]**	

	[persisting] – Repeatedly communicating concerns, misunderstanding, or personal opinions. **Examples:** **A:** *Well then, I might have missed something while reading. I've understood it like…* **B:** *The landing ship, it will certainly be damaged* (this argument was addressed previously by B). **[persisting]**	
	[listening "actively"] – Repeating, restating, or completing the utterances of other crew members as well as verbally expressing attention while others are speaking (e.g. hm, okay). **Example:** **A:** *Well, all three* (craters) *are somewhat dangerous.* **B:** *Uhu.* **[listening "actively"]**	
	[verifying] – Validating one's own comprehension of either task requirements or other crew members' utterances. **Example:** **A:** *Well as far as I understand, we need to select one crater.* **[verifying]** **B:** *No, we also need to prioritize all of them.*	
	[acknowledging confusion] – Admitting confusion either of what was said by someone (also speaker himself / herself if not well formulated) or the task requirements. **Example:** **A:** *Why three of us?* **[acknowledging confusion]** **B:** *Well, I, you, and* (name) *have chosen X as the least favorable crater.*	
Category 'Cross Cultural'	**[acknowledging linguistic dominance**] – Explicitly drawing attention to the linguistic barrier. **Example:** **A:** *You understand that, right?* (to a non-native Russian subject because the conversation was entirely in Russian) **[acknowledging linguistic dominance]**	

	[interpreting] – A subject performs an exercise of interpreting. The direction of interpreting is disregarded: either from L1 into L2 or vice versa. **Example:** **A:** *What does* (name of a subject) *have?* (asking in Russian about the opinion of a non-native Russian crew member) **B:** *What is your ranking* (name of a subject)*?* (asked in English to the non-native of Russian crew member) **[interpreting]**	

Table 4: Code book of categories for the qualitative content analysis. The categories are divided into nineteen pragmatic and seven formal-linguistic values. The distinction between the two different types of categories follows the methodology by Grote et al. (2003).

In total there are eight categories which consist of nineteen pragmatic (without considering the three types of subordinate quaestiones that also adhere pragmatic values however not assessed on the turn level, see section 7.2.) and seven formal-linguistic values. The assessment principles for formal-linguistic values are described in the table. For the pragmatic values, the assessment procedure is as follows: (i) for the group level analysis, the number of instances of the analyzed pragmatic value in a discussion will be compared to the total number of instances of all pragmatic values in this discussion; (ii) for the intra-individual and inter-individual analyses, the number of instances of the analyzed pragmatic value produced by a subject in a discussion will be compared to the total number of instances of all pragmatic values in this discussion in the speech of this subject.

7.1.4. Classification of pragmatic values according to illocutionary acts

In accordance with the requirements of the method of QCA, i.e. a hierarchical organization of coding categories, the pragmatic values will be grouped following the semantic differences of the basic IAs (see section 3.1.). With this intention in mind, the *direction of fit* (see section 3.1.) first has to be specified to satisfy the requirements of the present study. To do this, task descriptions and opinions of the fellow crew members on the conversational goal are to be defined as *world*. Furthermore, since declarative IAs were not typical in the data at hand, this IA will not provide the basis as one of the main categories.

In accordance with the classification by Searle (1976; see section 3.1.), six values are distinguished as being related to the representative IA: [adding information], [providing feedback], [listening "actively"], [verifying], [acknowledging confusion], and [acknowledging linguistic dominance]. All of these are an objective replication of either a task, another crew member's point of view, or they are used to draw attention to the in-group linguistic environment.

The values [activate resources], [seeking information], [order], and [persisting] belong to the category of the directive IA. These denote explicit instructions to make the crew think or do something. They dictate some form of behavior.

Commissive IAs are represented through the following six values: [own opinion], [react], [supporting], [agreeing], [raising concerns], and [disagreeing]. Their categorization as the commissive IA indicates that they denote the verbal commitment of a subject to his / her point of view regarding the conversational goal. It is important that these values are strongly related to the conversational goal.

The last two values [- task-related] and [comment] are associated with expressive IAs. Such utterances are not part of direct verbal actions towards successful and efficient problem-solving. They are rather assumed to be transmitters of a speaker's psychological state or a means to reveal emotions.

The last value, [interpreting], cannot be classified in accordance with one of Searle's IA taxonomy. Its semantic qualities are a combination of many basic IAs, i.e. representative, directive, and commissive. Therefore, this value will be considered on its own.

In terms of the assessment principle of the pragmatic values grouped according to IAs, a sum of the individual pragmatic values which fall under one respective IA represents the accumulated rate of this particular IA as a superordinate category.

Furthermore, many formal-linguistic values can find their theoretical evidence in the framework of the ConvA approach (see section 3.2.). Hence, turns (in the present interpretation of the linguistic data, they can be compared with TCUs), topics (in the present study, subordinate quaestiones), and parallel discussions which are evident in a conversation with many interlocutors will all be examined in the present research.

7.2. Procedure of content-oriented analysis

The group discussions were manually transcribed starting from the point in time when the crew began communicating on the conversational goal, i.e. when they began with the subtask of group discussion within the decision-making tasks (see section 5.4.).

Considering the content-analytical entities (see section 3.3.), the coding unit is a TCU (termed as 'turn' in the present research)[108], the context unit is an entire utterance / turn, and the recording unit are all five discussions.

Similar to Grote et al. (2003), each turn was evaluated according to the pragmatic and formal-linguistic categories. Occasionally, there were more than one pragmatic value assigned to one unit of coding; however, it was not attempted to code one unit with several pragmatic values (as graphically indicated with square brackets; cf. Silberstein & Dietrich 2003) which fall under the same main category, i.e. IA (see the requirements of QCA in section 3.3.)[109]. An example of a transcript with a completed analysis is introduced below[110,111]:

[108] On this terminology, cf. n. 87.

[109] Cases in which one turn was coded by pragmatic values which fall under the same IA were only rarely evident, as it was aimed at excluding such instances. Thus, in D1, 4% of all pragmatic values fell under the same IA within one turn, which made up 2.3% turns in total; in D2, 5.6% of all pragmatic values fell under the same IA within one turn, which made up 3.1% of all turns; in D3, 7% of all pragmatic values fell under the same IA within one turn, which made up 3.9% of all turns; in D4, 8.8% of all pragmatic values fell under the same IA within one turn, which made up 4.6% turns (there was one turn with 4 pragmatic values which fell under two same IAs, respectively); and in D5, 4% of all pragmatic values fell under the same IA within one turn, which made up 2.3% of all turns.

[110] Utterances that were originally in Russian are indicated with [R]; all translations are made by V.A..

[111] To ensure anonymity of the subjects, they are coded by letters. In the subsequent analysis, the coding is performed by means of digits.

Turn	Subject	Utterance	Pragmatic categories	Formal-linguistic categories
1	subject A	*Alright, I am ready, by the way. Who else?* [R]	[adding information] [seeking information]	new quaestio (coordination) information-shift
2	subject C	*I am done.* [R]	[adding information]	information-shift
3	subject D	*Well, I am too.* [R]	[adding information]	information-shift
4	subject A	*It means next month* (an instance of thinking aloud). [R]	[comment]	information-maintenance
5	subject C	*Well, shall we start?* [R]	[order]	new quaestio (coordination) information-shift
6	subject A	*Uhu.*	[adding information]	information-shift
	subject C	*Let's go.* [R]		
7	subject B	(calling subject D by the name)	[activate resources]	information-shift
8	subject D	*Astral, Blazar, and Cometa.* [R]	[react]	information-shift
9	subject B	*Who has* [R]	[seeking information]	information-shift
	subject D	*The first, the second,* [R]		
	subject B	*a different opinion?* [R]		
	subject D	*the third.* [R]		
10	subject E	*Who does not agree?* [R]	[seeking information] [listening "actively"]	information-maintenance
11	subject A	*Well, frankly, I have decided differently because perhaps the information I have received differs greatly from yours. I don't agree on Blazar and Cometa. I have Cometa as first, then Blazar.* [R]	[own opinion]	information-shift

Table 5: An example of the qualitative content analysis approach. The discussion is one of the five discussions which are analyzed in the present research. The brackets connect two parts of one utterance, i.e. turn. The visualization of the data analysis is adapted from Grote et al. (2003: 146ff.).

In the next chapter, the elaborated coding frame will be implemented to address the questions within the QCA of the present research (see Chapter 6).

8. Content-oriented analysis: Group level[112]

The content-oriented analysis of the crew's discussions will start from an analysis of the group level. The analysis based on the above-mentioned pragmatic and formal-linguistic[113] categories will be given for each discussion separately. This will provide an exhaustive overview of changes in the communicative behavior of the crew as a coherent body.

The QCA on the group level will begin with an analysis of the formal-linguistic categories and conclude with an analysis of the pragmatic categories. The content-oriented analysis of the group level helps to answer the following key question:

> How did the communicative behavior of the crew, as a coherent body, change across the entire isolation period, under "normal" isolation conditions, and during the discussions with the additionally designed stressors?

The formal-linguistic categories are evaluated holistically, i.e. according to their total frequency in a given discussion (see section 7.1.3. on the choice of the categories evaluation approach). One formal-linguistic category – "Responsiveness" – will be measured by taking an average of the subjects' performance, rather than by means of a holistic analysis, since each subordinate quaestio was addressed by at least one crew member. Hence, all discussions would be assessed as 100% according to the category "Responsiveness" if the category was measured holistically.

Likewise, the pragmatic values will be evaluated by considering their holistic frequency in each discussion. Specifically, the number of instances of a particular pragmatic value in a discussion will be compared to the total number of all instances of pragmatic values in the respective discussion. So for instance, if there is a total of 348 instances of pragmatic values in a discussion while 45 instances are labeled as [adding information], then the value [adding information] makes up 12.93% of the entire discussion. The content-oriented analysis based on IAs is made by summarizing the frequencies of the pragmatic values which fall under the respective IA (see section 7.1.4.). For instance, expressive IAs will constitute 20.28% of an entire discussion if utterances that are labeled as [- task-related] account for 12.59% and utterances that are labeled as [comment] account for 7.69%.

The minimum and maximum percentage of each category, based on the data of the individual subjects, will supplement the QCA on the group level; standard deviation (SD) will be given to categories where the data type allows it. For the analysis based on the pragmatic values, the evolutions of the main categories, i.e. IAs, across the discussions will be reviewed, while only two of the most frequent pragmatic subcategories, i.e. the values as indicated in the square brackets (cf. Silberstein and Dietrich 2003), will be mentioned in addition (e.g. [adding information] and [listening "actively"] if these values are uttered with the highest frequency in a given discussion among Representative IAs[114]). The review of the pragmatic values allows for a more detailed overview of the discussion than one which is characterized by means of the four IAs, i.e. representative, directive, commissive, and expressive.

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[112] For D1, D2, and D4, the results of the pragmatic categories grouped according to the IAs and formal-linguistic categories (i.e. Information Sharing, Receptiveness, Responsiveness, Coherence, and Efficiency of Communication) are briefly introduced and discussed in Anikushina et al. (2022).

[113] In this chapter, for better readability, no differentiation is made between a 'category' and 'value' within the formal-linguistic categories (cf. section 7.1.3. and n. 105).

[114] For an overview of the dynamics of all pragmatic values, see Table 61 in Appendix.

It is expected that a gradual *linear* evolution of the examined categories (in either an increasing or decreasing direction) will be identified during the "routine" isolation discussions, i.e. D1, D2, and D4. This linearity is understood as a reflection of adapting to the period of isolation (cf. Anikushina et al. (2022), as well as the stages of adaptation to isolation that were discussed in section 2.1.1.). The two other discussions with the pre-planned stressors, i.e. D3 and D5, are expected to "disrupt" the linear character of the categories evolution, because the linear character of the categories evolution is expected to indicate "normal" isolation conditions. These two discussions imply additional demands and thus could provoke "irregularity" in the communicative behavior.

To validate the findings of the QCA, sociometric data on group cohesiveness (see section 2.1.1.) will be related to the interpretation of the communicative data.

8.1. Formal-linguistic categories

Information Sharing

With respect to the length of the discussions measured by means of the number of turns, D1 was the longest discussion (309 turns). This was followed by D4 (237 turns), D3 (181 turns), D2 and D5 (both 130 turns):

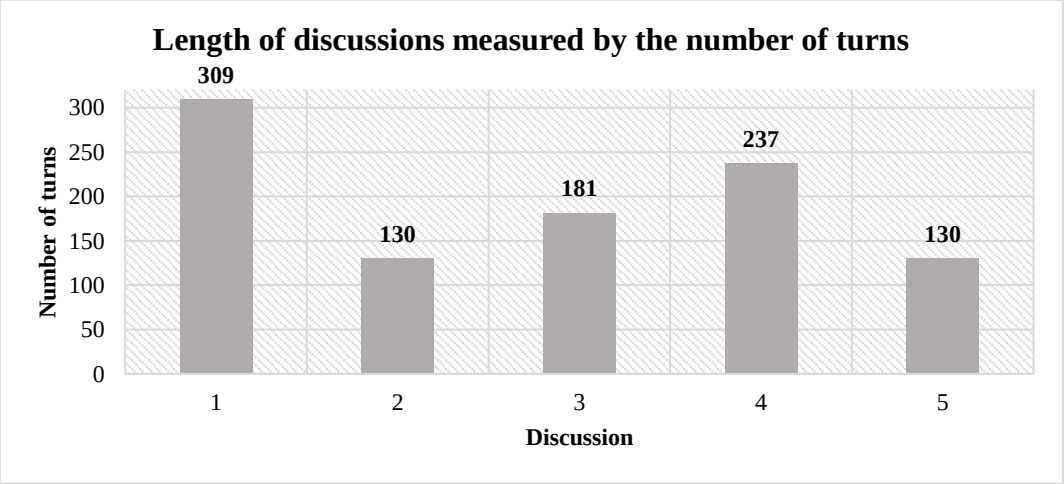

Figure 3: Number of turns on the group level assessed in each discussion. D1 and D4 were the longest discussions, while D2 and D5 were the shortest.

Number of turns [number of observations]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	67	43	49	57	39
Min	30	8	13	20	10
SD	12.72	11.93	12.89	14.96	10.43

Table 6: Number of turns on the group level assessed in each discussion. Standard deviation, minimum, and maximum data points in each discussion are based on the data of the individual subjects.

The length of the discussions measured by means of the number of words was slightly different from that based on the number of turns: while D1 was still the longest discussion (2355 words) and D4 (1845 words) was the second longest discussion, D2 (1077 words) was longer than D3 (1024 words) and D5 (829 words):

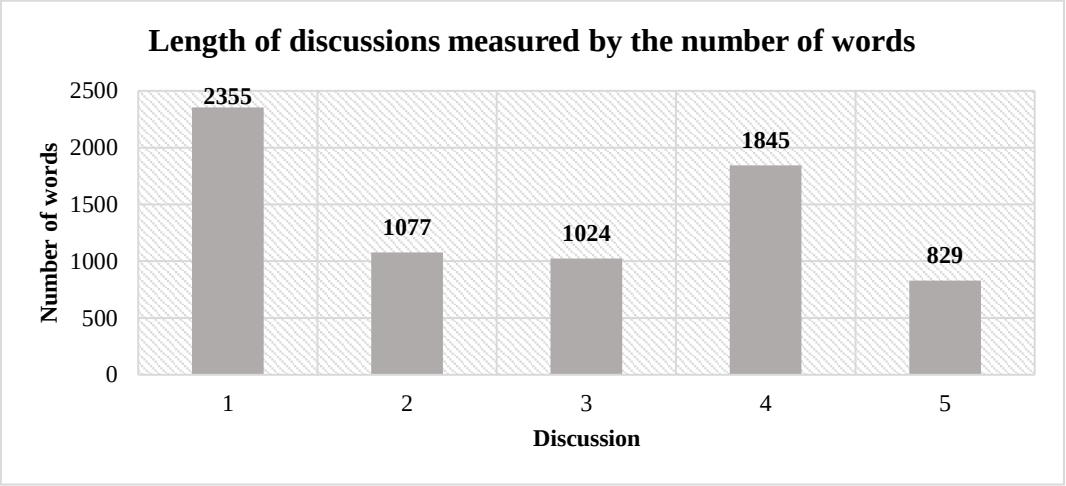

Figure 4: Number of words on the group level assessed in each discussion. D1 and D4 were the longest discussions, while D5 was the shortest.

Number of words [number of observations]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	535	255	324	458	363
Min	225	129	46	128	31
SD	127.23	57.27	106.78	138.22	121.48

Table 7: Number of words on the group level assessed in each discussion. Standard deviation, minimum, and maximum data points in each category are based on the data of the individual subjects.

All in all, the length of the discussions, measured by means of the number of turns and words, was very dynamic and unpredictable. In other words, it was not constant and did not evolve according to a linear pattern. The latter result is particularly noteworthy for the discussions under "normal" isolation conditions, i.e. D1, D2, and D4.

Coherence: New quaestiones

The highest number of subordinate quaestiones was found in D1 – 25 quaestiones. In D2, there were seven quaestiones. In D4, there were eight quaestiones. During the discussions with the additional demanding factors, i.e. D3 and D5, the number of subordinate quaestiones were eleven and six, respectively:

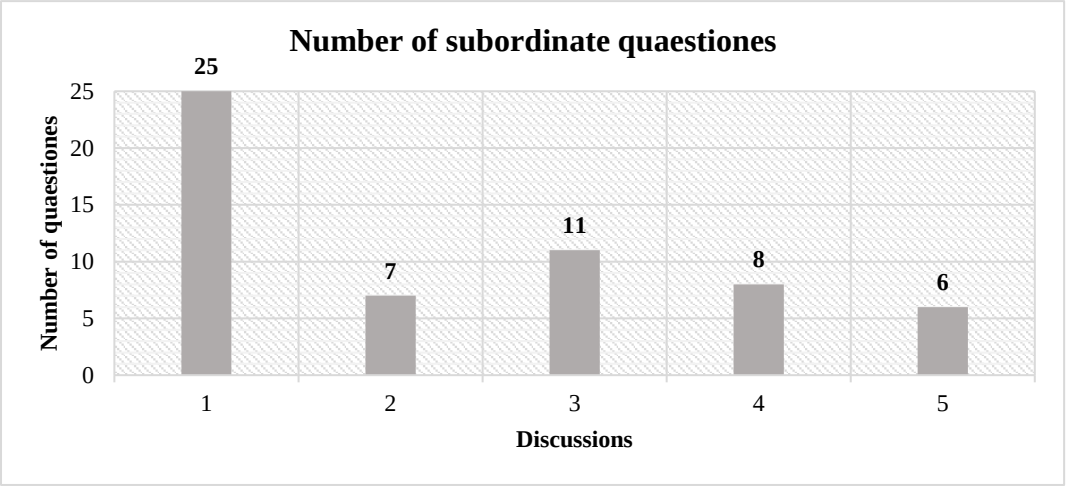

Figure 5: Number of subordinate quaestiones on the group level assessed in each discussion. D1 was a discussion with by far the largest number of subordinate quaestiones, followed by D3 and D4. D2 and D5 were the discussions with the fewest number of subordinate quaestiones.

Even though D1 can be considered as poorly organized (cf. section 3.2.), and hence incoherent, all subjects, except for subject 5, initiated at least one subordinate quaestio. Furthermore, the majority of subjects (with the exception of subject 1 and subject 5) were able to openly express their opinion on the conversational goal by initiating a new subordinate quaestio of the type "own opinion" (cf. Tables 62-67 in Appendix).

With respect to the types of initiated subordinate quaestiones[115], "coordination" was the most frequently used subordinate quaestio type in all discussions. This was also the only quaestio type in D2 and D5. Subordinate quaestiones of the type "own opinion" were found in D1 (32%) and D3 (9.09%) and subordinate quaestiones of the type "side structure" were found in D1 (16%), D3 (36.36%), and D4 (25%).

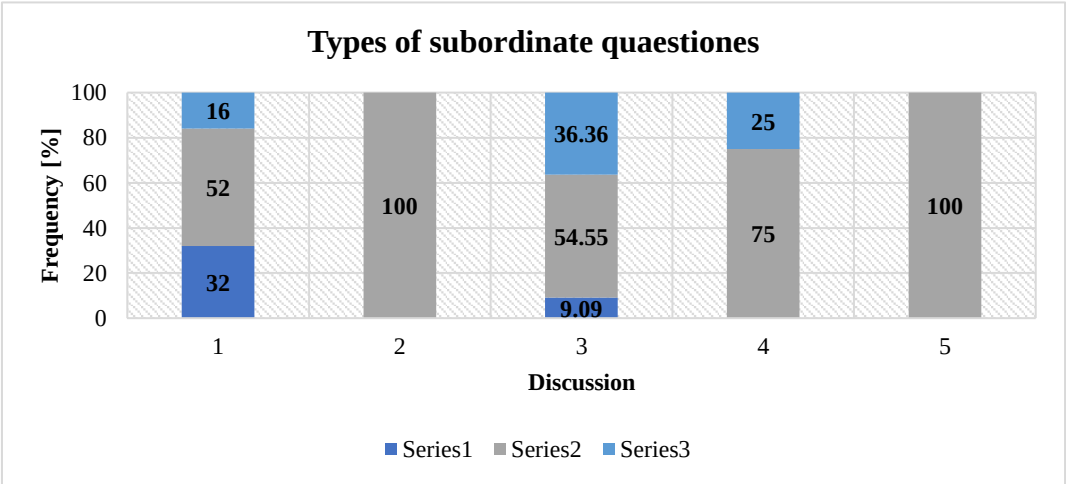

Figure 6: Types of subordinate quaestiones on the group level assessed in each discussion. D1 and D3 entailed subordinate quaestiones of all three types. In contrast, D2 and D5 were structured by means of only one type of subordinate quaestiones, i.e. "coordination".

[115] For the purpose of the convenient reading, this pragmatic information – type of subordinate quaestiones – will be discussed together with the formal-linguistic category the number of subordinate quaestiones.

Subordinate quaestiones of the type "own opinion" [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	66.67	0	100	0	0
Min	0	0	0	0	0

Table 8: Subordinate quaestiones of the type "own opinion" on the group level assessed in each discussion. Minimum, and maximum data points in each discussion are based on the data of the individual subjects.

Subordinate quaestiones of the type "coordination" [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	66.67	100	100	100	100
Min	0	0	0	0	0

Table 9: Subordinate quaestiones of the type "coordination" on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

Subordinate quaestiones of the type "side structure" [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	50	0	100	33.33	0
Min	0	0	0	0	0

Table 10: Subordinate quaestiones of the type "side structure" on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

In summary, the number and type of the subordinate quaestiones varied greatly in the discussions. However, the coordination of the teamwork was the first and greatest intention behind the initiation of a new subordinate quaestio in all discussions[116].

Coherence: Parallel discussions

Turns that were associated with parallel discussions constituted 5.5% of D1, 3.85% of D2, and 4.22% of D4. Thus, coherence, according to this parameter, improved over the period of isolation in general, when one compares D4 against D1, and indicated the best performance metrics in D2[117]:

[116] See Chapter 12 for the interpretation of the distribution of the types of the subordinate quaestiones in the discussions.

[117] A further interpretation of the data can be suggested when taking into account the number of turns which subject 5 produced in D2. This is important because subject 5 was a leading contributor in all parallel discussions. The subject's general participation in the discussions, assessed by means of turns, was at the lowest level (6.15%) in D2, when compared with other discussions (see section 9.5.). Therefore, subject 5 might have been "less talkative" in D2 alone, which influenced the incoherence of team communication to a lesser degree.

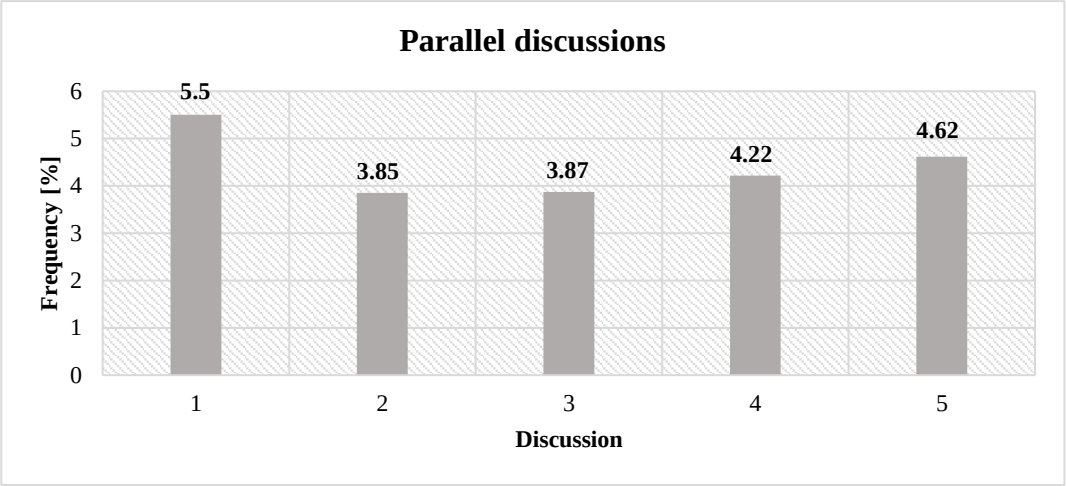

Figure 7: Parallel discussions on the group level assessed in each discussion. During D1 and D5, occurrence of parallel discussions was the most frequent, while the opposite can be stated for D2 and D3.

Parallel discussions [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	26.67	25	5.56	15	18.18
Min	0	0	0	0	0

Table 11: Parallel discussions on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

To sum up, the frequency of parallel discussions declined between D1 and D2 and gradually increased after D2, although never reaching the level of D1.

Efficiency of communication

The obtained data revealed that the frequency of turns defined as information-shift utterances increased throughout the period of isolation under "normal" isolation conditions, i.e. between D1 and D4. However, during D2 the number of utterances contributing new information to the current discoursal stage to resolve the conversational goal was at the lowest level:

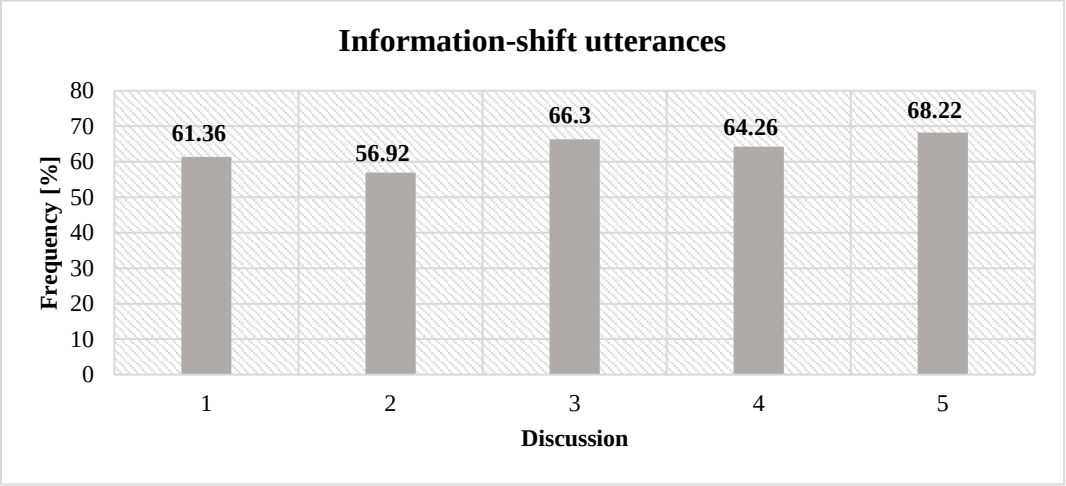

Figure 8: Information-shift utterances on the group level assessed in each discussion. All discussions were dominated by information-shift utterances, which constituted more than half of each discussion.

Information-shift utterances [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	73.58	100	73.47	75	76.19
Min	55	36.84	46.15	59.65	61.54

Table 12: Information-shift utterances on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

Quite the opposite can be observed in relation to D3 and D5. During these two discussions, there was an increase in information-shift utterances; in D5, the frequency of information-shift utterances reached its peak across the entire isolation period[118].

By and large, the efficiency of communication, as analyzed by means of information-movements in the discussions, moderately increased across the four months of isolation, with the exception of D2. It is noteworthy that, during the discussions with the additional stressors (i.e. D3 and D5), the crew's communicative behavior was more efficient than under the "normal" isolation conditions.

Receptiveness

The category "Receptiveness" displayed a negative tendency from a chronological perspective under "normal" isolation conditions, i.e. from D1 to D4. Furthermore, the dynamic of the category evolution under "normal" isolation conditions was not linear:

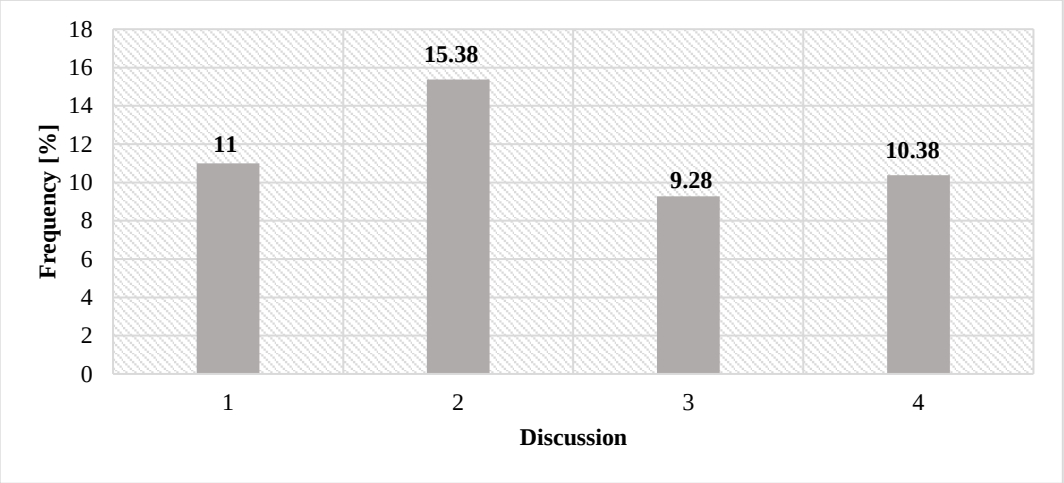

Figure 9: The category "Receptiveness" on the group level assessed in each discussion. D2 was the discussion with the highest frequency of the category "Receptiveness". D3 was conducted in English which was an L2 for the majority of subjects. Therefore, D3 will be excluded from the cross-discussion comparison.

[118] In general, the low ratios of information-shifts can be explained by the extensive use of [listening "actively"] utterances, which were almost always labeled as information-maintenance. In other words, subjects who produced more turns tended to speak less efficiently. This observation is not fully conclusive, but it allows for different interpretations. Thus, the correlation between the total number of turns and the number of information-maintenance turns throughout all discussions was significantly relevant in subjects 2, 3, 4, and 5 (subject 2: $r_s = .97$, $p = .00482$ according to Spearman's correlation analysis; subject 3: $r_s = 1$ $p < .001$ according to Spearman's correlation analysis; subject 4: $r_s = .9$ $p = .03739$ according to Spearman's correlation analysis; and subject 5: $r_s = 1$, $p < .001$ according to Spearman's correlation analysis).

Furthermore, it is assumed that utterances of the type [listening "actively"] can be associated with the leadership communication style. This indicates an unconscious technique that is used to control other interlocutors while not building up a conversation on the qualitative side (cf. Davis & Maclagen's (2020) study on pragmatic functions of discourse markers, i.e. UH, in dementia patients).

Receptiveness [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	43.48	28.85	N/A	30	40
Min	0	0	N/A	0	0

Table 13: The category "Receptiveness" on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects. D3 was conducted in English which was an L2 for the majority of subjects. Therefore, D3 will be excluded from the cross-discussion comparison.

It is important to mention that there were subjects who would always avoid uttering L2 as well as subjects who would make such utterances regularly.

Responsiveness

The category "Responsiveness" was found to increase gradually throughout the first three discussions followed by a slight decline in D4 and a substantial drop in D5:

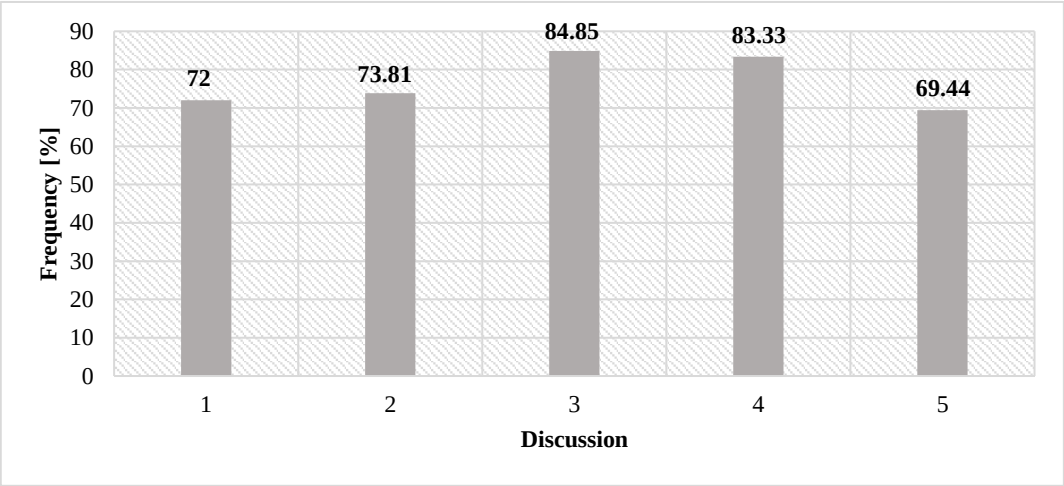

Figure 10: The category "Responsiveness" on the group level assessed in each discussion. The discussions characterized by the highest frequency of the category "Responsiveness" were D3 and D4. In other discussions – D1, D2, and D5 – this category was less pronounced.

Responsiveness [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	76	100	90.91	100	100
Min	40	42.86	63.64	62.5	50

Table 14: The category "Responsiveness" on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

Overall, the crew tended to become more attentive to the new information as isolation progressed across all discussions, with the exception of D5, which indicated a substantial decline in the metrics on the category "Responsiveness" when compared to that in D4 and all other discussions.

8.2. Pragmatic categories

Representative illocutionary acts

Among all IAs in the five discussions, the representative IA was the most frequent. It was prevalent in the discussions throughout the entire isolation period:

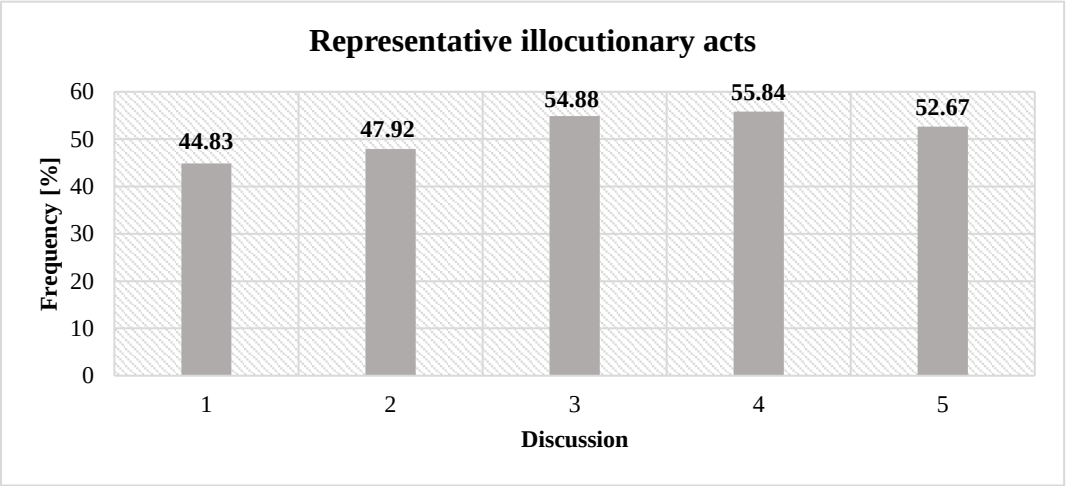

Figure 11: Representative illocutionary acts on the group level assessed in each discussion. Utterances of the representative illocutionary act constituted around half of all utterances in the discussions.

Representative illocutionary acts [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	57.35	60	68.29	76.19	75
Min	30.43	30	38.46	49.09	41.67

Table 15: Representative illocutionary acts on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

The utterances of the representative IA were most likely to be expressed through the values [adding information] and [listening "actively"]. The value [listening "actively"] was most frequent in D1, D2, and D3, whereas [adding information] was most frequent in D4 and D5:

Values of representative illocutionary acts [%]										
	D1		**D2**		**D3**		**D4**		**D5**	
[listening "actively"]	17.53		22.92		23.72		18.25		14	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	27.94	9.38	42.55	0	33.33	0	25.86	7.27	28	0
[adding information]	12.93		16.67		15.35		24.45		23.33	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	20.34	3.8	30	10	21.95	6.25	47.62	16.9	37.5	16.67

Table 16: Values of representative illocutionary acts on the group level assessed in each discussion. The most frequent values used by the subjects throughout all five discussions within the utterances of the representative illocutionary act were [listening "actively"] and [adding information]. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

Overall, the frequency of the utterances that were defined as representative acts increased gradually throughout the isolation period with a minor decrease in D5.

Directive illocutionary acts

Utterances defined as directive IAs were among the most frequent utterances as well. The frequency of their occurrence in the discussions is illustrated in the graph below:

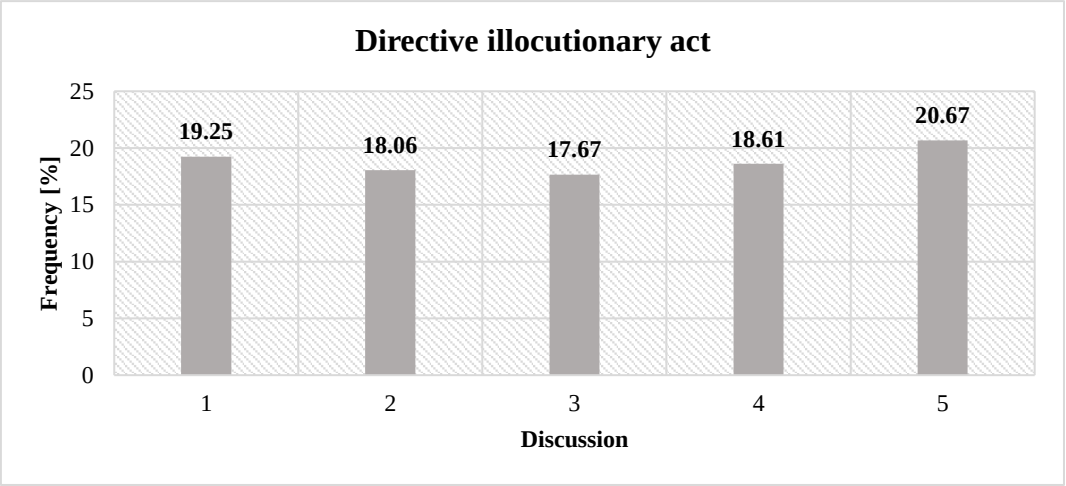

Figure 12: Directive illocutionary acts on the group level assessed in each discussion. Directive utterances were particularly frequent during sleep deprivation, i.e. D5, and in the beginning of isolation, i.e. D1.

Directive illocutionary act [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	28.13	34.04	23.08	28.17	28
Min	9.38	0	14.29	9.52	8.33

Table 17: Directive illocutionary acts on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

The most frequent values were [seeking information] and [order]. In D5, however, [activate resources] and [persisting] were common as well. Furthermore, even though D5 was the discussion which contained the highest proportion of directive utterances (20.67%), direct commands, labeled as [order], prevailed in D3 (6.51%) and were slightly less common in D1 (6.03%):

Values of directive illocutionary acts [%]										
	D1		**D2**		**D3**		**D4**		**D5**	
[order]	6.03		4.86		6.51		4.74		4	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	14.06	0	12.77	0	15.38	0	9.86	0	8.33	0
[seeking information]	5.46		5.56		10.23		7.3		8.67	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	8.7	3.8	11.54	0	14.29	0	11.27	0	16	3.45
[activate resources], [persisting]	N/A		N/A		N/A		N/A		4	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.33	0

Table 18: Values of directive illocutionary acts on the group level assessed in each discussion. Two values were particularly frequent within the utterances of the directive illocutionary act – [order] and [seeking information]. Only in D5 were further values also often used, i.e. [activate resources] and [persisting]. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

Thus, the frequency of directive IAs in the examined discussions fluctuated over the period of the "normal" isolation. In the discussions with the pre-planned stressors, the tendency to utter directive IAs was inconclusive as well.

Commissive illocutionary acts

The frequency of commissive utterances declined in the course of the isolation period under "normal" conditions. However, the frequency of commissive utterances in the discussions with

the additional demanding factors, i.e. D3 and D5, exhibited a non-consistent pattern. D3 contained the lowest proportion of commissive utterances when compared to all the discussions, while D5 was characterized by their increase in comparison to D4[119]:

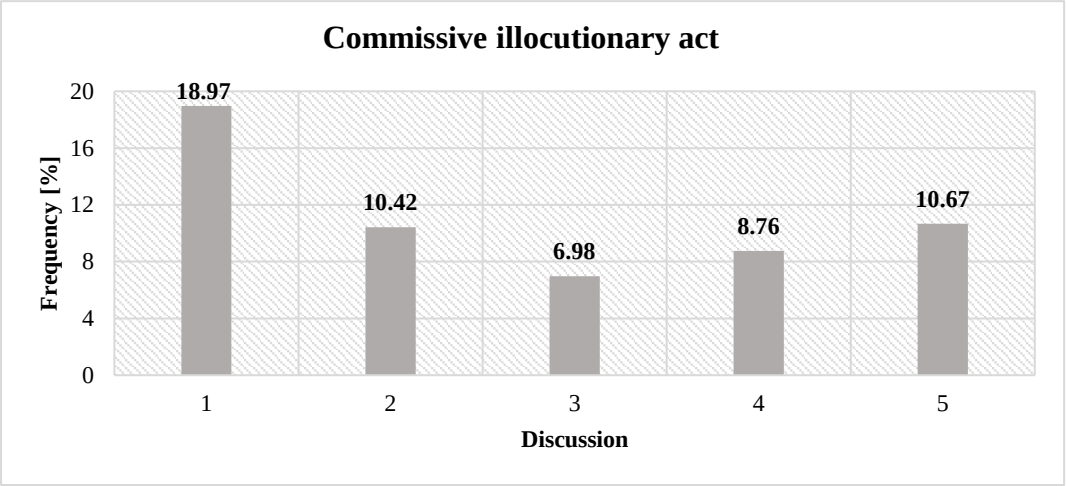

Figure 13: Commissive illocutionary acts on the group level assessed in each discussion. Commissive utterances were used most often in D1, while less so in D2 and in D5. Commissive utterances were uttered least frequently in D3.

Commissive illocutionary act [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	31.25	25	15.38	16.22	16.67
Min	13.04	6.38	3.28	6.25	4.17

Table 19: Commissive illocutionary acts on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

With respect to the singled-out values, [react] and [own opinion] were employed with the highest frequency. The other values, i.e. [agreeing] and [raising concerns], were common in D3 and D4:

[119] An alternative explanation for the findings for D5 concerns the significant number of utterances labeled as [activate resources] and other frequently applied directive IAs which required the crew to respond (cf. the subsection dedicated to the directive IAs above). The same was evident for D1. Nevertheless, the correlations between the *frequency* of commissive utterances and [activate resources] or the directive IAs were found not to be statistically significant. However, the correlation between the *number* of commissive IAs and [activate resources] was statistically significant (r_s = .92 p = .026 according to Spearman's correlation analysis); the correlation between the number of commissive utterances and the directive IAs were found not to be statistically significant (cf. Table 61 in Appendix).

Values of commissive illocutionary acts [%]										
	D1		**D2**		**D3**		**D4**		**D5**	
[own opinion]	7.47		3.47		5.58		2.55		3.33	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	10.17	2.17	5.26	0	7.69	3.28	5.45	0	6.9	0
[react]	4.31		5.56		NA		2.55		4.67	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	15.63	0	25	0	NA	NA	9.52	0	16.67	0
[agreeing]	N/A		N/A		1.4		2.55		N/A	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	N/A	N/A	N/A	N/A	7.69	0	8.11	0	N/A	N/A
[raising concerns]	N/A		N/A		N/A		0.73		N/A	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	N/A	N/A	N/A	N/A	N/A	N/A	2.7	0	N/A	N/A

Table 20: Values of commissive illocutionary acts on the group level assessed in each discussion. Two values, [own opinion] and [react], were uttered with highest frequency during the isolation experiment within the commissive IAs; however, in D3, [react] was less frequent than [agreeing]. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

In summary, the utterances of commissive IAs gradually declined under "normal" isolation conditions while the character of their occurrence was inconsistent in the discussions with the additional demanding requirements.

Expressive illocutionary acts

In D2, utterances that were labeled as expressive IAs were most frequent (19.44%), while the expressive utterances in D3, D4, and D5 gradually and continuously decreased in frequency:

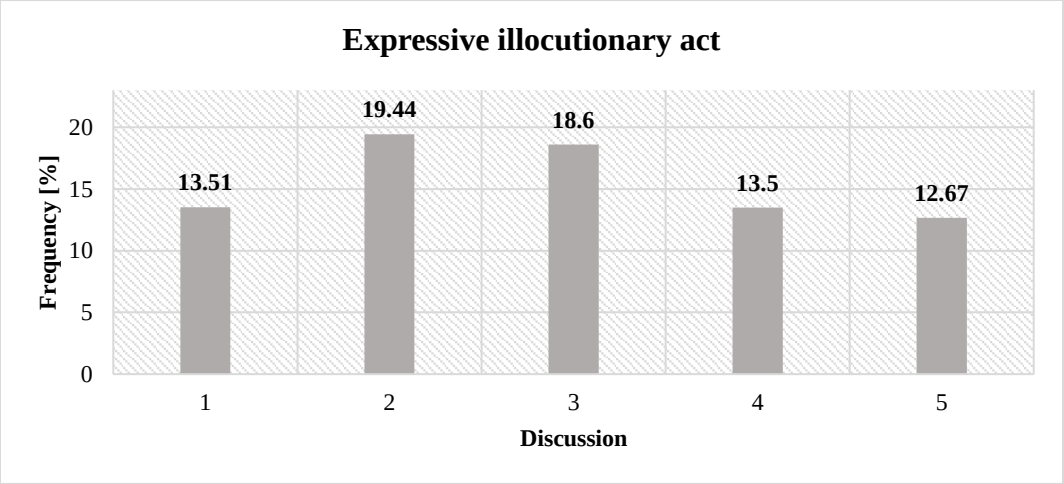

Figure 14: Expressive illocutionary acts on the group level assessed in each discussion. Expressive utterances constituted around one fifth of the utterances during D2 and D3, which was the highest proportion of expressive utterances throughout isolation.

Expressive illocutionary act [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	19.57	60	34.62	21.88	33.33
Min	8.86	0	4.88	4.76	0

Table 21: Expressive illocutionary acts on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

The pragmatic values [comment] and [- task-related] were both used quite regularly in all discussions. However, [- task-related] was more frequent in D2 while [comment] was most frequent in D1, D4, and D5:

Values of expressive illocutionary acts [%]										
	D1		**D2**		**D3**		**D4**		**D5**	
[comment]	10.06		7.64		9.3		9.12		8	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	14.6	6.33	35	0	12.5	0	16.36	0	16.67	0
[- task-related]	3.45		12.5		9.3		4.38		4.67	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
	6.52	0	26.32	2.13	23.08	0	12.05	0	16.67	0

Table 22: Values of expressive illocutionary acts on the group level assessed in each discussion. Both values of the expressive IA, i.e. [comment] and [-task-related], were uttered consistently in all discussions. Furthermore, they were used equally frequently in D3. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

In sum, expressive utterances were present in all discussions to a varying degree. They were found with a similar frequency in two discussions under "normal" isolation conditions (i.e. D1 and D4), but were by far more frequent in D2. The frequency of expressive utterances varied substantially in the discussions with the additional demanding conditions, i.e. D3 and D5.

8.3. Interpreting

The proportion of the crew's utterances dedicated to interpreting was more or less equal in the discussions throughout the entire period of isolation. D3 was the only discussion with a considerable negative dynamic in this respect. D3 was conducted in English and, thus, there was little need for interpretation among the English native subjects who would usually benefit from interpreting from Russian into English. Similarly, there was no need to interpret into Russian since the Russian-native subjects spoke "a simple English" that was understandable to everyone in the crew.

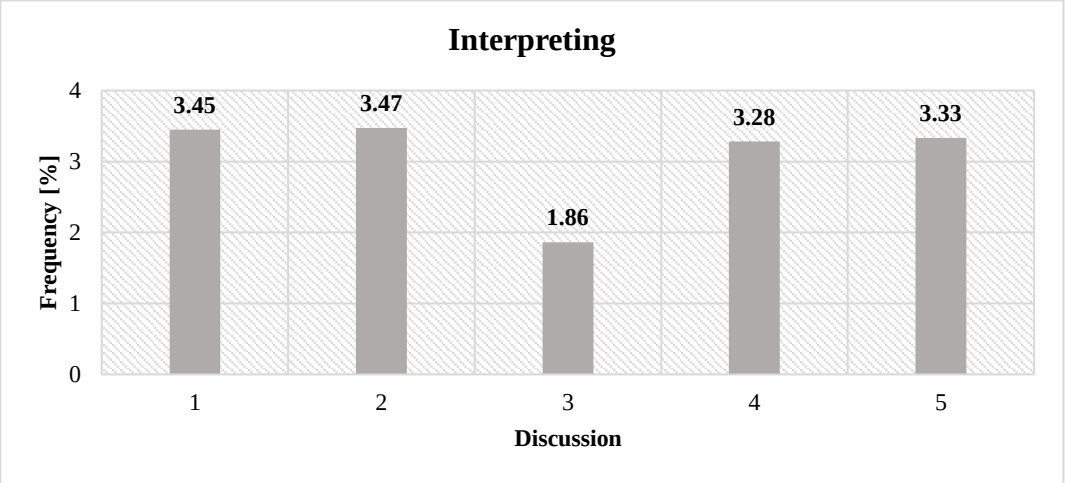

Figure 15: Interpreting on the group level assessed in each discussion. The voluntary task of interpreting was not broadly acknowledged in the crew. Thus, the proportion of the utterances dedicated to interpretation were quite stable and moderate. D3 indicated a substantial drop in such utterances, presumably due to the discussion requirement to speak English, which was an L2 for the majority of the crew.

Interpreting [%]					
	D1	**D2**	**D3**	**D4**	**D5**
Max	21.47	15.38	4.92	14.55	17.24
Min	0	0	0	0	0

Table 23: Interpreting on the group level assessed in each discussion. Minimum and maximum data points in each discussion are based on the data of the individual subjects.

Furthermore, it is worth mentioning that interpreting was seen as an essential duty by only a few subjects while others preferred to refrain from this activity (cf. Chapter 9).

8.4. Preliminary results: Content-oriented analysis on the group level

Based on the group-level analysis of the discussions, it may be concluded that the evolution of the majority of the categories was not linear under the conditions of "normal" isolation, i.e. D1, D2, and D4. This non-linearity applied to the following categories: the number of turns, the number of words, the number of initiated subordinate quaestiones, the density of parallel discussions, efficiency of communication, receptiveness, directive IAs, expressive IAs, and interpreting. Consequently, aside from the influence of time, which is a stressor that is intrinsic to any long-term isolation (see section 2.1.1.) and which was undoubtedly expected to affect the crew's communicative behavior, there must have been a further and unplanned stressor that led to the idiosyncratic evolution of the crew's communicative behavior.

By inferring that there was an additional, unforeseen, and unplanned stressor in the framework of the isolation experiment, one has to elaborate two further questions:

- At what point of the isolation experiment was this stressor initiated?
- What form did this unexpected and unplanned stressor take?

In answer to the first question, this demanding factor is posited as taking place during the time around D2. The period between the other two "normal" discussions, i.e. D1 and D4, which stretch across the entire four months of isolation, indicated a decrease in the perceived load by the crew. Hence, there are two specifications to the first question, namely:

- D2 was a discussion which contained the unforeseen and unplanned stressor;
- From a chronological perspective, as assessed through the two discussions under the "normal" isolation conditions, i.e. D1 and D4, the time in isolation was "beneficial" to the crew so that they perceived fewer strains in D4 than in D1.

In order to explicate the rationale behind these conclusions, the categories will be discussed first in which it is assumed that there was a decrease in the perceived load by the crew from a chronological perspective, i.e. from D1 to D4. Then, the categories will be considered which indicate an increase in the perceived load during D2. The table below offers an overview of the categories which justify the above-mentioned inferences:

Categories that indicate a decrease in perceived load under "normal" isolation conditions (D1 vs. D4)		**Categories that indicate a demanding factor in D2**	
Formal-linguistic categories			
	D1 vs. D4 dynamic		**D2 dynamic**
The number of words / turns	*decrease*	The number of words / turns	*minimum*
Efficiency of communication	*increase*	Efficiency of communication	*minimum*
Receptiveness	*decrease*	Receptiveness	*maximum*
Pragmatic categories			
	D1 vs. D4 dynamic		**D2 dynamic**
Types of subordinate quaestiones	*see below*	Types of subordinate quaestiones	*see below*
Representative IAs	*increase*	Expressive IAs	*maximum*

Table 24: Dynamics of categories and perceived load on the group level. The table outlines those formal-linguistic and pragmatic categories that denote a decrease in the perceived load under the "normal" isolation conditions, i.e. D1 to D4, and an increase in the perceived load during D2. The data interpretations are based on descriptive statistics.

In the following, these findings on the formal-linguistic (see section 8.1.) and pragmatic (see section 8.2.) categories will be compared with what is known about the effects of stress on humans' speech from previous studies (see section 3.4.). This will help to rationalize the suggested inferences.

As can be deduced from the information in Table 24, most of the categories indicate both a decrease in the perceived load within the period of isolation as well as its increase during D2. Hence, in the following, the dynamics of these categories will be discussed as indicative of either an increased or a decreased load.

With regard to the second question, the consideration of the form of the demanding factor in D2 will be addressed following the analysis of the perceived load by the crew from a chronological perspective and in D2 (see section 8.4.2.).

8.4.1. Interpretation of the data

<u>The number of words and turns</u>

A principle for evaluating the data from the category "Information Sharing" on the perceived load can be described as follows:

> […] crews communicated about twice to three times as much during abnormal flights segments as during routine flight segments […] (Sexton & Helmreich 2003: 62)

However, considering the two extremes of the present data (D1 being the lengthiest discussion and D5 being the shortest), D1 should thus be judged as an abnormal discussion and D5 as a normal one. Nonetheless, D5 was conducted during a period of sleep deprivation and therefore cannot be regarded as normal. Yet the study by Dietrich & Grommes (2003) reveals that increasing demands can also result in a shift in one's preferences between verbal and non-verbal information coding:

> The results show that under conditions of increased workload the balance between explicit linguistic coding of information and non-verbal communication is shifted in favour of the latter. (ibid.: 103)

Even though the frequency of non-verbal communication was not analyzed, the frequency of verbal communication was analyzed and showed a decline in D5. In fact, there is a general human predisposition to minimize communicative efforts whenever humans deem it possible:

> Humans tend to use as little energy as possible in achieving their (communicative) goals. If they can choose between elaborate and succinct utterances, they will generally opt for the latter. (Stolz et al. 2014: 53)

Therefore, while under "normal" isolation conditions the slight decrease in communication activity can be explained through a decrease in the perceived load, the abrupt reduction of active verbal exchange in D2, as well as in other situations with the extra designed stressors, must have been caused by some other factor(s). In the discussions with the planned (D3 and D5) and unplanned (D2) additional demanding conditions, the significant decrease in efforts to sustain active communication presumably reflected a re-direction in the crew's limited mental capacity towards resolving the additional demanding factors, i.e. L2, sleep deprivation, and the as yet unclarified stressor in D2.

Such a connection between communicative intensity and the degrees of perceived mental load can be compared with the Yerkes-Dodson law which was described in section 2.1. According to the Yerkes-Dodson law, there is an inverse U-shaped relationship between the degree of stress and performance, so that one's peak level of performance is achieved at the optimal degree of experienced stress; after surpassing the optimal degree of stress, performance starts gradually to decrease. Concerning the data at hand, D1 represents a discussion during which there was the "optimal level" of load. D1 was the lengthiest discussion both in terms of the number of words and the number of turns, while D2, D3, and D5 were the shortest discussions. Thus, it can be deduced that the crew experience of load by these points had surpassed the optimal level. On the other hand, D4 did not yet reach the optimal level and was shorter than D1, although it was longer than D2, D3, or D5 (cf. Zhabin (2009: 79), discussed in section 3.4.3., who suggested a similar interpretation of his data on the speech of defendants and victims in a trial court: their quantity of speech increased with the degree of experienced distress in comparison to a medium degree of distress, while in the state of the highest degree of stress there was a substantial decline in their quantity of speech)[120].

Efficiency of communication

The gradual increase in the proportion of information-shift utterances from D1 (61.36%) to D4 (64.26%), combined with the lowest proportion of information-shift utterances in D2 (56.92%), indicate that communication during the "normal" isolation conditions became less challenging over the entire period of isolation, but that D2 was identified by the crew as demanding (cf. the Yerkes-Dodson law discussed in section 2.1.).

> […] the capacity to organise coherent communication during phases of increasing task load gradually decreases. Under conditions of relatively low task load […] coherence emerges more frequently through quaestio-shift than it does through quaestio-maintenance. Under higher task

[120] The phenomenon called "psychological closing", which is studied in the realm of space psychology and psychiatry, can be further juxtaposed with the obtained data on the reduction of communication under stress. Psychological closing is defined as "a reduction in quantity and quality/richness of communication" (Landon 2022: 48) which is "problematic for crew-to-ground coordination, and is frustrating when trying to maintain relatedness with colleagues and family/friends on the ground. Psychological closing increases over time, particularly during communication delays" (ibid.; cf. also Gushin et al. 2012; Kanas & Manzey 2008: 105f.). The "classical" view on psychological closing is thus related to the *crew-to-ground* interactions, whereas the present research suggests that it should also be considered in *in-crew* interactions.

> load […] nearly no quaestio-shift takes place, but quaestio-maintenance still succeeds. (Dietrich & Grommes 2003: 120)[121]

Hence, the perception of the increased load must have imposed significant strains on the crew and, consequently, hampered them in conducting efficient and fruitful discussion during D2. Nevertheless, such an interpretation of the data stands in contradiction to the assumption that speaking an L2 (66.3%) or sleep deprivation (68.22%) would impose a greater load on the crew because D3 as well as D5 were discussions containing the highest percentage of information-shift utterances. Thus, the data in D3 and D5 can be explained by assuming that, in D5, the crew was trying to reduce unnecessary interactions in favor of a quicker resolution of the conversational goal, while the crew still experienced the environment as demanding. Therefore, the improvement on the "content-novelty side" of communication is judged to be a trade-off between the physical need for sleep and the need to participate in the discussion. Considering D3, the crew preferred to express only the most essential information in discussion, which was more likely to be new to the current discoursal stage; the majority of crew members was not native in English and were hence, presumably, not so confident (or, better to say, so *comfortable*) using it (see section 5.2.).

In summary, communication became less informative and less efficient only during the unexpected stressor, i.e. D2, while the efficiency of communication improved in the discussions with the pre-designed stressors as well as during the course of the period of isolation.

Receptiveness

According to Dietrich and Silberstein (2003: 31), receptiveness is systematically affected by the influence of workload and danger. For instance, speakers become more focused when they experience an increase in perceived workload (ibid.). A similar pattern was evident in the present study; the crew was slightly less receptive to L2 in D4 (9.28%) in comparison to D1 (11%). Furthermore, they were more actively engaged in speaking an L2 in all discussions with additional stressors, i.e. D2 (15.38%) and (to a lesser degree) D5 (10.38%)[122].

Subordinate quaestiones

Citing Bowers et al. (1997), Grote et al. (2003: 136; see also section 3.4.1.) state that the task of coordination by means of communication creates an additional task load. Consequently, the absolute predominance of coordinative quaestiones in D2 (100%) and D5 (100%) shows that these discussions were aggravated by the addition of further tasks. On the other hand, the other two subordinate quaestio types, "own opinion" and "side structure", denote that the subjects felt free to share their viewpoint openly on the main conversational goal as well as to address topics that were unrelated to the main conversational goal. Although, in comparison to the "own opinion" quaestiones, instances of the "side structure" quaestio can be regarded as inefficient patterns of communicative behavior in terms of time, their usage might manifest that the subjects experienced psychological security. Table 25 exemplifies one of these situations:

[121] Dietrich & Grommes (2003) operate with the terms "quaestio-shift" and "quaestio-maintenance", but in the present research, the terms "information-shift" and "information-maintenance" are used to distinguish them clearly from term "subordinate quaestio". Nevertheless, the terms "quaestio-shift" and "quaestio-maintenance" can be used interchangeably with the terms "information-shift" and "information-maintenance", respectively (see section 7.1.1. the category "Responsiveness").

[122] D3 was a discussion which was conducted in English, L2 for the majority of the crew. Thus, D3 ought to be excluded from the investigation of the influence of mental load on speech as assessed by means of the category "Receptiveness".

Turn	Speaker	Utterance	Pragmatic categories	Formal-linguistic categories
152	subject D	*No worries,* [R]	[comment]	new quaestio (side structure) information-shift
	subject F	*and, I mean, how should we evacuate the whole of India?* [R]	[comment]	
	subject D	*cleaning is tomorrow?* [R]		
153	subject H	*Uhu.*	[comment]	information-shift[123]
	subject F	*I don't understand.* [R]		

Table 25: An example of a "side structure" quaestio in Discussion 4. The brackets connect two parts of one utterance[124,125].

In this excerpt, subject D asks subject H whether they, as a crew, would need to do the cleaning on the next day. Subject D asks this because, while the crew members were eating snacks, a few crumbs fell on the kitchen table where the subjects were sitting.

Overall, even though D4 (75%) contained more coordinative quaestiones than D1 (52%), the greater proportion of "side structure" quaestiones in D4 (25% in D4 vs 16% in D1) indicates that the crew felt psychologically more secure and relaxed towards the end of isolation and experienced fewer challenges. Alternatively, one may infer that the crew was simply more bored than at the beginning of the isolation. This latter inference is upheld by the fact that there were a few instances of proactive opinion exchange by means of the "own opinion" quaestio in D1 (32%), but not in D4.

It is noteworthy that D3, the discussion which was conducted in English, also contained a high proportion of "side structure" quaestiones (36.36%) and few instances of the "own opinion" quaestio (9.09%). This was the only discussion with the additional demanding conditions that also entailed other subordinate quaestiones than "coordinative" ones[126].

Representative illocutionary acts

Utterances that were defined as adhering to the representative IA were used most frequently in D4 (55.84%). Hence, this denoted an efficient discussion because representative utterances can be associated with an implicit communication style which signals a harmonious interaction (see in section 3.4.1.):

> Supplying another team member with critical information without being requested to do so is generally considered as one important indicator for implicit coordination […] (Grote et al. 2003: 133)

In general, a steady increase in representative utterances throughout the period of isolation indicates that the teamwork became more harmonized (from 44.83% in D1 to 55.84% in D4). Only D5 (52.67%) revealed a slight negative trend with respect to the proportion of

[123] In the given context, the uttered "uhu" is to be interpreted as "yes". This interpretation is based on the larger context of the discussion.

[124] Utterances that were originally in Russian are marked as [R]. Translation of Russian utterances into English was carried out by V.A..

[125] To ensure anonymity of the subjects, they are coded by letters. In the subsequent analysis of the intra-individual and inter-individual levels, the coding is performed by means of digits.

[126] See Chapter 12 for the interpretation of the distribution of the types of the subordinate quaestiones in the discussions.

representative utterances. This can be explained by the fact that an attempt was made to reduce (pro)active participation in the conversation in order to balance out the tiredness experienced by the crew during the period of sleep deprivation.

Expressive illocutionary acts

As mentioned in section 3.4., discussions which are characterized by frequent usage of utterances that are not directly relevant to the main conversational goal or utterances that express humor constitute either the "easiest" or the most difficult conversations for the crew to take part in (cf. Yusupova et al. 2019; Silberstein & Dietrich 2003). D2 (19.44%) was a discussion which contained the highest proportion of emotionally charged speech. However, in contrast to D3 (18.6%), which also displayed a substantial amount of emotional speech, D2 contained a number of figurative expressions and remarks that seemed unpleasant to other crew members. On the other hand, emotional utterances in D3 can be holistically characterized as entertaining to the entire group:

Turn	Speaker	Utterance	Pragmatic categories	Formal-linguistic categories
21	subject S	*Do you know how the politicians vote?* [R]	[- task-related]	new quaestio (side structure) information-shift
22	subject U	*How?* [R]	[listening "actively"]	information-maintenance
	subject S	*There are these red cards* [R]		
23	subject K	*Uhu.*	[listening "actively"]	information-maintenance
	subject S	*with weight* [R]		
24	subject T	*Uhu.*	[listening "actively"]	information-maintenance
25	subject U	*With weight?* [R]	[listening "actively"]	information-maintenance
26	subject T	*So you wanna to vote that* [E]	[verifying]	information-shift
…				
28	subject K	*We should hand out dried apricots and plums* [R]	[- task-related]	information-shift
…				
	subject K	*and dried plumes are, like, against* [R]		
…				
30	subject L	*It's like in "The Last Hero"*[127], [R]	[- task-related]	information-shift
…				
	subject L	*where they had white and black* [R]		
32	subject K	*Yes, yes.* [R]	[- task-related]	information-maintenance

Table 26: Expressive utterances in the crew's speech as exemplified by Discussion 3. The brackets connect two or more parts of one utterance[128,129].

However, in D2 the instances that were labeled as [- task-related] were of a different kind. Here, expressive speech given by some of the crew members, who themselves were not actively engaged in this line of conversation, made some others feel uncomfortable. Along with the utterances with negative connotations, there were also a few examples of vulgar colloquialisms:

[127] A popular Russian TV show.

[128] Utterances given in Russian are indicated with [R], while utterances given in English are indicated with [E]. Translation of Russian utterances into English was done by V.A..

[129] To ensure anonymity of the subjects, they are coded by letters. In the subsequent analysis on the intra-individual and inter-individual levels, the coding is performed by means of digits.

Turn	Speaker	Utterance	Pragmatic categories	Formal-linguistic categories
	subject G	*these little planets are also not so good. But why Marianna Marianna? Well* [R]		
10	subject N	*Well, you like the name.* [R]	[- task-related]	information-maintenance
	subject G	[*who knows*][130] [R]	[- task-related]	
11	subject B	*There was a girlfriend, Marianna.* [R]	[- task-related]	information-shift

Table 27: Expressive utterances in the crew's speech as exemplified by Discussion 2. The bracket connects two parts of one utterance[131,132].

Such variation of emotionally charged speech was described by Silberstein & Dietrich (2003) as a consequence of different degrees of stress and workload (see section 3.4.1.). It may be inferred that the frequent occurrence of emotionally loaded speech patterns emerged due to increased demands that, however, are manifested differently (cf. Yusupova et al. (2019: 712) who state that "good humor" (ibid.) is particularly frequently used by astronauts during difficult situations on the basis that, following Plutchik (2003, cited in Yusupova et al. (2019: 712)), humor helps to positively reevaluate such situations and thereby reduce emotional stress).

In order to account for the demanding factor in D2 – which, as was just illustrated via the example of the expressive utterances, differs from that of D3 – the data on the sociometric tests will be referred to. In particular, attention falls on the sociometric data on the group structure; in the framework of the present analysis, these data are worthy of investigation because intergroup dynamics, e.g. conflicts, are often among the main stressors that exist among small groups and, especially, small groups under conditions of isolation (see section 2.1.1.). Moreover, the analysis of the group coherence will be referred to because it delivers data on the crew holistically, which, as mentioned previously (see Chapter 6), is consistent with the research interests of the linguistic analysis on the group level[133].

8.4.2. Validation

To summarize the arguments given in the previous section, D1 was assessed as more demanding than D4. Furthermore, due to the non-linear character of the evolution of a number of pragmatic and formal-linguistic categories, D2 was assessed as a discussion with an unexpected stressor. Given that D2 did not include any pre-designed demanding factor (such as, for instance, sleep deprivation) and since D2 did not differ from the other two "normal" discussions in isolation, i.e. D1 and D4, in terms of its methodology, the time and intergroup dynamics are estimated to be the most likely root causes which led to the perception of increased demand in D2 by the crew (cf. Anikushina et al. 2022). Therefore, sociometric research, which assesses the dynamics of the group structure over time, constitutes a suitable technique that simultaneously accounts for time and group dynamics in order to elucidate the nature of the stress-inducing D2.

According to the sociometric research (Gushin & Vinokhodova 2020), the crew became more cohesive and harmonized on the "work criterion" throughout the isolation period ('Situation 1' in Table 28).

[130] A synonymous expression in its colloquial form.
[131] Utterances given in Russian are indicated with [R], while utterances given in English are indicated with [E]. Translation of Russian utterances into English was done by V.A..
[132] To ensure anonymity of the subjects, they are coded by letters. In the subsequent analysis on the intra-individual and inter-individual levels, the coding is performed by means of digits.
[133] The sociometric tests were conducted by IBMP; the present study only refers to their findings.

	Before isolation	Check point 1	Check point 2	Check point 3	Check point 4	Check point 5	Check point 6	Check point 7
Discussions in an approx. timeline comparison to the sociometric surveys		**D1**	**D2**		**D3**		**D4**	**D5**
Situation 1	0.10	0.33	0.40	0.40	0.40	0.40	0.40	0.40
Situation 2	0.75	0.47	0.47	0.40	0.33	0.33	0.33	0.33

Table 28: Sociometric research - group cohesion before isolation and during isolation, i.e. check points 1 to 7[134]. "Situation 1" signifies a work-related criterion; "Situation 2" signifies a leisure-related criterion (see section 5.6.). According to the work-related criterion, the crew became more cohesive throughout the isolation time, whereas, following the leisure-related criterion, the crew cohesion decreased over time (Gushin & Vinokhodova 2020; see also Anikushina et al. 2022).

This finding agrees with the judgment that communication under "normal" isolation conditions became less demanding towards the end of the isolation period, i.e. from D1 to D4 (cf. Anikushina et al. 2022).

On the other hand, group cohesion assessed using the "leisure-related criterion" ('Situation 2' in Table 28; "the leisure-related criterion" is used synonymously to "the 'joint rest' criterion" in Anikushina et al. 2022) decreased from the value before isolation to the value at the beginning of isolation (from 0.75 to 0.47), as well as in the isolation itself beginning at checkpoint 3 (from 0.47 to 0.40 and 0.33). Whereas the first negative trend at checkpoint 3 can be explained by the fact that one crew member did not fill out the questionnaire, so that the sociometric data were not complete, the next negative shift at checkpoint 4 offers a full picture of the crew's cohesion, since the questionnaires were filled out by all crew members (according to personal communication with IBMP). Consequently, the negative trend that is perceived in the crew's cohesion using the "leisure-related criterion" must have already been evident between D2 and D3 (cf. Anikushina et al. 2022). Therefore, one can assume that the crew experienced some interpersonal tension around the time when D2 took place (cf. ibid.)[135].

Furthermore, the "deviant" nature of D2 is supported by the data on the vocal communicative aspects of the crew members (see Supolkina et al. (2021) in section 3.4.2.1.). Specifically, starting from the second month of isolation, a difference in the fundamental frequency of a speech signal between the morning and the evening was reported in all crew members; this finding was interpreted as a sign of increasing fatigue (Supolkina et al. 2021)[136]. The signs of emerging fatigue from the second month in isolation was also noted in Anikushina et al. (2022), where it was stated that the crew members, given their lack of psycho-emotional reserve, "decided" to remain functional and efficient as a crew (i.e. as evaluated using "the 'work' criterion") in lieu of nurturing interpersonal relationships (i.e. as evaluated using "the 'joint rest' criterion"). Hence, D2 was judged to fall during a critical period in isolation in terms of the interpersonal dynamics of the crew and commencing fatigue (ibid.).

[134] The data are provided by IBMP. This is a slightly modified adoption of the original table in Gushin & Vinokhodova (2020); one data point was corrected following personal communication with IBMP.

[135] Following an analysis by IBMP of the crew's physical activity, the most significant difference in the reduction of physical activity occurred during the second month of isolation for the majority of the crew members (Anikushina et al. 2022). The interrelation between the crew's communicative behavior (the present analysis), individual physical activity, duration of individual daily planning conferences with MCC, sociometric dynamics, and creativity of the crew is thoroughly explored in ibid.. The analysis of the subjects' physical activity, duration of the daily planning conferences with MCC, and sociometric research were conducted by IBMP; the analysis of the crew's creativity was conducted by the University of Muenster. The coefficient of sociometric cohesion displayed in Table 28 was calculated on a different equation than that in the paper (Anikushina et al. 2022); nevertheless, there were identical results and their interpretations (according to personal communication with IBMP).

[136] See Kanas & Manzey (2008: 190f.) for an overview of the voice analysis to monitor stress in astronauts and cosmonauts.

8.5. Content-oriented analysis on the group level: Discussion

To conclude the analysis of the crew's communication on the group level, one can firstly observe that, at the beginning of isolation, the crew had not yet acquired a functioning coping strategy concerning how to operate *as a team*. However, as isolation progressed, the crew developed strategies to conduct efficient teamwork; therefore, D1 was perceived by the crew as more demanding than D4, a result which was reflected in how the crew communicated during the decision-making tasks (cf. ibid.).

Second, considering the results of the sociometric test, D2 revealed the emergence of interpersonal tension within the crew (cf. ibid)[137]. Following the Belonginess hypothesis (Baumeister & Leary 1995, see section 2.1.1.), interpersonal conflicts are a source of stress. Therefore, D2 was a discussion with an additional, unforeseen, and unplanned stressor[138].

To sum up, the elaborated coding frame turned out to be effective in identifying variations in the degrees of experienced load on the group level. Having determined the discussions that caused additional strains for the crew, i.e. interpersonal tension (D2)[139], foreign language (D3), and sleep deprivation (D5), analyses of each of these on the intra-individual and inter-individual levels will next be carried out. In the following, the intra-individual linguistic analysis will provide an overview of the subjects' individual communicative strategies for coping with isolation as well as with the extra stressors imposed on them.

[137] It is assumed that this psycholinguistic analysis, along with the analysis of the crew's physical activity (number of steps) and duration of their daily communicational activity with MCC, can predict the development of sociometric dynamics (Anikushina et al. 2022). The psycholinguistic analysis and physical activity data indicated that the second month was critical to the crew's mental well-being (ibid.). Following the sociometric surveys, the interpersonal discord became evident between the second and third quarters in isolation (ibid.). The psycholinguistic data (as well as the data on physical activity and, to a lesser degree, the duration of daily conferences with MCC) can therefore be seen as a "tangible" gauge for measuring the underlying and imperceptible changes in the group structure (for more on this aspect, see ibid.).

[138] See section 2.1.1. for the notion of increasing interpersonal tensions in isolated environments as time progresses, as well as also Kanas & Manzey (2008: 7f., 34ff., 89f.).

[139] The term "interpersonal tension" implies only a very mild form of interpersonal disagreements. It does not suggest that there were any severe forms of disagreement among the crew members.

9. Content-oriented analysis: Intra-individual level

In this chapter, communication under the conditions of isolation will be analyzed with a focus given to the communicative behavior of individual subjects. The characteristics of the group discussions (see Chapter 8) will be considered. To assess how the crew members' communicative behavior changed *during the isolation time*, the proportion of each category (see section 7.1.3. for the evaluation approach of the categories) which is found in the speech of a subject at the start of the isolation (i.e. D1) will be compared with the proportion of the same category at the end of the isolation (i.e. D4). Thus, a subject's "communicative coping strategy" (cf. "the space crew communication as a form of behavioral manifestations of astronauts' coping strategies of dealing with problematic situations emerging during space flight" in Yusupova et al. (2019: 711) and discussed in section 3.4.2.1.) during the period of isolation will be analyzed by means of a simple calculation:

the proportion of a category in D4 – the proportion of the same category in D1[140]

To assess the subjects' communicative behavior in the discussions containing additional demands – D2, D3, and D5 – the proportion of a category will be compared with the average proportion of the same category in D1 and D4. The average proportion of a category in D1 and D4 denotes a quotient of a category in isolation under its "normal" conditions; D1 took place on the 17th day of isolation and D4 on the 101st day (cf. section 5.5.) so that the intervening period made up almost the entire period of isolation from beginning to end. This approach can be visualized by means of a simple calculation:

the proportion of a category in D2 – (the proportion of the same category in D1 + the proportion of the same category in D4)/2
the proportion of a category in D3 – (the proportion of the same category in D1 + the proportion of the same category in D4)/2
the proportion of a category in D5 – (the proportion of the same category in D1 + the proportion of the same category in D4)/2

When describing the subjects' communicative behavior in the discussions *with the additional stressors*, only those categories whose dynamic deviates from those under the "normal" isolation conditions will be explicitly mentioned. For example, if a subject produced fewer expressive utterances in D4 than in D1 (so that the decrease in the frequency of expressive utterances is considered his / her communicative coping strategy throughout the isolation) while there were more expressive utterances in D2, D3, and D5 than in D1 and D4 on average, then this category will be explicitly mentioned. Furthermore, a typical strategy of communicative behavior during the discussions with additional demands will be formulated. To do this, a prevailing character of the "evolution" of a category (increasing or decreasing) will be captured. For instance, if a subject uttered more words in D2 and D3 but fewer in D5 than in D1 and D4 on average, then the subject's prevailing strategy for coping with increased load *tends* to be reflected in the production of more words. The deviant characteristics, as a reflection of the specific stressor, will also be mentioned within the "typical" communicative behavior under increased demands. Hence, D5 would be characterized as "deviant" from the "typical"

[140] Cf. the subtraction method in neuroimaging during speech processing, as described in Dietrich & Gerwien (2017: 143).

communicative behavior under additional stressors in terms of the number of produced words in the above example. To answer the question whether individual communicative behavior interrelates with one's physiological response to demands (see section 2.2.), a nonparametric Spearman's rank correlational analysis will be performed. A correlation between a subject's median HR[141] and the proportion of individual categories[142] in each discussion will be calculated. In the conclusion of the intra-individual level analysis, statistically significant correlations, measured by means of the Spearman's correlation coefficient, will be further restricted using the Bonferroni correction method in order to control for type I error.

Hence, the communication analysis on the intra-individual level attempts to answer the following questions:

> Did the communicative behavior of individual subjects change across the entire isolation period under the "normal" isolation conditions and during the discussions with the additionally designed stressors? Does one's communicative behavior correlate with the character of his / her HR? How common were these individual types of communicative behavior among the subjects?

The communicative behavior of each subject will be analyzed separately based on the following sections:

- Section A provides an analysis of changes in a subject's communicative behavior as a response to the isolation period as it advances.
- Section B is dedicated to analyzing a subject's communicative behavior during the discussions with the additional demands.
- Section C focuses on the interrelation of one's physiological response to demands and his / her communicative behavior.

In the following, the intra-individual analysis will start with subject 1 and end with subject 6.

9.1. Subject 1

Section A

Analyzing the data obtained during the "normal" discussions (i.e. D1 and D4), it emerged that, by the end of the isolation period, subject 1 shared more information as well as did so more efficiently. The subject also engaged in more communicative behavior in the category "Responsiveness" but did so only partially in "Coherence" (with fewer parallel discussions but more initiated quaestiones by the end of the isolation)[143]. Furthermore, the subject became less willing to speak L2:

[141] The subjects' HR values were not normally distributed (cf. Tables 68–73 in Appendix).
[142] In this chapter, no distinction will be made between the terms 'category' and 'value' within the formal-linguistic categories (cf. section 7.1.3.).
[143] The decline in both (i.e. number of subordinate quaestiones and parallel discussions) signifies enhancement in the category "Coherence" (cf. section 7.1.1.).

Subject 1	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**[144]	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Information Sharing									
Number of words	11.30	22.71	11.41	12.63	- 4.37	31.64	14.64	21.35	4.35
Number of turns	14.89	21.10	6.21	20.00	2.01	27.07	9.08	20.00	2.01
Efficiency of communication									
Information-shift	63.04	68.00	4.96	69.23	3.71	73.47	7.95	61.54	- 3.98
Coherence									
Subordinate quaestiones	8.00	37.50	29.50	28.57	5.82	18.18	- 4.57	33.33	10.58
Parallel discussions	15.22	8.00	- 7.22	11.54	- 0.07	4.08	- 7.53	7.69	- 3.92
Receptiveness	43.48	30.00	- 13.48	28.85	- 7.89	N/A[145]	N/A	28.85	- 7.89
Responsiveness	72.00	100.00	28.00	100.00	14.00	90.91	4.91	100.00	14.00

Table 29: The evolution of the formal-linguistic categories produced by subject 1. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the formal-linguistic categories in the speech of subject 1 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

With respect to the characteristics of utterances grouped according to the IAs, only representatives were used with a higher frequency by the end of the isolation period:

Subject 1	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Representative IAs	30.43	49.09	18.66	46.15	6.39	57.38	17.61	44.83	5.06
Directive IAs	15.22	12.73	- 2.49	11.54	- 2.43	18.03	4.06	13.79	- 0.18
Commissive IAs	13.04	7.27	- 5.77	11.54	1.38	3.28	- 6.88	13.79	3.64
Expressive IAs	19.57	16.36	- 3.20	15.38	- 2.58	16.39	- 1.57	10.34	- 7.62
Interpreting	21.74	14.55	- 7.19	15.38	- 2.76	4.92	- 13.22	17.24	- 0.90

Table 30: The evolution of the pragmatic categories produced by subject 1. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the pragmatic categories in the speech of subject 1 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

[144] The quotation is to be read as follows: the proportion of a category in D2 minus the mean of the same category proportion in D1 and D4 (cf. the introduction to the present chapter for explanation of the methodology). A similar approach to the data analysis applies to D3 and D5.

[145] To ensure the anonymity of the subjects, which might be compromised when indicating the evolution of the category "Receptiveness" in D3 (because D3 was a discussion in an L2 for only some of the subjects), no overview will be given of this category in D3 for the subjects.

Section B

A similar communicative behavior as that described in section A was observed in the discussions with the additional demanding factors. However, commissive utterances tended to increase in D2 and D5 (cf. Table 29 and Table 30)[146].

Even though the communicative behavior of subject 1 remained fairly consistent after the increased load, each of these discussions demonstrated slightly deviant characteristics which are thought to be a response to the specifics of the respective demanding condition:

- In D2, subject 1 produced fewer words.
- In D3, subject 1 reduced the number of initiated quaestiones; furthermore, subject 1 uttered more directive and fewer commissive utterances.
- In D5, the subject's speech was less efficient with respect to the group problem-solving exercise, i.e. there were fewer instances of information-shift.

Section C

Based on the Spearman's correlation analysis, correlations were found between the subject's median HR and the frequency of expressive utterances ($r_s = .975$ $p = .005$), initiated subordinate quaestiones of type "coordination" ($r_s = -.973$ $p = .005$) and "side structure" ($r_s = .973$ $p = .005$) (see Table 74 and Table 75 in Appendix).

9.2. Subject 2

Section A

The subject's communicative behavior as the isolation period progressed is characterized by a decrease in active verbal participation, as well as in the categories "Receptiveness" and "Responsiveness". An increase was observed in the number of information-shift instances as well as an improvement on the category "Coherence":

[146] Only the dynamics of commissive IAs are mentioned explicitly because two out of three discussions under the increased demands (D2 and D5) indicated an opposite, i.e. increasing, dynamic compared to that under the "normal" isolation conditions, which showed a decreasing dynamic. However, there were other categories whose evolution was opposite to that under the "normal" isolation conditions, e.g. the frequency of information-shift utterances in D5. Nevertheless, in the latter case, two discussions with the additional demands, i.e. D2 and D3, exhibited the same dynamic as in the "normal" isolation period (i.e. an increasing tendency). Therefore, the prevailing character of the communicative behavior during the discussions with the additional stressors was the same as that under the "normal" isolation conditions for the category "Efficiency of communication".

Subject 2	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Information Sharing									
Number of words	19.11	8.73	- 10.38	11.98	- 1.94	27.05	13.13	8.56	- 5.35
Number of turns	19.42	14.35	- 5.07	13.08	- 3.80	19.89	3.01	17.69	0.81
Efficiency of communication									
Information-shift	55.00	67.65	12.65	76.47	15.15	69.44	8.12	63.64	2.31
Coherence									
Subordinate quaestiones	24	0	- 24.00	0	- 12.00	27.27	15.27	16.67	4.67
Parallel discussions	1.67	0	- 1.67	0	- 0.83	5.56	4.72	0	- 0.83
Receptiveness	6.67	2.94	- 3.73	20.59	15.78	N/A	N/A	4.35	- 0.46
Responsiveness	72.00	62.50	- 9.50	57.14	- 10.11	81.82	14.57	66.67	- 0.58

Table 31: The evolution of the formal-linguistic categories produced by subject 2. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the formal-linguistic categories in the speech of subject 2 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

Directive and expressive utterances along with the exercising of interpretation were categories that became more common by the end of the "normal" isolation period:

Subject 2	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Representative IAs	57.35	54.05	- 3.30	42.11	- 13.60	68.29	12.59	56.00	0.30
Directive IAs	10.29	13.51	3.22	5.26	- 6.64	17.07	5.17	28.00	16.10
Commissive IAs	17.65	16.22	- 1.43	10.53	- 6.41	7.32	- 9.61	8.00	- 8.93
Expressive IAs	13.24	13.51	0.28	36.84	23.47	4.88	- 8.50	8.00	- 5.37
Interpreting	1.47	2.70	1.23	5.26	3.18	2.44	0.35	-	- 2.09

Table 32: The evolution of the pragmatic categories produced by subject 2. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the pragmatic categories in the speech of subject 2 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

Section B

Quite different was the subject's communicative behavior during the unconventional isolation conditions: expressive utterances tended to decrease, as well as the category "Receptiveness" was ambiguous. The representative IAs, the number of turns and initiated quaestiones were apt to increase.

Some aspects of the subjects' communicative behavior deviated from the typical communicative patterns during the demanding conditions and were thus specific to the particular stressor, namely:

- In D2, subject 2 initiated fewer turns and subordinate quaestiones and additionally produced fewer representative and directive utterances, whereas more expressive speech acts.
- In D3, subject 2 was more verbose and engaged in more parallel discussions, and the subject's speech became more responsive.
- In D5, the subject interpreted less often.

Section C

There are positive correlations between the subject's HR and the value [providing feedback] as well as commissive utterances (r_s = .9 p = .037) (see Table 76 and Table 77 in Appendix).

9.3. Subject 3

Section A

As the isolation progressed, subject 3 shared more information, enhanced efficiency of the speech, and became more responsive:

Subject 3	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Information Sharing									
Number of words	22.72	24.82	2.11	23.68	- 0.09	12.21	- 11.56	43.79	20.02
Number of turns	21.68	24.05	2.37	33.08	10.21	14.92	- 7.95	30.00	7.13
Efficiency of communication									
Information-shift	55.22	59.65	4.43	48.84	- 8.60	59.26	1.82	69.23	11.79
Coherence									
Subordinate quaestiones	36.00	50.00	14.00	57.14	14.14	9.09	- 33.91	50.00	7.00
Parallel discussions	0	0	0	0	0	3.70	3.70	0	0
Receptiveness	2.99	2.63	- 0.35	19.77	16.96	N/A	N/A	2.56	- 0.24
Responsiveness	72.00	87.50	15.50	85.71	5.96	90.91	11.16	83.33	3.58

Table 33: The evolution of the formal-linguistic categories produced by subject 3. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the formal-linguistic categories in the speech of subject 3 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

On the other hand, subject 3 was less attentive to L2 as well as less willing to express their personal opinion on the conversational goal (i.e. by means of commissive utterances) or interpret for others:

Subject 3	[%]								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Representative IAs	43.04	53.52	10.48	57.45	9.17	43.75	- 4.53	47.92	- 0.36
Directive IAs	27.85	28.17	0.32	34.04	6.03	18.75	- 9.26	27.08	- 0.93
Commissive IAs	18.99	7.04	- 11.95	6.38	- 6.63	9.38	- 3.64	10.42	- 2.60
Expressive IAs	8.86	11.27	2.41	2.13	- 7.94	28.13	18.06	14.58	4.52
Interpreting	1.27	0	- 1.27	0	- 0.63	0	- 0.63	0	- 0.63

Table 34: The evolution of the pragmatic categories produced by subject 3. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the pragmatic categories in the speech of subject 3 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

Section B

In the course of the discussions with the additional stressors, the speech of subject 3 tended to contain fewer directive and representative IAs and their utterances tended to be less verbose in character. From this general review on the subject's speech during the demanding discussions, there are variations within each of the discussions, namely:

- In D2, the speech of subject 3 included more representative and directive IAs but fewer expressive IAs. Their speech was also less efficient.
- In D3, subject 3 spoke less frequently, in terms of the number of turns, and the number of self-initiated quaestiones was reduced. Nevertheless, the subject participated in a few parallel discussions, which was not evident in the subject's behavior in any other discussion.
- During the phase of sleep deprivation, the utterances were verbose.

Section C

No statistically significant correlations were found between the subject's dynamics of cardiovascular reactivity and their communicative behavior measured by means of the established categories (see Table 78 and Table 79 in Appendix).

9.4. Subject 4

Section A

The communicative behavior of subject 4 is characterized by a decrease in the majority of the analyzed categories: "Sharing information" (both the number of words and the number of turns) "Receptiveness", and "Responsiveness". The coherence of the subject's speech changed ambiguously: while the subject initiated fewer quaestiones, the subject took part in more parallel discussions:

Subject 4	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Information Sharing									
Number of words	21.49	15.77	- 5.71	13.56	- 5.07	4.49	- 14.14	7.72	- 10.91
Number of turns	17.15	10.97	- 6.18	14.62	0.55	7.18	- 6.88	8.46	- 5.60
Efficiency of communication									
Information-shift	55.77	60.00	4.23	36.84	- 21.04	46.15	- 11.73	72.73	14.84
Coherence									
Subordinate quaestiones	24.00	0	- 24.00	0	- 12.00	9.09	- 2.91	0	- 12.00
Parallel discussions	1.89	7.69	5.81	0	- 4.79	0	- 4.79	18.18	13.39
Receptiveness	1.89	0	- 1.89	2.63	1.69	N/A	N/A	0	- 0.94
Responsiveness	76.00	75.00	- 1.00	71.43	- 4.07	63.64	- 11.86	50.00	- 25.50

Table 35: The evolution of the formal-linguistic categories produced by subject 4. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the formal-linguistic categories in the speech of subject 4 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

According to the analysis of the pragmatic categories, subject 4 was less likely to direct others or express their own opinion on the conversational goal. The speech of subject 4 also included more representative and expressive utterances as the isolation progressed:

Subject 4	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Representative IAs	39.06	56.25	17.19	30.00	- 17.66	53.85	6.19	41.67	- 5.99
Directive IAs	28.13	15.63	- 12.50	0	- 21.88	15.38	- 6.49	8.33	- 13.54
Commissive IAs	15.63	6.25	- 9.38	10.00	- 0.94	15.38	4.45	16.67	5.73
Expressive IAs	17.19	21.88	4.69	60.00	40.47	15.38	- 4.15	33.33	13.80
Interpreting	0	0	0	0	0	0	0	0	0

Table 36: The evolution of the pragmatic categories produced by subject 4. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the pragmatic categories in the speech of subject 4 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

Section B

In the discussions with increased load, there was a tendency towards a negative shift in the frequency of information-shift utterances and participation in parallel discussions. Considering the pragmatic categories, there was a tendency to reduced frequency of representatives and increased frequency of commissives.

In the discussions with the additional demanding conditions, some patterns of incongruity from the communicative strategies mentioned above could be detected:

- In D2, subject 4 would produce more turns but fewer commissive utterances.

- In D3, the frequency of utterances specified as adhering to the representative IA increased, whereas utterances categorized as expressive decreased.
- In D5, the frequency of information-shift utterances as well as engagement in parallel discussions increased.

Section C

Two positive correlations were statistically significant: that between the subject's median HR and directive utterances (r_s = .9 p = .037) and the category "Responsiveness" (r_s = .9 p = .037). One negative correlation was found: the median HR and the turns labeled as [- task-related] (r_s = - .9 p = .037) (see Table 80 and Table 81 in Appendix).

9.5. Subject 5

Section A

By the end of isolation, subject 5 was less verbally active in the group discussions (both in terms of the number of words and the number of turns). This decline was also evident in the proportion of L2 turns in the subject's speech. On the other hand, the subject's speech became more coherent, efficient, and the communicative behavior became more responsive:

Subject 5	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Information Sharing									
Number of words	9.55	6.94	- 2.62	15.04	6.80	13.96	5.72	3.74	- 4.51
Number of turns	9.71	8.44	- 1.27	6.15	- 2.92	19.89	10.82	7.69	- 1.38
Efficiency of communication									
Information-shift	73.33	75.00	1.67	100.00	25.83	50.00	- 24.17	70.00	- 4.17
Coherence									
Subordinate quaestiones	0	0	0	0	0	0	0	0	0
Parallel discussions	26.67	15.00	- 11.67	25.00	4.17	2.78	- 18.06	10.00	- 10.83
Receptiveness	23.33	22.50	- 0.83	0	- 22.92	N/A	N/A	40.00	17.08
Responsiveness	40.00	75.00	35.00	42.86	- 14.64	90.91	33.41	50.00	- 7.50

Table 37: The evolution of the formal-linguistic categories produced by subject 5. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the formal-linguistic categories in the speech of subject 5 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

With respect to the IAs, the subject's speech included more representative and directive utterances, but fewer commissive and expressive utterances by the end of isolation. Notably, the subject did not offer interpretation throughout the entire isolation period and did not initiate subordinate quaestiones.

Subject 5	[%]								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Representative IAs	46.88	76.19	29.32	33.33	- 28.20	57.14	- 4.39	75.00	13.47
Directive IAs	9.38	9.52	0.15	33.33	23.88	14.29	4.84	8.33	- 1.12
Commissive IAs	31.25	9.52	- 21.73	25.00	4.61	9.52	- 10.86	16.67	- 3.72
Expressive IAs	12.50	4.76	- 7.74	8.33	- 0.30	19.05	10.42	0	- 8.63
Interpreting	0	0	0	0	0	0	0	0	0

Table 38: The evolution of the pragmatic categories produced by subject 5. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the pragmatic categories in the speech of subject 5 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

Section B

During the discussions with increased load, the subject's speech tended to contain more words, but it tended to be less efficient and responsive. In comparison to the "normal" isolation conditions, the subject's speech tended to include fewer representative utterances. Nevertheless, some exceptions to these generalized behavioral patterns under the demanding conditions can be noted:

- In D2, the subject's speech was more efficient and included more commissive utterances. On the other hand, the subject was more eager to take part in parallel discussions.
- In the course of D3, subject 5 spoke up more often, i.e. in terms of the number of turns, and more expressively and was more responsive to new quaestiones.
- When deprived of sleep, the number of produced words declined. Moreover, the subject's utterances were more often characterized as representative and less as directive.

Section C

According to Spearman's correlation analysis, the subject's median HR was negatively correlated with [acknowledging linguistic dominance] (r_s = - .894 p = .041) and [verifying] (r_s = - .9 p = .037) utterances (see Table 82 and Table 83 in Appendix).

9.6. Subject 6

Section A

More active information exchange and enhancement in the category "Responsiveness" characterized the subject's communicative behavior by the end of the "normal" isolation conditions. Furthermore, the subject's communication became less efficient and coherent:

Subject 6	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Information Sharing									
Number of words	15.84	21.03	5.19	23.12	4.69	10.64	- 7.79	14.84	- 3.60
Number of turns	17.15	21.10	3.94	13.08	- 6.05	11.05	- 8.07	16.15	- 2.97
Efficiency of communication									
Information-shift	73.58	61.22	- 12.36	41.18	- 26.23	95.00	27.60	76.19	8.79
Coherence									
Subordinate quaestiones	8.00	12.50	4.50	14.29	4.04	36.36	26.11	0	- 10.25
Parallel discussions	0	2.00	2.00	0	- 1.00	5.00	4.00	4.76	3.76
Receptiveness	0	0	0	0	0	N/A	N/A	0	0
Responsiveness	72.00	100.00	28.00	85.71	- 0.29	90.91	4.91	66.67	- 19.33

Table 39: The evolution of the formal-linguistic categories produced by subject 6. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the formal-linguistic categories in the speech of subject 6 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

Considering the pragmatic categories, isolation led to more representative, directive, and expressive as well as fewer commissive utterances. The subject also refrained from performing interpreting during the entire isolation period.

Subject 6	**[%]**								
	D1	**D4**	**D4-D1**	**D2**	**D2-(D1+D4)/2**	**D3**	**D3-(D1+D4)/2**	**D5**	**D5-(D1+D4)/2**
Representative IAs	49.15	58.62	9.47	60.00	6.11	38.46	- 15.43	62.50	8.61
Directive IAs	16.95	20.69	3.74	10.00	- 8.82	23.08	4.26	20.83	2.01
Commissive IAs	22.03	8.62	- 13.41	10.00	- 5.33	3.85	- 11.48	4.17	- 11.16
Expressive IAs	11.86	12.07	0.20	20.00	8.03	34.62	22.65	12.50	0.53
Interpreting	0	0	0	0	0	0	0	0	0

Table 40: The evolution of the pragmatic categories produced by subject 6. The table outlines the proportions (in the white cells) and the dynamics (in the grey cells) of the pragmatic categories in the speech of subject 6 in all five analyzed discussions. The data in the grey cells signify the difference in the expression of a category between the compared discussions: (i) the proportion of a category in D4 vs. D1, which indicates the influence of isolation progression as a stressor on the subject's communicative behavior; (ii) the proportion of a category in a discussion with an additional stressor (i.e. D2, D3, or D5) vs. the mean proportion of this category in the discussions without additional stressors (i.e. D1 and D4), which indicates the influence of the additional stressor on the subject's communicative behavior.

Section B

In the discussions with the additional stressors, the communicative behavior of subject 6 can be described as typically less active (both regarding the number of words and the number of turns) and less responsive, but as more efficient. No deviating tendencies in the dynamic changes expressed through the pragmatic categories were found in the discussions with increased load, compared to those under the "normal" isolation conditions.

Analyzing each discussion with the extra stressors individually, the following inconsistencies with regard to the "emblematic" communicative behavior during the "stressful" discussions can be mentioned:

- In D2, subject 6 produced more words and took part in fewer parallel discussions. Nevertheless, the speech was often less efficient. Moreover, directive utterances were used with the lowest frequency.
- In D3, the subject's communicative behavior was more responsive and contained fewer representative utterances.
- In D5, subject 6 did not initiate subordinate quaestiones.

Section C

Two negative correlations between the subject's median HR and individual categories were found to be statistically significant, namely expressive utterances (r_s = - .9 p = .037) and utterances labeled as [- task-related] (r_s = - .9 p = .037). One positive correlation was found to be statistically significant: median HR and commissive utterances (r_s = .9 p = .037) (see Table 84 and Table 85 in Appendix).

9.7. Content-oriented analysis on the intra-individual level: Discussion

Having outlined the dynamics of the subjects' individual communicative behavior, the first question which was raised in the content-oriented analysis on the intra-individual level can now be approached, namely:

> Did the communicative behavior of individual subjects change across the entire isolation period under the "normal" isolation conditions and during the discussions with the additionally designed stressors?

Taking a closer look at the design of the study, it is clear that there are four possible kinds of variation in the evolutions of the categories:

A. An evolution of a category is *consistently* increasing / decreasing both in response (i) to the isolation progression (i.e. D4 vs. D1) and in response (ii) to the additional stressors, when compared to the average proportion of this category in the discussions without extra stressors (i.e. D2, D3, or D5 vs. the mean of D1 and D4, respectively).
B. An evolution of a category is *consistently* increasing / decreasing in all discussions with additional demands when compared to the average proportion of this category in the discussions without extra stressors (i.e. D2, D3, or D5 vs. the mean of D1 and D4, respectively) and indicates the opposite dynamic character in the "normal" discussions (i.e. D4 vs. D1).
C. An evolution of a category *tends* to be increasing / decreasing during the discussions with the additional demands when compared to the average proportion of this category in the discussions without extra stressors (i.e. D2, D3, or D5 vs. the mean of D1 and D4, respectively) and indicates the opposite dynamic character in the "normal" discussions (i.e. D4 vs. D1).
D. An evolution of a category *tends* to be increasing / decreasing during the discussions with the additional demands when compared to the average proportion of this category in the discussions without extra stressors (i.e. D2, D3, or D5 vs. the mean of D1 and D4, respectively) and indicates the same dynamic character in the "normal" discussions (i.e. D4 vs. D1).

Among these four possibilities, the former two are of interest for the present purposes because they show sustainable variation in the crew-members' communicative behavior within either

the entire isolation period (A) or when they were exposed to the additional stressors (B). Hence, focus will be given to these two types of variation in the evolution of the categories.

The subjects differed in terms of how frequently the two types of variation in the evolution of the categories were evident in their speech as well as with respect to what category. The table below summarizes the findings:

	Subject 1	**Subject 2**	**Subject 3**	**Subject 4**	**Subject 5**	**Subject 6**
Formal-linguistic categories						
Sharing information						
Number of words				always decreasing		
Number of turns	always increasing					always decreasing in discussions with extra demands
Efficiency of communication and Coherence						
Information-shift turns		always increasing				
Subordinate quaestiones				always decreasing		
Parallel discussions	always decreasing					
Receptiveness[147]						
	always decreasing					
Responsiveness						
	always increasing		always increasing	always decreasing		
Pragmatic categories						
Representative illocutionary acts	always increasing					
Directive illocutionary acts				always decreasing		
Commissive illocutionary acts		always decreasing	always decreasing			always decreasing
Expressive illocutionary acts	always decreasing					always increasing
Interpreting						
	always decreasing		always decreasing			

Table 41: Evolutions of the categories in the subjects' communicative behavior in response to stressors. The values "always increasing / decreasing" means that the proportions of a category consistently increased / decreased throughout all discussions in the speech of a subject (e.g. subject 2 produced fewer commissive utterances both in response to (i) the isolation progression (i.e. D4 vs. D1) and (ii) the additional stressors in comparison to the average

[147] The assessment is based on the four discussions, i.e. D1, D2, D4, and D5.

proportion of the commissive utterances in the "normal" discussions (e.g. D2-(D1+D4)/2), see Table 32). This corresponds with variation A, which was discussed above. The value "always negative in discussions with extra demands" means that an evolution of a category is consistently decreasing throughout all discussions with additional demands, but indicates the opposite dynamic character in the "normal" discussions (i.e. subject 6 produced (i) *more* turns when analyzing the influence of the isolation progression (i.e. D4 vs. D1) and (ii) *fewer* turns when analyzing the influence of each additional stressor in comparison to the average proportion of turns in the "normal" discussions, respectively (i.e. D2-(D1+D4)/2; D3-(D1+D4)/2; D5-(D1+D4)/2, see Table 39). This corresponds with variation B which was discussed above. An empty cell indicates that there was no pattern of a consistent evolution of a category according to variations A or B within a subject in the respective category. The assessment of an evolution of a category made by means of descriptive statistics.

As can be seen in Table 41, variation A in the subjects' communicative behavior, either an increasing or the decreasing evolution of a category, was observed in all categories, i.e. both when one considers communication under the "normal" isolation conditions and in discussions with the additional demands. Furthermore, all subjects, except for subject 5, consistently signaled a communicative behavior in at least two categories according to variation A.

As to the specific expression of communicative behavior in the discussions with the additional demands according to variation B, only subject 6 consistently produced fewer turns, which was the opposite dynamic to the subject's communicative behavior during the "normal" isolation conditions. Therefore, the pattern to reduce active participation in the group discussions, as assessed through a number of turns, can be seen as the subject's general strategy to adapt to the demanding discussions.

A further question which needs to be answered in the intra-individual content-oriented analysis is the following:

> How common were these individual types of communicative behavior among the subjects?

Table 42 below reflects the cross-subject frequency with which the analyzed categories indicate either an increasing or a decreasing evolution in the crew members' communicative behavior throughout all stressors in isolation (i.e. the variation type "A"):

Category	**[number of subjects compared to the total]**	
	Always decreasing	**Always increasing**
Number of words	1/6	
Number of turns		1/6
Information-shift		1/6
Subordinate quaestiones	1/6	
Parallel discussions	1/6	
Receptiveness	1/6	
Responsiveness	1/6	2/6
Representative illocutionary acts		1/6
Directive illocutionary acts	1/6	
Commissive illocutionary acts	3/6	
Expressive illocutionary acts	1/6	1/6
Interpreting	2/6	

Table 42: Cross-subject frequency with which categories increased or decreased throughout isolation. Half of the subjects (i.e. 3 out of 6) produced fewer commissive utterances throughout all stressors, i.e. both when analyzing (i) the influence of the isolation progression (i.e. D4 vs. D1) and (ii) the influence of each additional stressor in comparison to the average proportion of the respective category in the "normal" discussions (e.g. D2-(D1+D4)/2). Other categories varied to a greater extent considering the dynamic character of their evolutions (i.e. increasing or decreasing) in response to the stressors in isolation.

According to the obtained data, utterances that were characterized as belonging to commissive IAs displayed a decreasing character in three out of six subjects; this meant that the subjects were inclined to withhold expressing their point of view on the conversational goal when under

stress[148]. This was the most common pattern in the subjects' communicative behavior in coping with the isolation as it progressed as well as the additional stressors, such as interpersonal tension, L2, and sleep deprivation. Therefore, the assumption regarding the existence of common intra-individual patterns in communicative behavior as a response to distress can be seen as valid.

To sum up, the study revealed that the conversion of the subjects' communicative behavior, according to the established categories, tended to be more profound when expressed in response to isolation as such (throughout all discussions) rather than to the specific additional demands within isolation. Therefore, the conditions of long-term confinement can be assumed to exercise greater influence on the subjects' communicative behavior than individual additional stressors, i.e. interpersonal tension, L2, and sleep deprivation. Furthermore, it can be assumed that the communicative behaviors, which were evident in the subjects' speech as the "normal" isolation progressed, were amplified to cope higher demands and increased load during the discussions with the additional stressors (cf. Satir's theory on the manifestation of humans' typical communicative reactions under stress mentioned in Yusupova et al. (2019), see section 3.4.2.1.). This accords with the finding in Yusupova et al. (2019) that "[i]n problematic situations in flight, the astronauts who cope with the mission program fulfillment successfully are characterized by *an increase* of statements that contain manifestations of coping strategies" (ibid.: 716, italics are not in the original text)[149].

The last question in the intra-individual analysis, which is concerned with the possible correlation between formal-linguistic and pragmatic categories and the degree of physiological arousal, measured through cardiovascular reactivity, can now be addressed:

Does one's communicative behavior correlate with the character of his / her HR?

In total, there were thirteen statistically significant correlations found in the speech of five subjects and their respective median HR values. Among them, three correlations – expressive utterances and subordinate quaestiones of types "coordination" and "side structure", all of which belonged to the speech of subject 1 – were statistically significant at $p < .01$ according to Spearman's rank correlation coefficient.

Typically, each category was found to be statistically significant in one subject; in other words, the same category usually did not correlate with median HR in other crew members. However, there were several exceptions:

- The first exception is the correlation of expressive utterances with the median HR which was found to be statistically significant in subject 1 and subject 6.
- The second exception is the correlation of commissive utterances with the median HR in subject 2 and subject 6.
- The third exception is the correlation of utterances labeled as [- task-related] with the median HR in subject 4 and subject 6.

Applying the Bonferroni correction to all 179 *p* values available in the data set[150], the adjusted *p* is .000279. Hence, none of the previous statistically significant correlations remains

[148] Cf. the similar finding in Yusupova et al. (2019) that "the desire to refer the responsibility for the problem" (ibid.: 712) is evident in a final phase of a spaceflight that is especially difficult for the crew (ibid.).

[149] See also Yusupova et al. (2019), who refer to "the manifestation of the typical style of communicative reactions when a person is under stress, due to significant increase in the workload and responsibility" (ibid.: 715) as well as the "actualization of […] ways of responding to stress" (ibid.).

[150] Nineteen *p*-values were eliminated from the analysis since the frequency of their respective categories equaled 0%.

statistically significant at the adjusted *p* with a 5% probability of error. On the other hand, such a strict alpha threshold can be considered exaggerated in a study on unconstrained language:

> Obviously, statistical validation of observed patterns is highly desirable and provides substantial support for the linguistic analysis results whenever it can be achieved. It should be recognized, however, that this is notoriously hard to obtain based on unconstrained language data, and statistical significance is not the only valid evidence of cognitive phenomena […] Showing that phenomena exist (maybe systematically under distinct circumstances) can be a decisive step forward in the understanding of the human mind. Case studies and the identification of qualitative patterns can therefore be regarded as inspiring explorative insights, leading towards more controlled study designs that can shed further light on the observed phenomena. (Tenbrink 2015: 121)

Thus, statistically significant correlations on the linguistic data provide notable results even without applying the Bonferroni correction. The defined correlations can be scrutinized in future studies with a "less naturalistic" and more controlled design.

Some limitations have to be addressed when reporting the results of the present study. Firstly, the analysis was restricted to only one physiological metric – HR median. Consequently, this limits the analysis based on the dynamics of the defined communicative categories and their interplay with the fluctuating physiological parameter. To partially resolve this, boxplots of the HR metrics for each subject are provided for each discussion in the Appendix (Figures 19 – 24). Secondly (and similarly), the correlation analysis only considered the proportion of the respective category; thus, it was not possible to analyse a dynamic character of the categories within the discussions. Acknowledging this, in the analysis of the context-sensitive use of language, attention will be explicitly directed towards the above-mentioned relation of the cardiovascular reactivity and linguistic data (see Chapter 11).

In the following, the content-oriented analysis will be continued. Having shed light on the individual variation in the communicative behavior in isolation, they will now be compared. The inter-individual analysis of the communicative behavior will conclude the empirical part which is based on the analysis of the content of the subjects' speech.

10. Content-oriented analysis: Inter-individual level

The following and final content-oriented analysis of the subjects' communication in isolation will aim at a comparison of their communicative behavior. The following questions will be addressed:

> Were there any similarities in the patterns of communicative behavior among the subjects? Can such similarities in the patterns of communicative behavior be considered a consequence of sympathy and affinity between the crew members?

To answer these questions, the formal-linguistic and pragmatic categories will be reviewed individually. When interpreting the data on the pragmatic categories, four values (i.e. subcategories which are marked with square brackets following Silberstein and Dietrich (2003), see section 7.1.) will be singled out as representing the evolutions of all instances of pragmatic categories in a discussion in each subject: two values with the highest positive (i.e. increasing) and two values with the highest negative (i.e. decreasing) difference. Should there be more than two values whose differences are equally high or low, all of them will be considered in the evaluation.

Following the previous content-oriented analysis on the intra-individual level, an evolution of a category / value will either reflect *the progression of time in isolation as a stressor* during the "normal" isolation conditions (the equation 'D4 – D1' is used for these purposes) or *the extra demands in the discussions associated with additional stressors*, i.e. interpersonal tension, speaking an L2, and sleep deprivation. For instance, for D2, the equation 'D2 – (D1+D4)/2' is used for these purposes (cf. section 9 for the explanation of how an evolution of a category / value is calculated). By comparing the intra-individual dynamics of evolutions of the categories / values – the dynamics are either increasing or decreasing – among the subjects, this approach will allow to answer the first question raised in the present chapter, namely:

> Were there any similarities in the patterns of communicative behavior among the subjects?

Should such similarities be found in the evolution of the subjects' communicative behavior, they will be explicated through the sociometric data, and especially through the data on the mutual preferences associated with work-related and leisure-related situations (see section 5.6.). For example, it is expected that, if some crew member is amicable, this will be reflected in the communicative behavior of the subject who feels an affinity towards this crew member; this assumption provides grounds for the concept "linguistic mimicry" (see section 2.1.1). This approach will allow to answer the second question raised in the present chapter, namely:

> Can such similarities in the patterns of communicative behavior be considered a consequence of sympathy and affinity between the crew members?

In the following, the inter-individual analysis will begin from an examination of the discussions during the "normal" isolation conditions; in this way, the isolation progression as a stressor will be brought into focus. Then, an overview of the discussions with the additional demands will be given. Subjects who exhibited a higher degree of similarity in their communicative behavior

based on the defined formal-linguistic categories will be considered prior to those subjects whose degree of similarity was less notable. The degree of similarity will be calculated as a percentage; for instance, if all seven formal-linguistic categories / values indicate an identical character of the evolution of the categories / values in the analyzed subject dyad (e.g. if the number of turns, number of words, Receptiveness, and Responsiveness all increased while the participation in parallel discussions as well as the proportion of information-shift utterances and initiated quaesiones decreased in *both* subjects), the similarity of the dyad's communicative behavior, based on the formal-linguistic categories / values, will be recorded as 100%, in six out of seven categories / values as 86%, and so on. It is noteworthy that this metric will only be mentioned for those subject dyads whose degree of similarity in the formal-linguistic categories is at least 71%, i.e. if five out of seven categories / values are inclined in the same direction, either as increasing or decreasing. The degree of similarity in the subjects' communicative behavior as assessed by means of the pragmatic categories will be analyzed after that based on the formal-linguistic categories, in the section "Preliminary results".

10.1. Isolation progression as a stressor

10.1.1. Subject 1 and subject 3

According to the formal-linguistic categories, subject 1 and subject 3 exhibited a high degree of similarity (86%) in their communicative behavior across the isolation period under its "normal" conditions. Both subjects tended to engage more actively in the discussion while at the same time enhancing efficiency of their speech, initiating more subordinate quaestiones and responding to more of them. On the other hand, subject 3 did not engage in any parallel discussions, whereas subject 1 became less active in this regard by the end of the isolation period, i.e. in D4.

10.1.2. Subject 2 and subject 4

Subject 2 and subject 4 were also alike (86%) in the way that they adapted their communicative behavior to long-term confinement. Their communicative behavior can be characterized through a decline in most of the analyzed formal-linguistic categories, with an increase in the frequency of information-shift utterances towards the end of the isolation period. Despite their similarity in communicative behavior, subject 4 was engaged in more parallel discussions towards the end of isolation than at its beginning, but the opposite was true for subject 2.

10.1.3. Subject 2 and subject 5

The communicative behavior of subject 2 and subject 5 had a similarity measurement of 71%. Both subjects became less verbally active, while their speech became more efficient towards the end of isolation. The subjects participated in fewer parallel discussions, but they also became less receptive to L2. The aspects in which the subjects differed were, firstly, associated with the category "Responsiveness": while subject 2 became less responsive to emerging topics, subject 5 became more attentive to them. Secondly, while subject 2 initiated fewer subordinated topics, subject 5 did not produce any of them in D1 and D4.

10.1.4. Preliminary results

The above-mentioned data on the subjects' communicative behavior during the "normal" isolation conditions are summarized in the table below:

	[%]					
Category and Value	**Subject 1**	**Subject 2**	**Subject 3**	**Subject 4**	**Subject 5**	**Subject 6**
Information Sharing						
Number of words	11.41	- 10.38	2.11	- 5.71	- 2.62	5.19
Number of turns	6.21	- 5.07	2.37	- 6.18	- 1.27	3.94
Efficiency of communication						
Information-shift	4.96	12.65	4.43	4.23	1.67	- 12.36
Coherence						
Subordinate quaestiones	29.50	- 24.00	14.00	- 24.00	0	4.50
Parallel discussions	- 7.22	- 1.67	0	5.81	- 11.67	2.00
Receptiveness	- 13.48	- 3.73	- 0.35	- 1.89	- 0.83	0
Responsiveness	28.00	- 9.50	15.50	- 1.00	35.00	28.00

Table 43: Evolutions of the formal-linguistic categories in the subjects' communicative behavior in response to isolation progression. The numeric information denotes the evolution of a respective category / value in the subjects' speech as isolation progressed (e.g. subject 1, subject 3, and subject 6 produced more words in D4 than in D1; subject 2, subject 4, and subject 5 produced fewer words in D4 than in D1).

The category "Information Sharing"[151] is measured by the two separate values: the number of words and the number of turns. These varied substantially from subject to subject but remained consistent within the subjects themselves. Accordingly, subject 1, subject 3, and subject 6 reinforced their speech characteristics, both in terms of how much and how often they spoke (in other words, the number of words and turns), whereas the rest of the crew displayed the opposite dynamics in the characterization of their speech measured according to the two values.

Efficiency of communication, which was measured by means of information-movements, improved in all subjects, except for subject 6.

The results for the category "Coherence" was not as consistent as those for the category "Information Sharing". Whereas subject 2 improved their communicative behavior in this category towards the end of isolation, the speech patterns of other subjects became less coherent with respect to at least one value, i.e. "subordinate quaestiones" or "parallel discussions". The evolution of the category "Coherence" in subject 5 was not adverse either, but it lacked the subject's activity regarding their initiation of subordinate quaestiones. The communicative behavior of subject 6 was characterized as less coherent according to both values.

The category "Receptiveness" declined in all subjects, except for subject 6 who did not produce any L2 throughout both discussions under the "normal" isolation conditions.

The character of the category "Responsiveness" presented ambiguous results. Subject 2 and subject 4 exhibited a decreased ability (or willingness) to respond actively to new quaestiones, while the rest of the crew became more responsive to them.

Regarding the pragmatic values, the values with the highest decreasing (marked in red) and increasing (marked in green) differences between D4 and D1 are reported in the table below:

[151] For the overview and the description of each category, see section 7.1.3..

Value	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
[adding information]	x	x	x		x	
[providing feedback]						x
[listening "actively"]		x		x		x
[acknowledging confusion]						
[acknowledging linguistic dominance]						
[verifying]	x				x	
[activate resources]						x
[seeking information]			x			
[order]				x	x	
[persisting]			x			
[own opinion]		x		x		x
[react]	x					
[supporting]						
[agreeing]		x			x	
[raising concerns]						
[disagreeing]			x			
[- task-related]	x			x		
[comment]					x	
Interpreting	x					

Table 44: Evolutions of the pragmatic values in the subjects' communicative behavior in response to isolation progression. For each subject, two values with the highest increasing difference in their respective proportions in the discussion between the end and beginning of isolation (i.e. D4 vs. D1) are marked by green crosses; two values with the highest decreasing difference in their respective proportions between the end and beginning of isolation (i.e. D4 vs. D1) are marked by red crosses. If there are more than two values whose differences are equally profoundly increasing / decreasing, they are all marked by a green / red cross.

The most frequent values that indicated an increasing evolution throughout the period under the "normal" isolation conditions were [adding information] (subject 1, subject 2, subject 3, and subject 5) and [listening "actively"] (subject 4 and subject 6). The value [own opinion], on the other hand, decreased in the maximal number of subjects (subject 2, subject 4, and subject 6).

10.2. Interpersonal tension as a stressor

10.2.1. Subject 2 and subject 4

Subject 2 and subject 4 were highly alike in their dynamics of communicative behavior, measured through the formal-linguistic categories, but to a smaller degree (71%) than during the "normal" isolation conditions (86%, cf. section 10.1.2.). In D2, they both produced fewer words, did not initiate subordinate quaestiones, participated in fewer parallel discussions, and were less responsive to new quaestiones. Subject 2 also produced fewer turns and the speech of subject 4 turned out to be less efficient.

10.2.2. Preliminary results

Findings from the subjects' communicative behavior, as measured by means of the formal-linguistic categories, during the discussion with the socially induced stressor are illustrated in the table below:

	[%]					
Category and Value	**Subject 1**	**Subject 2**	**Subject 3**	**Subject 4**	**Subject 5**	**Subject 6**
Information Sharing						
Number of words	- 4.37	- 1.94	- 0.09	- 5.07	6.80	4.69
Number of turns	2.01	- 3.80	10.21	0.55	- 2.92	- 6.05
Efficiency of communication						
Information-shift	3.71	15.15	- 8.60	- 21.04	25.83	- 26.23
Coherence						
Subordinate quaestiones	5.82	- 12.00	14.14	- 12.00	0	4.04
Parallel discussions	- 0.07	- 0.83	0	- 4.79	4.17	- 1.00
Receptiveness	- 7.89	15.78	16.96	1.69	- 22.92	0
Responsiveness	14.00	- 10.11	5.96	- 4.07	- 14.64	- 0.29

Table 45: Evolutions of the formal-linguistic categories in the subjects' communicative behavior in response to the social stressor. The numeric information indicates the difference between the proportion of a category / value in the discussion with the social stressor and the mean proportion of this category / value in the discussions without additional stressors in the subjects' speech (e.g. subject 1, subject 3, and subject 6 produced more subordinate quastiones in D2 than on average in D1 and D4).

The obtained data show that the category "Information Sharing" was not consistent either within the crew as a whole or within the individual subjects when considering the two subcategories jointly: the number of words and the number of turns. However, subject 2 had to be excluded from this generalization since this subject's communicative behavior became less active according to both subcategories.

Efficiency of communication did not evolve consistently within the crew either: the communicative behavior of some subjects included fewer and of other subjects more information-shift turns.

With respect to the category "Coherence", subject 2 and subject 4 improved their communicative performance whereas the communicative performance of the rest of the crew was inconsistent in this respect. Furthermore, to assess the evolution of the category "Coherence" in subjects 3 and subject 5, the respective values lacked the subjects' activity regarding either their engagement in parallel discussions (subject 3) or initiation of subordinate quaestiones (subject 5).

The categories "Receptiveness" and "Responsiveness" turned out to be those which lacked any consistent tendencies across the subjects.

Considering the pragmatic categories by which the communicative behavior of the subjects was assessed, the following table outlines the respective tendencies based on the separate values:

Value	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
[adding information]		x		x	x	x
[providing feedback]			x	x		
[listening "actively"]			x		x	
[acknowledging confusion]			x			
[acknowledging linguistic dominance]						
[verifying]						
[activate resources]			x			x
[seeking information]	x					x
[order]	x					
[persisting]					x	
[own opinion]	x					
[react]		x			x	
[supporting]						
[agreeing]		x				
[raising concerns]						
[disagreeing]						
[- task-related]	x	x		x		x
[comment]	x		x	x		
Interpreting		x				

Table 46: Evolutions of the pragmatic values in the subjects' communicative behavior in response to the social stressor. For each subject, two values with the highest increasing difference in their respective proportions in the discussion with the social stressor vs. the average proportions of the respective values in the two discussions without extra stressors (i.e. D2-(D1+D4)/2) are marked by green crosses; two values with the highest decreasing difference in their respective proportions in the discussion with the social stressor vs. the average proportions of the respective values in the two discussions without extra stressors (i.e. D2-(D1+D4)/2) are marked by red crosses. If there are more than two values whose differences are equally profoundly increasing / decreasing, they are all marked by a green / red cross.

In D2, two values were found to be used more frequently than under the "normal" isolation conditions by more than one subject: [- task-related] (subject 1, subject 2, subject 4, and subject 6) and [react] (subject 2 and subject 5). Furthermore, utterances labeled with the following values were used less frequently by more than one subject in comparison to the discussions under the "normal" isolation conditions: [adding information] (subject 2, subject 4, and subject 5), [providing feedback] (subject 3 and subject 4), and [comment] (subject 1 and subject 3).

10.3. Language as a stressor[152]

10.3.1. Subject 3 and subject 6

Communicative behavior assessed by means of the formal-linguistic categories was similar (83%) in subject 3 and subject 6. Both these subjects increased their frequency of almost all assessed categories / values with an exception of the number of words and the number of turns. Furthermore, subject 3 initiated fewer quaestiones.

[152] Since the requirement of D3 was to speak English, an L2 for the majority of the crew members (see section 5.2.), the category "Receptiveness" was excluded from the current analysis (i.e. section 10.3.) due to its un-informative nature in the given discussion design. Furthermore, the exclusion of the category "Receptiveness" in D3 evaluation protected the anonymity of the subjects who differed according to their native (or foreign) language. Thus, there was a total of six formal-linguistic categories / values, with interindividual similarity in their dynamics being calculated as following: five out of six makes up 83%, four out of six 67%, etc.

10.3.2. Subject 1 and subject 2

The speech of subject 1 and subject 2 reflected similar (67%) dynamic patterns. In comparison to the communicative behavior under "normal" isolation conditions, they spoke more, both in terms of the number of words and the number of turns, and more efficiently. The subjects also became more responsive to new quaestiones. Nevertheless, while subject 1 initiated fewer subordinate quaestiones and took part in fewer parallel discussions, the opposite was true for subject 2.

10.3.3. Subject 2 and subject 6

In D3, subject 2 and subject 6 were alike (67%) following the data obtained on the formal-linguistic categories. The subjects' communicative behavior differed only in that subject 2 became more verbally active, both in terms of the number of words and the number of turns. Subject 6, on the other hand, spoke up less often and uttered fewer words. All other formal-linguistic categories / values indicated an increasing dynamic in the speech of both subjects.

10.3.4. Subject 1 and subject 5

In D3, subject 1 and subject 5 were similar (67%) and became more verbally active (both in terms of the number of words and the number of turns) and more responsive to new quaestiones, although they were engaged in fewer parallel discussions. What differentiated the patterns of communicative behavior in these two subjects was that the speech of subject 5 contained fewer information-shift utterances and subject 5 did not initiate a new subordinate quaestio.

10.3.5. Preliminary results

To sum up the changes that took place in the communicative behavior of the individual crew members, as assessed through the formal-linguistic categories, the following table can be provided:

	[%]					
Category and Value	**Subject 1**	**Subject 2**	**Subject 3**	**Subject 4**	**Subject 5**	**Subject 6**
Information Sharing						
Number of words	14.64	13.13	- 11.56	- 14.14	5.72	- 7.79
Number of turns	9.08	3.01	- 7.95	- 6.88	10.82	- 8.07
Efficiency of communication						
Information-shift	7.95	8.12	1.82	- 11.73	- 24.17	27.60
Coherence						
Subordinate quaestiones	- 4.57	15.27	- 33.91	- 2.91	0	26.11
Parallel discussions	- 7.53	4.72	3.70	- 4.79	- 18.06	4.00
Responsiveness	4.91	14.57	11.16	- 11.86	33.41	4.91

Table 47: Evolutions of the formal-linguistic categories in the subjects' communicative behavior in response to the language stressor. The numeric information indicates the difference between the proportion of a category / value in the discussion with the language stressor and the mean proporion of this category / value in the discussions without additional stressors in the subjects' speech (e.g. subject 4 and subject 5 produced fewer information-shift utterances in D3 than on average in D1 and D4).

In D3, the category "Information Sharing" was consistent in the subjects' communicative behavior: the subjects either increased (subject 1, subject 2, and subject 5) or reduced (subject 3, subject 4, and subject 6) both their number of words and their number of turns.

The evolution of the category “Efficiency of communication”, which was measured by the number of information-shifts compared to the total of all information-movements, varied across the crew members, so that the direction of its dynamic differed from subject to subject.

The evolution of the category “Coherence” increased in the speech of subject 1 and subject 4 and decreased in subject 2 and subject 6. The category was ambiguous in subject 3 while subject 5 failed to initiate any subordinate quaestiones.

With respect to the category “Responsiveness”, most of the subjects displayed an increase of the communicative behavior, while only subject 4 became less willing to contribute to emerging subordinate quaestiones.

As to the subjects’ communicative behavior assessed through the pragmatic values, the table below illustrates their most significant differences:

Value	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
[adding information]					x	x
[providing feedback]						
[listening "actively"]	x	x			x	x
[acknowledging confusion]						
[acknowledging linguistic dominance]						x
[verifying]		x	x			
[activate resources]						
[seeking information]	x			x	x	
[order]			x	x		
[persisting]						
[own opinion]						
[react]					x	
[supporting]						
[agreeing]		x				
[raising concerns]						
[disagreeing]						
[- task-related]			x	x		x
[comment]	x	x	x	x		
Interpreting	x					

Table 48: Evolutions of the pragmatic values in the subjects’ communicative behavior in response to the language stressor. For each subject, two values with the highest increasing difference in their respective proportions in the discussion with the language stressor vs. the average proportions of the respective values in the two discussions without extra stressors (i.e. D3-(D1+D4)/2) are marked by green crosses; two values with the highest decreasing difference in their respective proportions in the discussion with the language stressor vs. the average proportions of the respective values in the two discussions without extra stressors (i.e. D3-(D1+D4)/2) are marked by red crosses. If there are more than two values whose differences are equally profoundly increasing / decreasing, they are all marked by a green / red cross.

During D3, subject 1, subject 2, and subject 5 were inclined to more attentive listening ([listening “actively”]), subject 3, subject 4, and subject 6 to more emotional speech ([- task-related]), while subject 1 and subject 5 tended to ask for general information more frequently ([seeking information]). Furthermore, the values [adding information] (subject 5 and subject 6) and [comment] (subject 1, subject 2, and subject 4) declined in the speech of more than one subject.

10.4. Sleep deprivation as a stressor

10.4.1. Subject 4 and subject 6

During the discussion that was conducted when the crew was deprived of sleep, the speech dynamics of subject 4 and subject 6 revealed a high degree of similarity (86%). They were both loath to speak (both in terms of the number of words and the number of turns), initiate quaestiones, and all in all contribute to emerging quaestiones. On the other hand, their utterances tended to be more efficient. However, at the same time, the subjects were inclined to engage in more parallel discussions. As to the usage of L2, while subject 4 was only less eager to use it, subject 6 kept on neglecting it.

10.4.2. Subject 1 and subject 3

As in some previously reviewed discussions, the communicative dynamics of subject 1 and subject 3 were substantially alike (71%) also under conditions of sleep deprivation. The subjects were both more verbally active (in terms of both the number of words and the number of turns) and coordinated the discussion development by initiating subordinate quaestiones. Further, they became more responsive to quaestiones changes in the discussion. On the other hand, they were less receptive to L2.

The subjects' communicative behavior differed with respect to the efficiency of communication. In particular, subject 3 improved on this category while subject 1 produced fewer information-shift utterances than on average during the discussions under the "normal" isolation conditions. Furthermore, subject 1 took part in fewer parallel discussions, whereas subject 3 was not involved in any of them.

10.4.3. Preliminary results

Dynamics of the category "Information Sharing" were consistent in the subjects' communicative behavior during sleep deprivation, with the exception of subject 2. Subject 1 and subject 3 both increased their active participation in the discussion, while the opposite was true for subject 4, subject 5, and subject 6:

	[%]					
Category and Value	**Subject 1**	**Subject 2**	**Subject 3**	**Subject 4**	**Subject 5**	**Subject 6**
Information Sharing						
Number of words	4.35	- 5.35	20.02	- 10.91	- 4.51	- 3.60
Number of turns	2.01	0.81	7.13	- 5.60	- 1.38	- 2.97
Efficiency of communication						
Information-shift	- 3.98	2.31	11.79	14.84	- 4.17	8.79
Coherence						
Subordinate quaestiones	10.58	4.67	7.00	- 12.00	0	- 10.25
Parallel discussions	- 3.92	- 0.83	0	13.39	- 10.83	3.76
Receptiveness	- 7.89	- 0.46	- 0.24	- 0.94	17.08	0
Responsiveness	14.00	- 0.58	3.58	- 25.50	- 7.50	- 19.33

Table 49: Evolutions of the formal-linguistic categories in the subjects' communicative behavior in response to the sleep deprivation stressor. The numeric information indicates the difference between the proportion of a category / value in the discussion during sleep deprivation and the mean proportion of this category / value in the discussions without additional stressors in the subjects' speech (e.g. subject 4, subject 5, and subject 6 produced fewer turns in D5 than on average in D1 and D4).

The efficiency of communication tended to improve in the crew, while the speech of subject 1 and subject 5 displayed the opposite character of the evolution of the category.

Sleep deprivation affected the coherence of subjects' speech in different ways, but none of the crew members was able to enhance their communicative behavior according to both subcategories (the number of subordinate quaestiones and frequency of parallel discussions) simultaneously. Furthermore, it was not feasible to assess the evolution of the category "Coherence" in subjects 3 and subject 5 due to the subjects' lack of activity in either engaging in parallel discussions (subject 3) or initiating subordinate quaestiones (subject 5).

"Receptiveness" was a category with a quite consistent decreasing character in the crew. Subject 5 was the only crew member who spoke an L2 more frequently, while subject 6 kept on neglecting it.

The evolution of the category "Responsiveness" varied across the subjects. Only subject 1 and subject 3 were able (or willing) to respond to new subordinate quaestiones more frequently than on average during the "normal" isolation conditions.

In the table below, the most indicative differences of the pragmatic values, along with their character, are depicted:

Value	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
[adding information]	x		x		x	x
[providing feedback]		x	x			
[listening "actively"]		x		x		x
[acknowledging confusion]	x		x			x
[acknowledging linguistic dominance]					x	
[verifying]	x			x	x	
[activate resources]						
[seeking information]		x				
[order]				x		
[persisting]						
[own opinion]						
[react]				x		x
[supporting]						
[agreeing]		x		x		
[raising concerns]						
[disagreeing]			x			
[- task-related]				x		
[comment]	x		x		x	
Interpreting						

Table 50: Evolutions of the pragmatic values in the subjects' communicative behavior in response to the sleep deprivation stressor. For each subject, two values with the highest increasing difference in their respective proportions in the discussion during sleep deprivation vs. the average proportions of the respective values in the two discussions without extra stressors (i.e. D5-(D1+D4)/2) are marked by green crosses; two values with the highest decreasing difference in their respective proportions in the discussion during sleep deprivation vs. the average proportions of the respective values in the two discussions without extra stressors (i.e. D5-(D1+D4)/2) are marked by red crosses. If there are more than two values whose differences are equally profoundly increasing / decreasing, they are all marked by a green / red cross.

A few pragmatic values indicated increasing evolutions among more than one crew member: [adding information] (subject 1, subject 3, and subject 6) and [verifying] (subject 1, subject 4, and subject 5). On the other hand, pragmatic values [providing feedback] (subject 2 and subject 3), [acknowledging confusion] (subject 1 and subject 3), [listening "actively"] (subject 4 and

subject 6), and [comment] (subject 1 and subject 5) were found to be used less frequently in more than one crew member[153].

10.5. Content-oriented analysis on the inter-individual level: Discussion

Similarly to the approach of the previous content-oriented analyses (i.e. on the group and intra-individual levels), the data obtained on the formal-linguistic and pragmatic categories will be discussed individually also in the framework applied to the inter-individual analysis. Firstly, the results based on the formal-linguistic categories will be outlined, before those based on the pragmatic categories.

After the categories have been reviewed independently of each other, both types of categories will be considered together to enable a holistic analysis of the subjects' communicative behavior as well as to juxtapose the findings of the inter-individual analysis with the sociometric data.

10.5.1. Formal-linguistic categories

There are three assemblages according to which the subjects' communicative behavior can be grouped based on the formal-linguistic categories. The first is constituted of subject 1 and subject 3 as well as subject 2 and subject 4; their communicative behavior was similar under the isolation progression stressor (86%) and in one discussion with the additional stressor (71%): D2 (subject 2 and subject 4) and D5 (subject 1 and subject 3).

The second assemblage includes two pairs of subjects: subject 3 and subject 6, as well as subject 4 and subject 6. In D3, subject 3 and subject 6 were measured as 83% similar in their communicative behavior; in D5, subject 4 and subject 6 were 86% similar in their communicative behavior.

The third assemblage accommodates four subject dyads: subject 1 and subject 2 (67% in D3), subject 1 and subject 5 (67% in D3), subject 2 and subject 6 (67% in D3), and subject 2 and subject 5 (71% under the isolation progression stressor).

The figure below graphically delineates the findings based on the evolutions in the subjects' communicative behaviors, according to the formal-linguistic categories, arranged into two subject groups for better visualization:

[153] The data on the decreasing dynamics of the outlined values ([providing feedback], [acknowledging confusion], [listening "actively"], [comment]) make clear that comprehension of others was negatively affected during (or as a result of) sleep deprivation.

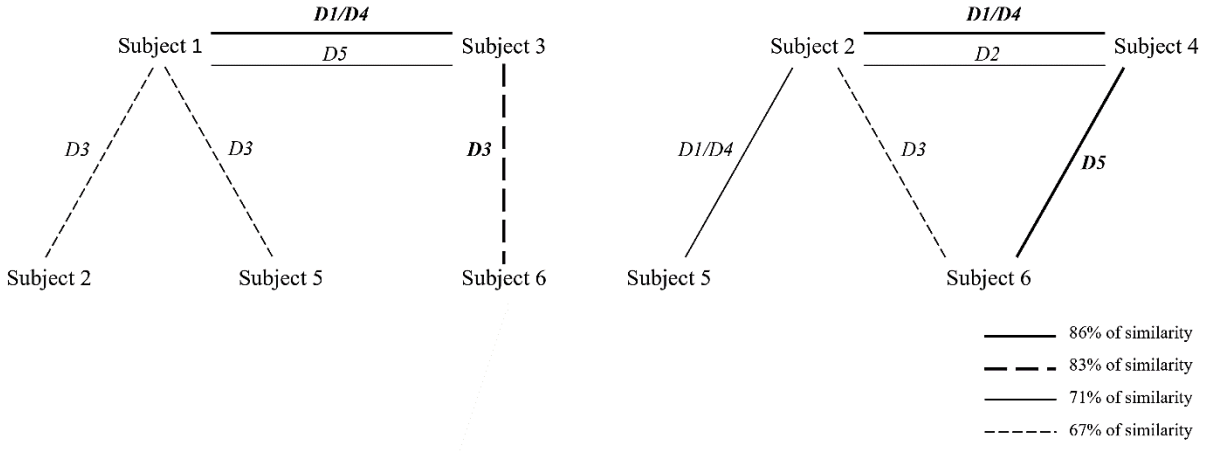

Figure 16: Similarity of subjects' communicative behavior based on the formal-linguistic categories. The subjects were divided into the two groups following the similarity patterns in the evolutions of their communicative behavior. "D1/D4" denotes the similarity of the communicative behavior in response to the stressor of the isolation progression; "D2" denotes the similarity of the communicative behavior in response to the social stressor; "D3" denotes the similarity of the communicative behavior in response to the language stressor; "D5" denotes the similarity of the communicative behavior in response to the phase of sleep deprivation. Different types of lines, which link the subjects, stand for various degrees of similarity of the communicative behavior (varying from 67% to 86%).

As one can see, there was no subject pair that was similar in their communicative behavior under all isolation conditions. In the following, the interpretation of the data on the inter-individual analysis will be continued, based on the results of the pragmatic values.

10.5.2. Pragmatic categories

In total, there were seven dyads of subjects with more than one pragmatic value with an identical dynamic character (i.e. increasing or decreasing) in the analyzed stressors, namely:

- subject 4 and subject 6 under the factor of isolation progression.
- subject 2 and subject 4 as well as

  subject 2 and subject 5 under the influence of the social stressor.
- subject 1 and subject 2 as well as

  subject 1 and subject 5 in the discussion with the requirement to speak English.
- subject 1 and subject 3 as well as

  subject 1 and subject 5 in the discussion conducted during sleep deprivation.

The figure below illustrates the above-mentioned subject pairs within one layout:

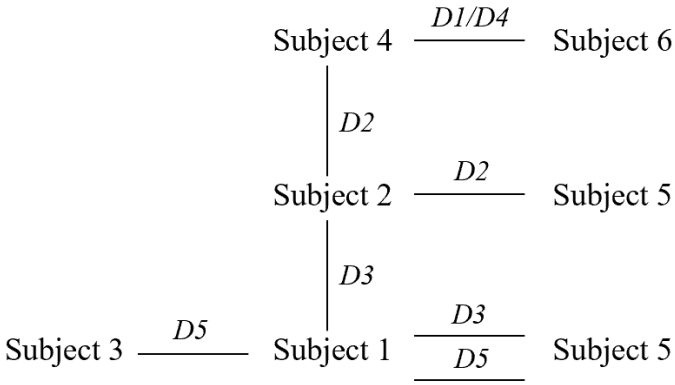

Figure 17: Similarity of subjects' communicative behavior based on the pragmatic values. "D1/D4" denotes the similarity of the communicative behavior in response to the stressor of the isolation progression; "D2" denotes the similarity of the communicative behavior in response to the social stressor; "D3" denotes the similarity of the communicative behavior in response to the language stressor; "D5" denotes the similarity of the communicative behavior in response to the phase of sleep deprivation.

From the above figure, it can be seen that the inter-individual analysis based on the pragmatic values was not fruitful because it is difficult to deduce patterns of similar communicative behavior among the subjects in more than one discussion. The only exception in this regard was the pair of subject 1 and subject 5. When considering the present results, one should be mindful that the analysis was carried out by regarding only four pragmatic values in each subject per discussion out of the nineteen possible in the majority of cases[154] (see the introduction to Chapter 10 for the methodology).

Nevertheless, all of the introduced subject pairs, based on the data collected on the pragmatic values, correspond with the subject pairs that were defined as similar in the context of the formal-linguistic categories[155]. These are:

- subject 4 and subject 6 (D5 according to the formal-linguistic and D1/D4 the pragmatic values).
- subject 1 and subject 5 (D3[156] according to the formal-linguistic and D3 as well as D5 the pragmatic values).
- subject 2 and subject 4 (D1/D4, D2 according to the formal-linguistic and D2 the pragmatic values).
- subject 2 and subject 5 (D1/D4 according to the formal-linguistic and D2 the pragmatic values).
- subject 1 and subject 3 (D1/D4, D5 according to the formal-linguistic and D5 the pragmatic values).

[154] Four pragmatic values were evaluated in 70.8% of all cases, five pragmatic values were evaluated in 25% of all cases, and six pragmatic values were evaluated in 4.2% of all cases. One case is equivalent to one subject for each discussion; hence, there was a total of 24 cases in all analyzed stressors (six subjects in the "D1 to D4" stressor; six subjects in the "D2 vs. the average of D1 and D4" stressor; six subjects in the "D3 vs. the average of D1 and D4" stressor; and six subjects in the "D5 vs. the average of D1 and D4" stressor).

[155] The only two subject pairs who were similar according to the formal-linguistic but not pragmatic categories / values were (i) subject 3 and subject 6 and (ii) subject 2 and subject 6.

[156] The reader can be reminded that six out of seven categories / values were considered in D3, since the category "Receptiveness" was excluded (cf. section 10.3.). Therefore, in D3, the calculation of the degree of similarity based on the formal-linguistic categories is less defined than in the other discussions.

- subject 1 and subject 2 (D3 according to the formal-linguistic and D3 the pragmatic values).

There were four subject pairs who demonstrated an identical character in the evolution of their communicative behaviors, when measured by the pragmatic and formal-linguistic categories in the respective discussions (marked as underlined in above) simultaneously:

- subject 1 and subject 3 in D5
- subject 2 and subject 4 in D2
- subject 1 and subject 5 in D3
- subject 1 and subject 2 in D3

This finding might suggest that the high degree of similarity (86%) in communicative behavior during the discussion under the "normal" isolation conditions tends to serve as a prerequisite for similarity in the evolution of the communicative behaviors according to the pragmatic categories in the discussions with additional stressors, i.e. D2 and D5 for subject dyads subject 2 and subject 4 as well as subject 1 and subject 3, respectively. Hence, a high degree of similarity (86%) according to the formal-linguistic categories during the "normal" isolation conditions appears relevant for similar dynamics in the communicative behavior based on the formal-linguistic and pragmatic categories in the discussions with additional stressors. However, the other subject dyads – subject 1 and subject 5 as well as subject 1 and subject 2 – places a limit on these results. The dyad subject 1 and subject 5 displayed a similarity according to the pragmatic values in two discussions (i.e. D3 and D5), within which one (i.e. D3) corresponds to the similarity (i.e. 67%) following the formal-linguistic categories which took place during the not "normal" isolation conditions, i.e. during the discussion with additional demands D3. Similarly, the dyad subject 1 and subject 2 displayed a similarity according to the pragmatic values in D3, in which the subjects were also similar (i.e. 67%) following the formal-linguistic categories. Nevertheless, given that D3 was less differentiated with respect to the assessment of the subjects' level of similarity (six categories / values, instead of seven, were considered), it is suggested that the similarity of these subject dyads is "less reliable" with respect to the formal-linguistic categories; their communicative behavior corresponded in only four categories while at least five were comparable according to the assessment principle in the remaining discussions. Furthermore, the similarity according to the pragmatic values were all based on only two out of (at least)[157] four possible correspondences in each discussion (e.g. [listening "actively"] and [seeking information] in D3 as well as [verifying] and [comment] in D5 for the dyad subject 1 and subject 5; [listening "actively"] and [comment] in D3 for the dyad subject 1 and subject 2). From this it can be concluded that the two subject dyads – subject 1 and subject 3 as well as subject 2 and subject 4 – are "distinctly similar" in their communicative behavior.

10.6. Content-oriented analysis on the inter-individual level: Closing discussion

Having elaborated the identical character of the communicative behavior dynamics among the subjects, the following question can be addressed:

> Were there any similarities in the patterns of communicative behavior among the subjects?

[157] Cf. n. 153.

Considering both formal-linguistic and pragmatic categories simultaneously, the aim of providing a holistic view on the subjects' communicative behavior based on both category types turned out to be valid for only four subject pairs and only with respect to one respective discussion:

- subject 1 and subject 3 in D5
- subject 2 and subject 4 in D2
- subject 1 and subject 5 in D3
- subject 1 and subject 2 in D3

Therefore, it seems warranted to offer two separate conclusions on the inter-individual analysis according to the formal-linguistic or pragmatic categories.

First, the analysis based on the formal-linguistic categories accounted for the evolution of seven separate categories / values (six categories / values in D3). However, only when the evolution directions of at least five of them (four in D3) were identical among the subjects, were these subjects considered as displaying similar communicative behavior. Thus, the inter-individual analysis based on the formal-linguistic categories was quite restricted. Nevertheless, two subject pairs, subject 1 and subject 3 as well as subject 2 and subject 4, were defined as demonstrating a high degree of similarity in the communicative behavior each under two demanding conditions: isolation progression (found in both subject pairs), socially-induced stressor (subject 2 and subject 4), and sleep deprivation (subject 1 and subject 3).

Second, similarities in the communicative behavior which were defined with the help of the pragmatic values varied greatly among the subjects, even though only those values were considered in the analysis that reflected the most significant differences in their usage. The evidence that there was only one subject pair who demonstrated an identical character in the evolution of two values in two discussions (subject 1 and subject 5) can be understood as the result of the overly detailed taxonomy of the pragmatic values (cf. Krifka et al. 2003: 96).

Since no noticeable pattern within the inter-individual analysis regarding both types of the categories was found, the data obtained on the formal-linguistic categories are considered "more robust" for the overall evaluation of the subjects' speech. The analysis based on the formal-linguistic categories also accounted for seven (six in D3) categories / values which was more detailed than the analysis based on the pragmatic categories that considered four pragmatic values in the majority of cases[158]. Among the pragmatic values, the maximum number of instances which corresponded was two separate values (50%) but never three or all four, while, with respect to the formal-linguistic categories, at least five (71%) categories / values – or four (67%) in D3 – were required to be identical in their evolution direction, i.e. as increasing or decreasing. Hence, the pragmatic values turned out to be less informative concerning the assessment of similarity in the subjects' communicative behavior.

For this reason, subject 1 and subject 3 as well as subject 2 and subject 4 were alike in their communicative behavior to the highest degree, following the formal-linguistic categories. Both subject pairs indicated a high degree of similarity as a response to the isolation progression (86%) and a slightly lower degree of similarity (71%) in one of the discussions with additionally designed demands (subject 1 and subject 3 in D5; subject 2 and subject 4 in D2).

To answer the last question concerning the inter-individual content-oriented analysis, the obtained data on the communicative behavior can be compared against the data based on the sociometric tests:

[158] Cf. n. 153.

Can such similarities in the patterns of communicative behavior be considered a consequence of sympathy and affinity between the crew members?

The sociometric research revealed that, despite the crew's consolidation by the third month of isolation on the "work" criterion (cf. section 5.6. for the sociometric analysis design), subgroups, i.e. crew-members who were related to others via mutual choices, developed towards the end of the isolation period according to the work-related criterion and the one isolated crew-member, who was not related to others via mutual choices, developed according to the leisure-related criterion (Gushin & Vinokhodova 2020; see also Anikushina et al. 2022)[159]. When one juxtaposes the findings of the sociometric analysis (Gushin & Vinokhodova 2020) on the work-related criterion approximately at the time of D4 and D5 (in other words, in the fourth and last month of isolation) with the results of the inter-individual content-oriented analysis based on the formal-linguistic categories, the two subgroups, based on the formal-linguistic categories (Figure 16) and sociometric analysis (Gushin & Vinokhodova 2020), appear to be represented by almost the same subjects:

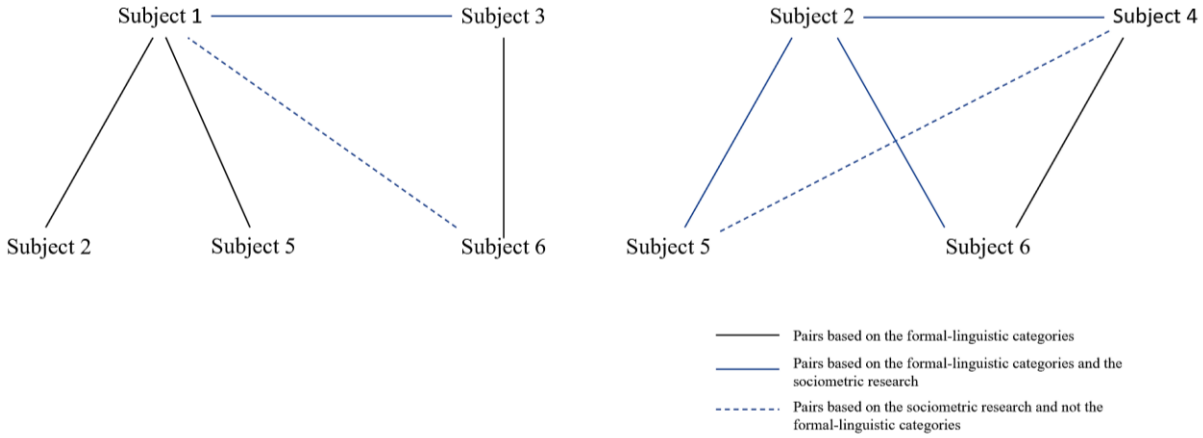

Figure 18: Comparison of inter-individual qualitative content-oriented analysis and sociometric research data. The data obtained on both analyses appear to deliver corresponding results with respect to the subject pairs who were similar according to the formal-linguistic categories (cf. Figure 16) and who mutually selected each other on the work-related criterion at the end of isolation according to the sociometric research (Gushin & Vinokhodova 2020). The lines, which link the subjects, stand for the character of the subjects' interrelations: (i) similarity according to the formal-linguistic categories, (ii) mutual selection following the sociometric research (ibid.), or (iii) both mentioned interrelations simultaneously.

Whereas there is still some inconsistency (for instance, subject 4 and subject 5 as well as subject 1 and subject 6 are not similar in their communicative behavior from the formal-linguistic point of view), the two strongest subject pairs according to the formal-linguistic analysis are replicated in the sociometric data: subject 1 and subject 3 as well as subject 2 and subject 4. According to the sociometric analysis, subject 1 and subject 3 chose each other on the work-related criterion throughout the entire isolation period and subject 2 and subject 4 from around the third month. The mutual selection with respect to the leisure-related criterion was never evident for the pair of subject 1 and subject 3; the mutual selection with respect to the leisure-related criterion was recorded only at two points of sociometric data collection between the

[159] The sociometric analysis was conducted by the IBMP. The present research simply refers to it. Four data points in Gushin & Vinokhodova (2020) was corrected following personal communication with the IBMP. Furthermore, for one subject, a data set at one point of data collection is missing (ibid.; cf. also section 8.4.2.); this will need to be disregarded in the following.

third and the last month of isolation in the pair of subject 2 and subject 4 (Gushin & Vinokhodova 2020).

On the other hand, two subject pairs (subject 1 and subject 6 as well as subject 4 and subject 5) chose each other on the work-related criterion throughout the entire isolation period (ibid.). However, they were not found to indicate similar communicative behavior according to the formal-linguistic categories. It is noteworthy that these two subject pairs also always chose each other on the leisure-related criterion (ibid. in which two data points were corrected following personal communication with IBMP).

Furthermore, two other subject pairs, namely subject 2 and subject 6 as well as subject 2 and subject 5, either always chose each other on the leisure-related criterion throughout entire isolation as well as on the work-related criterion, with an exception of the first point of data collection in the beginning of isolation for the work-related criterion (subject 2 and subject 6), or they chose each other simultaneously on both criteria at the last two points of sociometric data collection (subject 2 and subject 5) (ibid.).

Lastly, the subject dyad who was identified as similar according to one discussion following the formal-linguistic categories and two discussions following the pragmatic values – subject 1 and subject 5 – did not choose each other on either of the sociometric criteria throughout the entire isolation period (ibid.). Similarly, subject 3 and subject 6, who corresponded in their communicative behavior according to the formal-linguistic categories, did not choose each other on either of the sociometric criteria (ibid.), whereas subject 4 and subject 6 chose each other only in the case of the leisure-related criterion during around the first month (ibid.). Further, subject 1 and subject 2, who were alike in their communicative behavior according to the formal-linguistic and pragmatic categories in D3, chose each other only on the leisure-related criteria from around the middle of the first month till around the middle of the third month in isolation and in the last sociometric questionnaire (ibid.)[160].

The juxtaposition of the data on the formal-linguistic categories and sociometric data indicates that the data obtained from the work-related sociometric criterion tended to correspond with *high* degrees of similarity in communicative behavior evaluated by means of *the formal-linguistic categories* (i.e. in at least one discussion with additional demands (71%) and in the response to the isolation stressor (86%)). Furthermore, it might be assumed that the leisure-related criterion tended to inhibit such strong correspondence according to the formal-linguistic categories. In other words, consistent communication patterns, characterized by means of the formal-linguistic categories, can be regarded as an attempt to mimic and imitate a colleague with whom one would prefer to work (cf. the work-related criterion), although not to be bonded as a friend (cf. the leisure-related criterion).

The assumed parallels in the sociometric data with respect to the work-related criterion and the inter-individual similarity in the communicative behavior according to the formal-linguistic categories is supported by anecdotal observations. In two discussions (D1 and D3), subject 1 would say that the subject's opinion is similar to that of subject 3:

[160] The remaining subject dyads, who are not reflected in Figure 18, made the following sociometric choices: (i) subject 3 and subject 4 as well as subject 5 and subject 6 never chose each other on any criterion; (ii) subject 3 and subject 5 as well as subject 1 and subject 4, if they chose each other, then always did so simultaneously on both criteria; (iii) subject 2 and subject 3 never chose each other on a work-related criterion and only once on the leisure-related criterion in the very beginning of isolation (Gushin & Vinkhodova 2020; two data points were corrected following personal communication with IBMP).

Turn	Subject	Utterance	Pragmatic categories	Formal-linguistic categories
270	subject 3	*Alright I won't change my mind and vote for Antoniadi* (name of a crater) *as number two.*	[own opinion]	information-shift
		…		
275	subject 1	*I agree with you* (name subject 3) *I have it as two.*	[own opinion] [agreeing]	information-shift

Table 51: Anecdotal observation of explicit "opinion-mimicking" in Discussion 1[161]. Subject 1 overtly expresses agreement with the ranking made by subject 3.

Or in D2[162]:

Turn	Subject	Utterance	Pragmatic categories	Formal-linguistic categories
78	subject 1	*Yes, I have it as you do* (name of subject 3). *Mariana* (name of a planet),	[react]	information-shift
79	subject 3	*Nikita, Ariel* (names of planets).	[listening "actively"]	information-maintenance
	subject 1	*Nikita, Ariel.*		

Table 52: Anecdotal observation of explicit "opinion-mimicking" in Discussion 2[163]. Subject 1 overtly expresses agreement with the ranking of the planets made by subject 1.

To conclude, since there is barely any available information on possible factors that could have led to the similarity in the communicative behavior – because this was not an aim of investigation in the present research – further studies are needed to elucidate possible factors which may be pivotal to induce such "mimicking" in one's communicative behavior, e.g. one's personality traits that make one susceptible to such communicative behavior. Alternatively, one can assume that such similarity in the communicative behavior originates from a phenomenon known in enactivism as *attunement* and which implies a process of *mutual* mirroring and resonance, as a form of flexible adaptation between interlocutors with each other, which happens during social interactions (cf. e.g. Bolis et al. 2022; Manders et al. 2021).

On this note, the content-oriented analysis is concluded. The present content-oriented analysis was conducted on three levels: group level (Chapter 8), intra-individual level (Chapter 9), and inter-individual level (Chapter 10). Each level of the analysis poses a number of research questions which were elaborated in each of the three chapters. In the following chapter (Chapter 11), the analysis of linguistic data collected in the isolation conditions will be continued. The spontaneous L1 speech of the Russian-native crew members will be assessed with the help of the context-sensitive categories that were outlined in Chapter 4.

[161] The original language, in which the utterances were spoken, is not indicated to ensure the subjects' anonymity. All utterances, disregarding the original language, are presented in casual neutral English.

[162] Even though D2 was not assessed as similar according to the formal-linguistic categories for the subject pair subject 1 and subject 3 (cf. section 10.2.), it is assumed that this anecdotal evidence can be used to corroborate the assumption of the *consistency* in similarity within the communication patterns in the described subjects.

[163] The original language, in which the utterances were spoken, is not indicated to ensure the subjects' anonymity. All utterances, disregarding the original language, are presented in casual neutral English.

11. Analysis of context-sensitive categories

In the present chapter, the context-sensitive categories – the aspectual and grammatical voice systems as well as referring expressions, the theoretical background for which was introduced in Chapter 4 – will be analyzed with respect to their frequency in Russian L1 spontaneous speech under varying degrees of stress. The chapter consists of three parts. The first part (section 11.1.) is dedicated to the analysis of the aspectual system, i.e. frequency of Pfv. and Ipfv. verbs; as well as the grammatical voice system, i.e. frequency of active and passive clauses. In these sections, attention is drawn to the distribution of the respective grammatical oppositions in the subjects' spontaneous L1 speech under different degrees of perceived stress. The second part of the chapter (section 11.2.) investigates the frequency of different referring expressions, i.e. pronouns and instances of pro-drop, the distribution of which is assumed to be affected by the level of stress that a speaker is experiencing. The first (section 11.1.) and second parts (section 11.2.) of the present chapter are linked by means of the following hypothesis:

> Hypothesis: When the subjects' level of perceived stress increases, those linguistic structures are preferred by the speakers that require fewer cognitive resources.

The assumption that the cognitive resources required by a speaker vary is indebted to (i) the Markedness theory and (ii) the Givenness Hierarchy and the Accessibility theory (cf. Chapter 4). Hence, marked grammatical members – which, in the present research, include Pfv. verbs and passive clauses – and referring expressions that are less mentally accessible are expected to be distributed with significantly higher frequency in the subjects' speech when the speakers are not stressed.

The third part of the present chapter (section 11.3.) studies the linguistic data without a predefined hypothesis. The analysis carried out in this section adopts an inductive approach to speech patterns that were produced during speakers' elevated levels of stress and that were controlled by means of the speakers' HR measurement.

To systematize the continuum of physiological stress expression (see section 2.2.), the study by Saslow et al. (2014; see section 3.4.3.) is adopted. Saslow et al. (2014) identified that the mean HR of 93.46 bpm is associated with the lowest levels of linguistic cognitive complexity. Thus, the threshold of 94 bpm can be taken as a dividing line between linguistically less cognitively complex speech patterns and more cognitively complex speech patterns. Given that the normal diapason of HR stretches between 60 bpm and 80 bpm in healthy adult individuals, while beginning from significantly below 50 bpm for well-trained athletes (Sammito et al. 2014: 4; see section 2.2.), the threshold of 93.46 bpm is a solid indicator of high stress since it surpasses the upper level of 80 bpm by more than 13 bpm. Thus, HR of equal to or more than 94 bpm will be seen as an indicator of high stress and is expected to influence spontaneous language production, i.e. the preference a speaker has in choosing between available context-sensitive linguistic options. In other words, speech patterns that are uttered during HR of 94 bpm or more should indicate less complex cognitive speech patterns, while speech patterns that are uttered during HR of below 94 bpm should indicate more complex cognitive speech patterns. In this study, for instance, active voice clauses and Ipfv. verbs delineate less complex cognitive grammatical opposition members than passive voice clauses and Pfv. verbs, respectively (cf. section 4.1.). Therefore, the former two linguistic constructions are expected to be preferred by speakers when they experience increased levels of stress.

Similarly, the inductive analysis of the linguistic data – which is outlined in section 11.3. – will focus on the established HR threshold of 94 bpm. Thus, only those speech excerpts that

were produced while the subjects' HR was either equal to or more than 94 bpm will be analyzed. This selection of the available linguistic material enables detailed analysis of speech under stress that is not constrained like the previous analyses, which are based on Markedness theory and which focus on referring expressions.

In the following, the three types of analysis – based on (i) Markedness theory (Ipfv. verbs vs. Pfv. verbs and active clauses vs. passive clauses), (ii) the referring expressions, as well as (iii) the inductive approach to the data – will be outlined. The analysis of the context-sensitive categories will proceed in the above-indicated order.

11.1. Analysis based on the Markedness theory

11.1.1. Subjects

The speech samples of five out of six subjects (four Russian-native speakers and a bilingual subject) were analyzed. The native speaker of English was excluded from the analysis because the research was intended to address only spontaneous L1 speech. The decision to exclude the analysis based on L2 is grounded in the fact that the L2 data was sparse. Furthermore, the inclusion of L2 materials in the analysis would complicate the interpretation of the results due to further factors which might affect the choice that a speaker meets between linguistic options, e.g. due to his / her limited fluency in L2.

The subjects' mean age was 35.8 years of age (SD = 7.7 years of age).

11.1.2. Methodology

During all five group discussions (see section 5.5. for the design of the discussions), the subjects were sitting at a dinner table. They were asked to wear HR monitor chest strap Polar H7 or H10 as well as ActiGraph wGT3X-BT bracelets throughout all group discussions; their HR metrics were recorded with a one-second interval (see section 5.6. for the study methodology)[164].

Prior to the analysis of the physiological data, artifacts were eliminated from the raw HR data: all instances of fewer than 40 bpm and more than 120 bpm were excluded[165]. Given that the subjects were not exposed to further stressors (e.g. unexpected loud noises) other than those which arose naturally in a conversation (also including the extra stressors, such as social tension and sleep deprivation, that were thoroughly addressed in Chapter 8), the fluctuations of HR metrics were assumed to be linked with (i) varying degrees of mental load required during the decision-making tasks as well as (ii) with the subjects' emotional state in general (see sections 2.1. and 2.2. on the relation between the physiological arousal and experienced load).

The linguistic data were analyzed holistically for all the Russian native speaking subjects so that it was not differentiated for individual subjects.

11.1.3. Data

Two out of five discussions (D1 and D4) contained speech samples that adhered to either of both physiological parameters: (i) HR being below 94 bpm and (ii) HR being equal to or more than 94 bpm. In the remaining three discussions – D2, D3, and D5 – it was not possible to identify the analyzed linguistic variables which would be uttered if HR were equal to or more

[164] The psycholinguistic methodology for the crew in the entire SIRIUS-19 experiment was described in detail in Chapter 5.

[165] See section 2.2. on the normal range of HR and cf. also Li et al. (2016) who considered instances of HR fewer than 40 bpm to be an "obvious error" (ibid.).

than 94 bpm. In D2, D3, and D5, all patterns of the analyzed linguistic variables were uttered when the subjects' HR was below 94 bpm[166].

In D1, speech samples that were equal to or more than 94 bpm were found in the speech of four subjects. In D4, speech samples that were equal to or more than 94 bpm were found in the speech of three subjects.

11.1.4. Analysis

The two-sided Fisher's exact test was applied to examine whether the difference in the distribution of marked / unmarked linguistic structures of the two grammatical oppositions (aspectual and voice system of Russian; see sections 4.1.1. and 4.1.2.) was significant under the two physiological parameters: (i) HR being below 94 bpm and (ii) HR being equal to or more than 94 bpm. The statistical analysis was performed using IBM SPSS Statistics 27.0 or RStudio version 4.1.1 (2021-08-10) softwares.

In analyzing the distribution of Pfv. and Ipfv. verbs[167] in Russian L1 spontaneous speech, two tenses (past and future tenses) as well as the infinitive and imperative forms were evaluated. Present tense verbs were excluded from the analysis since they can only be used in Ipfv. (cf. section 4.1.1.). From the statistical analysis the following instances were excluded:

- Present tense because it is used only with Ipfv. verbs in the Russian language.
- Perfectiva tantum and imperfectiva tantum because they do not reflect a speaker's choice on what aspect to use.
- Verb forms that have both aspects and the context does not allow differentiation of the choice that a speaker has made, e.g. *mozno uspet' evakuirovat'* (Ipfv.? Pfv.?), 'it is possible to manage to evacuate (Ipfv.? Pfv.?)'.
- Incomplete compound predicates, e.g. *Nu davaite, ja dolgo ne budu* ?[govorit'] – 'Well alright, I will not ?[speak] long/much'.
- Participles that are not part of predicates, e.g. *rešajušyi faktor* – 'decisive argument'.

The total number of all Ipfv. and Pfv. verbs were also statistically analyzed. Verbs of compound predicates were analyzed individually, e.g. *mozem* (Ipfv. in present tense and which was excluded from the analysis) *otpravit'* (Pfv. in infinitive) – '(we) can send'.

When examining the distribution of active and passive clauses, only sentences with a verbalized *transitive finite* (compound) verb were considered. Intransitive verbs were excluded from the analysis because they cannot be passivized in Russian (cf. section 4.1.2.). Similarly, impersonal verbs and imperative sentences, as well as instances of the middle voice, were excluded from the analysis. Furthermore, in cases when verbs that can have two aspectual forms, e.g. *dumat'* – 'to think', were used without a direct object and a direct object cannot be retrieved from the context, then these verbs were assumed to be used in their intransitive form and thus were not considered in the analysis. Compare: *ja dumaju dumu* (direct object) – 'I am brooding' (literally, 'I am thinking thought') vs. *ja dumaju, što…* – 'I think that…'. In the former case, the verb clause is treated as an 'active clause used in the present tense', while in

[166] Decreased levels of HR during the discussions with the additional stressors, i.e. interpersonal tension, speaking an L2, and sleep deprivation, can be explained through the notion of fatigue that is oftentimes linked with decreased HR (cf. section 2.2.). However, there were very few instances of periods in which the subjects' HR was equal to or beyond 94 bpm in D2 and D3; during these periods, no analyzed linguistic categories were evident.

[167] In the present analysis, only morphological forms were considered which could deviate from the semantic interpretation, such as in the following example from the obtained material:
Esli mə sjadem na krater X, značit, mə yze pobedili (past tense with future meaning)
If we will land on crater X, then we already won (past tense with future meaning)
'If we land on crater X, then it would mean that we had won already.'

the latter it is not considered since the verb is used in its intransitive meaning. Further, verbs that are common for colloquial speech, e.g. *znaeš'* – '(you) know', were not considered either because they are rarely passivized despite being transitive and due to their high frequency in the corpus at hand, which could skew the data. To sum up, when deciding on whether to include a clause in the analysis, it was always considered whether its grammatical opposition (passive for active and active for passive) is feasible and acceptable in the given context.

11.1.5. Results

11.1.5.1. Aspectual system

In total, there were 316 verbs (102 verbs in Ipfv. and 214 verbs in Pfv.). Of the 80 verbs in the past tense, 22 were in Ipfv. and 58 were in Pfv. Of the 105 verbs in the future tense, 23 were in Ipfv. and 82 were in Pfv.. There were 114 instances of infinitives, of which 49 instances were in Ipfv. and 65 in Pfv.. In the imperative mood, there were 17 verbs; of these 8 verbs were in Ipfv. and 9 in Pfv. From this it follows that, as already noted in section 4.1.1., Pfv. verb forms were used more frequently than Ipfv. in all tenses despite the marked status of the former in the binary grammatical opposition of the Russian aspectual system (cf. section 4.1.1.).

Table 53 below summarizes the findings on the frequency of both aspectual forms in relation to the analyzed category and each one's relationship to the speakers' HR characteristics during spontaneous L1 speech:

Parameters	**Variables**	
	Imperfective aspect	**Perfective aspect**
Past tense		
HR below 94 bpm	22	52
HR equal to or more than 94 bpm	0	6
Future tense		
HR below 94 bpm	19	74
HR equal to or more than 94 bpm	4	8
Infinitive form		
HR below 94 bpm	43	60
HR equal to or more than 94 bpm	6	5
Imperative mood		
HR below 94 bpm	8	9
HR equal to or more than 94 bpm	0	0
Total number of all instances		
HR below 94 bpm	92	195
HR equal to or more than 94 bpm	10	19

Table 53: Distribution of aspectual verbal forms in relation to physiological reactivity.

Following the two-sided Fisher's exact test, the difference between the two HR parameters was not significant for any of the analyzed variables (past tense – $p = .180$; future tense – $p = .292$; infinitives – $p = .526$; total of all forms – $p = .836$). Furthermore, the analysis based on the forms of the imperative mood was not possible because no instances of this form were found in the subjects' speech during the elevated HR metrics, i.e. HR being equal to or more than 94 bpm.

In summary, the assumption of the "special" cognitive status of the marked – following the Markedness theory inference – Pfv. aspect was not confirmed according to the data at hand.

11.1.5.2. Grammatical voice system

In total, 232 clauses were found in the present linguistic corpus. In the corpus of 232 clauses, 212 instances were uttered when the subjects' HR was below 94 bpm and 20 instances when the subjects' HR was equal to or above 94 bpm. Of the clauses with HR below 94 bpm, 25 were in the passive voice. Among the clauses with HR equal to or more than 94 bpm, 2 were in the passive voice. Table 54 provides a summary of the above-mentioned findings:

Parameters	**Variables**	
	Active voice	**Passive voice**
HR below 94 bpm	185	25
HR equal to or more than 94 bpm	18	2

Table 54: Distribution of grammatical voice forms in relation to physiological reactivity.

According to the two-sided Fisher's exact test, the difference in the use of passive / active clauses was not statistically significant ($p = 1$) among the two conditions, HR below 94 bpm and HR equal to or more than 94 bpm[168].

In summary, the assumption of the "special" cognitive status of the Russian passive voice, following the Markedness theory inference, was not confirmed according to the data at hand.

11.1.6. Discussion

In the theoretical part (cf. section 4.1.), two grammatical systems of Russian were discussed: grammatical aspect and grammatical voice. It was argued that Pfv. is the marked member in the aspectual category and passive voice is the marked member in the voice category. Consequently, Pfv. and passive voice were assumed to require higher cognitive resources on the part of a speaker than their respective unmarked counterparts, i.e. Ipfv. verbs and active voice clauses. To prove this, the frequency with which the marked and unmarked members of both grammatical oppositions were used by five Russian native speakers under two physiological parameters was examined: HR being below 94 bpm and HR being equal to or more than 94 bpm. The physiological threshold of 94 bpm was chosen following the study by Saslow et al. (2014) (which was thoroughly discussed in section 3.4.3.), who demonstrated that subjects spoke with the lowest cognitive complexity once their mean HR was 93.46 bpm. According to the findings of the present study, the difference in the frequency of the analyzed linguistic variables that were assumed to bear a different status of cognitive complexity for the Russian native speakers was not statistically significant in response to the HR variations. Thus, the assumption of the "special" cognitive status of the marked grammatical aspectual form, i.e. Pfv., and voice, i.e. passive, was not confirmed by the data at hand.

As an explanation of the failing attempt to find statistical significance in the usage of marked / unmarked linguistic structures as a response to varying degrees of perceived load in a speaker, one can suggest that the chosen threshold of the HR data, i.e. 94 bpm, was not applicable to the variables in the present analysis. Thus, it is possible that establishing a lower or higher HR threshold might result in a (greater) statistically significant difference with respect to the distribution of the outlined variables, i.e. Ipfv. vs. Pfv. verbs and active vs. passive clauses. To address this assumption, the HR parameters were refined, in order to establish a stricter differentiation of the subjects' psychophysiological state. Hence, a supplementary

[168] After excluding the frequently uttered verb *govorit'* ('to say'), e.g. *da ja i govorju…* ('well, that is what I am saying…'), from the statistical analysis to control for possible skewness due to this high frequency verb in Russian colloquial speech, the difference in the distribution of active and passive clauses was still not significant according to the two-sided Fisher's exact test ($p = 1$).

parameter was added, in which HR ranges from 40 bpm to 80 bpm. This parameter corresponds to the diapason of the normal resting HR in healthy adults (cf. section 2.2.) and it was chosen to replace the parameter of HR being below 94 bpm, which now appears as "too vague". From this it follows that HR instances which fall under the diapason between 80 bpm and 94 bpm will be excluded from the subsequent analysis. In this choice, a stricter differentiation will be made between the two mental states: the "normal" state (i.e. HR being from 40 bpm to 80 bpm) and the state of increased load (i.e. HR being equal to or more than 94 bpm).

11.1.7. Analysis with adjusted parameters

As was discussed previously, two parameters which differed in their degree of cardiovascular reactivity were selected for the analysis: (i) HR being between 40 bpm and 80 bpm and (ii) HR being equal to or more than 94 bpm. The former parameter was chosen to reflect the normal resting state of healthy adults (see section 2.2.), while the latter was chosen following the study by Saslow et al. (2014) and which was found to be associated with the lowest cognitive linguistic complexity of speech (see section 3.4.3. for the study outline).

The variables remained the same as in the previously described analysis, i.e. the Russian aspectual and grammatical voice systems. The hypothesis remained the same as well. It is hypothesized that under increased levels of HR, the distribution of the marked grammatical structures should be lower than under the normal HR values, i.e. the resting state, in the subjects' spontaneous L1 speech.

11.1.7.1. Results

11.1.7.1.1. Aspectual system

In total, there were 184 verbs (61 Ipfv. verbs and 123 Pfv. verbs). In the past tense, there were 47 verbs of which 13 verbs were Ipfv. and 34 were Pfv.. In the future tense, there were 67 verbs of which 16 verbs were Ipfv. and 51 were Pfv.. Infinitives were encountered 61 times: 29 verbs in Ipfv. and 32 verbs in Pfv.. In the imperative mood, there were 9 verbs of which 3 verbs were Ipfv. verbs and 6 were Pfv.. Thus, as was already discussed in section 4.1.1. and observed in the previous section (section 11.1.5.1.), Pfv. was used more frequently than Ipfv. in all tenses despite its marked status.

Table 55 below summarizes the findings on the frequency with which both aspects were used in each analyzed category and each one's relationship to the HR characteristics:

Parameters	Variables	
	Imperfective aspect	**Perfective aspect**
Past tense		
HR from 40 bpm to 80 bpm	13	28
HR equal to or more than 94 bpm	0	6
Future tense		
HR from 40 bpm to 80 bpm	12	43
HR equal to or more than 94 bpm	4	8
Infinitive form		
HR from 40 bpm to 80 bpm	23	27
HR equal to or more than 94 bpm	6	5
Imperative		
HR from 40 bpm to 80 bpm	3	6
HR equal to or more than 94 bpm	0	0
Total of all forms		
HR from 40 bpm to 80 bpm	51	104
HR equal to or more than 94 bpm	10	19

Table 55: Distribution of aspectual verbal forms in relation to physiological reactivity with adjusted cardiovascular parameters.

Following the two-sided Fisher's exact test, the difference between the two HR parameters was not statistically significant for any of the analyzed variables (past tense – $p = .167$; future tense – $p = .460$; infinitives – $p = .743$; total of all forms – $p = 1$). The analysis based on the instances of the imperative mood was not possible since such forms were not identified in the subjects' speech during the elevated HR metrics.

Consequently, the assumption of the "special" cognitive status of the marked – following the Markedness theory inference – Pfv. aspect was not confirmed in the case with the adjusted physiological parameters.

11.1.7.1.2. Grammatical voice system

In total, 136 clauses were analyzed. In the corpus of 136 clauses, 116 instances were produced during the period of HR stretching from 40 bpm to 80 bpm, while 20 instances were produced during the period of HR being equal to or beyond 94 bpm. Of the clauses with HR stretching from 40 bpm to 80 bpm, 14 clauses were in the passive voice. Of the clauses in which HR was equal to or more than 94 bpm, 2 clauses were in the passive voice.

Table 56 below summarizes the findings on the frequency of both grammatical voice types that were juxtaposed with the speakers' HR characteristics during their spontaneous L1 speech:

Parameters	Variables	
	Active voice	**Passive voice**
HR from 40 bpm to 80 bpm	102	14
HR equal to or more than 94 bpm	18	2

Table 56: Distribution of grammatical voice forms in relation to physiological reactivity with adjusted cardiovascular parameters.

According to the two-sided Fisher's exact test, the difference in the use of passive vs. active clauses was not statistically significant ($p = 1$) in the two defined conditions – HR in the normal resting state (from 40 bpm to 80 bpm) and HR being equal to or more than 94 bpm[169].

[169] After excluding frequently uttered verb *govorit'* ('to say'), e.g. *da ja i govorju…* ('well, that is what I am saying…'), from the statistical analysis to control for possible skewness due to this high frequency verb in the

Thus, the assumption of the "special" cognitive status of the marked passive voice in Russian, according to the assumption of the Markedness theory, was not confirmed in the case of the adjusted physiological parameters.

11.1.8. Conclusion

Following the assumptions based on the Markedness theory (cf. section 4.1.), the marked linguistic structures of Russian (Pfv. verbs and passive clauses) were expected to be uttered less frequently when the subjects experienced a substantial amount of psychological stress because marked grammatical structures, following the Markedness theory, require more cognitive resources. Therefore, when under increased levels of stress, the subjects were expected to adapt their communicative behavior by producing less demanding linguistic structures and, consequently, trading off extralinguistic demands, such as stress. In the study, stress was assessed through HR and speech excerpts uttered when HR was equal to or more than 94 bpm were considered. The threshold of 94 bpm was chosen based on the study by Saslow et al. (2014; see section 3.4.3. for the study outline) who were able to show that spontaneous L1 speech becomes cognitively less complex when the mean HR is 93.46 bpm. Furthermore, the chosen HR threshold is set substantially above the resting state HR (cf. section 2.2.) and thus must be a reliable indicator of experienced stress in a speaker.

According to the present study, the choice among available linguistic options based on the Russian grammatical voice or grammatical aspectual systems does not depend on levels of stress experienced by the subjects. This conclusion is based on the two analyses that were conducted and that differed in terms of their physiological parameters: (i) in which HR was below 94 bpm and HR was equal to or more than 94 bpm, and (ii) in which HR was from 40 bpm to 80 bpm and HR was equal to or more than 94 bpm. Table 57 below offers a comparison of the results of the statistical analyses of both approaches:

Variables		**Parameters**	
		HR below 94 bpm vs. HR equal to or more than 94 bpm	HR from 40 bpm to 80 bpm vs. HR equal to or more than 94 bpm
Aspect	Past tense	$p = .180$	$p = .167$
	Future tense	$p = .292$	$p = .460$
	Infinitives	$p = .526$	$p = .743$
	Imperatives	N/A	N/A
	Total	$p = .836$	$p = 1$
Grammatical voice		$p = 1$	$p = 1$

Table 57: Comparison of the findings on aspectual and grammatical voice systems without and with adjusted cardiovascular parameters. The juxtaposition of the *p*-values obtained on the data without or with adjusted cardiovascular parameters does not present a consistent pattern; it cannot be stated, for instance, that the *p*-values obtained on the adjusted cardiovascular parameters (i.e. the right column in the parameters) tend to be smaller than those obtained on the parameters without adjusting (i.e. the left column in the parameters). Hence, this finding does not suggest that the stricter restriction of the physiological parameter *tends* to a greater statistically significant difference in the distribution of marked and unmarked structures of the aspectual and grammatical voice systems in the two examined physiological states in speakers.

It is noteworthy that only one category, namely the verb forms in the past tense, displayed a greater statistical difference (i.e. a smaller *p*-value) in the analysis with the stricter HR differentiation. The opposite is true for three categories: verb forms in future tense, infinitives, and the total number of all verbs in the variable aspect. In these cases, the *p*-value was rather

Russian colloquial speech, the distribution of active and passive clauses was still not significant according to the two-sided Fisher's exact test ($p = 1$).

smaller when the HR differentiation was less strict. In the case of the distribution of active and passive clauses, the resulted *p* values were equal in both defined parameters (i.e. (i) HR being below 94 bpm vs. HR being equal to or more than 94 bpm and (ii) HR being from 40 bpm to 80 bpm vs. HR being equal to or more than 94 bpm). These findings additionally reinforce the already rejected hypothesis according to which there should be an interrelation between the degree of stress and a choice among available linguistic options that are unequal in their cognitive demands, as follows from the Markedness theory. If the hypothesis were proven correct, the stricter restriction of HR (i.e. the comparison based on the following two physiological parameters (i) HR being from 40 bpm to 80 bpm and (ii) HR being equal to or more than 94 bpm) should have been reflected in smaller *p*-values than in the analysis based on the more "vague" HR characterization (i.e. the comparison based on the following two physiological parameters (i) in which HR was below 94 bpm and (ii) in which HR was equal to or more than 94 bpm). However, this was only true for one variable out of five, i.e. the aspectual verb forms in the past tense.

This section concludes the analysis based on the Markedness theory. In the following section, the analysis of the referring expressions, i.e. pronouns and instances of pro-drop, will be carried out. The distribution of the Russian pronouns and instances of pro-drop will be examined. Similar to the variables deduced from the Markedness theory, the choice of pronouns and frequency of instances of pro-drop are expected to depend on changing extralinguistic demands imposed on a speaker.

11.2. Analysis based on the referring expressions

11.2.1. Subjects

In analyzing the distribution of referring expressions in L1 Russian spontaneous speech, the subjects remained the same as those described in section 11.1.1.

11.2.2. Methodology

The experimental methodology was the same as that described in section 11.1.2.. Furthermore, following the argumentation outlined in section 11.1.6., two parameters based on cardiovascular data were defined: (i) HR being from 40 bpm to 80 bpm (i.e. HR being equal to its resting state in healthy adults) and (ii) HR being equal to or more than 94 bpm. By selecting the stricter parameter, i.e. eliminating all speech patterns uttered when HR was between 80 bpm and 94 bpm, a more precise differentiation of the subjects' psycho-emotional state was sought which was assumed to have influence on their speech.

The variables were nine semantic classes of the Russian pronouns: personal, reflexive, possessive, demonstrative, interrogative, relative, negative, determinative, and indefinite (see section 4.2.). Furthermore, the frequency of instances of pro-drop was analyzed by comparing their distribution to the distribution of the sum of personal and demonstrative pronouns. 'Pro-drop' structures were not considered instances of ellipse; in the case of an ellipse, an NP was omitted and could not be filled by a pronoun (i.e. a personal or a demonstrative), but only by a noun. The choice of these two semantic classes of pronoun, i.e. personal and demonstrative, was based on anecdotal evidence that pro-drops can often be used in lieu of only personal and demonstrative pronouns because the latter "merely" serve one function; they refer to an entity, which was previously introduced to a discourse, without adding additional semantic meanings as, for instance, in the case of indefinite pronouns, which cannot be omitted without a clause appearing incomplete.

11.2.3. Data

Two out of five discussions (D1 and D4) featured speech samples of both parameters: (i) HR being from 40 bpm to 80 bpm and (ii) HR being equal to or more than 94 bpm. In the remaining three discussions – D2, D3, and D5 – it was not possible to find the analyzed variables which would be uttered when HR was equal to or more than 94 bpm. In these three discussions, all instances of pronouns and pro-drop were uttered when the subjects' HR ranged from 40 bpm to 80 bpm.

Speech samples produced when HR was equal to or more than 94 bpm were present in the subjects' speech as follows: (i) in D1, in the speech of four subjects and (ii) in D4, in the speech of three subjects.

11.2.4. Statistical analysis

The two-sided Fisher-Freeman-Halton test was applied to answer the questions whether the difference in the distribution of instances of the nine pronominal semantic categories would be statistically significant in the subjects' spontaneous L1 speech under the two physiological parameters: HR being from 40 bpm and 80 bpm and HR being equal to or more than 94 bpm. The two-sided Fisher's exact test was applied to answer the question whether the difference in the distribution of instances of pro-drop vs. the sum of personal and demonstrative pronouns would be statistically significant in the subjects' spontaneous L1 speech under the two physiological parameters: HR being from 40 bpm to 80 bpm and HR being equal to or more than 94 bpm.

The data were analyzed holistically so that there was no differentiation between individual subjects. The statistical analysis was performed using IBM SPSS Statistics 27.0 software.

11.2.5. Results

In total, 571 instances of pronouns and pro-drop were found in all five discussions during the two considered physiological parameters: (i) HR being from 40 bpm to 80 bpm and (ii) HR being equal to or more than 94 bpm. Of these instances, there were 453 instances of pronouns and 118 instances of pro-drop. Of the observed 453 instances of pronouns, 61 pronouns were produced by the subjects when their HR was equal to or more than 94 bpm. Of the observed 118 instances of pro-drop, 15 were produced by the subjects when their HR was equal to or more than 94 bpm.

Table 58 below summarizes the distribution of the instances of pronouns, according to their semantic class, and pro-drop under the two physiological parameters:

Variables	**Parameters**	
	HR from 40 bpm to 80 bpm	HR equal to or more than 94 bpm
Personal pronouns	191	30
Reflexive pronouns	1	0
Possessive pronouns	4	1
Interrogative pronouns	38	4
Relative pronouns	20	4
Negative pronouns	8	3
Indefinite pronouns	6	3
Determinative pronouns	43	8
Demonstrative pronouns	81	8
Pro-drop	103	15

Table 58: Distribution of instances of pronouns and pro-drops in relation to physiological reactivity.

Following the two-sided Fisher-Freeman-Halton test, the difference in the distribution with which pronouns of the nine semantic classes were uttered under the two defined physiological parameters was not statistically significant (p = .316). Therefore, the two variables – distribution of the instances of pronouns, which belong to either of the nine semantic categories, and HR – are not dependent from each other and hence there is no association between HR and the pronominal classes. Table 59 below offers an overview of the number of actual instances of pronouns and their expected count:

			Personal	Reflexive	Possessive	Interrogative	Relative	Negative	Indefinite	Determinative	Demonstrative
HR	HR from 40 bpm to 80 bpm	Count	191	1	4	38	20	8	6	43	81
		Expected Count	191,2	,9	4,3	36,3	20,8	9,5	7,8	44,1	77,0
		Adjusted Residual	-,1	,4	-,4	,8	-,5	**-1,4**	**-1,8**	-,5	**1,4**
	HR equal to or more than 94 bpm	Count	30	0	1	4	4	3	3	8	8
		Expected Count	29,8	,1	,7	5,7	3,2	1,5	1,2	6,9	12,0
		Adjusted Residual	,1	-,4	,4	-,8	,5	**1,4**	**1,8**	,5	**-1,4**
Total		Count	221	1	5	42	24	11	9	51	89
		Expected Count	221,0	1,0	5,0	42,0	24,0	11,0	9,0	51,0	89,0

Table 59: Distribution of the nine semantic classes of pronouns in relation to physiological reactivity. According to the values of the adjusted residuals, the highest difference between the actual count and expected count was evident for negative, indefinite, and demonstrative pronouns. The adjusted residuals of the mentioned pronouns are highlighted in bold.

Following the values of the adjusted residuals, indefinite, negative, and demonstrative pronouns have the largest discrepancy between the expected and observed counts (marked in bold) among all other pronominal classes[170]. Thus, even though the nine semantic classes of pronouns were not associated with the speakers' physiological state, these three pronominal classes indicated observed values that deviated from the expected values to highest degree[171]. Hence, there were

[170] Cf. Fagerland et al. (2017: 328) for discussion of the association between the observed and estimated expected counts.

[171] The reader should be notified that the value of adjusted residuals usually has to be more than 1.96 or less than -1.96, when not considering the need for a Bonferroni correction, given that the association between the analyzed

fewer than expected negative and indefinite pronouns but more than expected demonstrative pronouns during the subjects' resting HR. The opposite applies for the instances of increased HR in the subjects: more observed indefinite and negative pronouns were counted than expected and fewer demonstrative pronouns than expected.

Considering the frequency of pro-drop instances in relation to the sum of personal and demonstrative pronouns, the difference of their distribution under the two physiological parameters was not statistically significant (p = .871), according to the two-sided Fisher's exact test:

			Personal & Demonstrative	Pro-drop
HR	HR from 40 bpm to 80 bpm	Count	272	103
		Expected Count	271,6	103,4
		Adjusted Residual	,1	-,1
	HR equal to or more than 94 bpm	Count	38	15
		Expected Count	38,4	14,6
		Adjusted Residual	-,1	,1
Total		Count	310	118
		Expected Count	310,0	118,0

Table 60: Distribution of personal and demonstrative pronouns in comparison to the distribution of pro-drop in relation to physiological reactivity.

In summary, the nine semantic classes of the Russian pronouns were found to have no association with the character of HR. Nevertheless, it was noticed that, among all semantic classes of the Russian pronouns, indefinite, negative, and demonstrative deviated to the highest extent from their respective expected count. Further, the relation between a sum of instances of personal and demonstrative pronouns compared to the number of instances of pro-drop was found not to be statistically significant.

11.2.6. Discussion

The use of the Russian pronouns, classified according to their meaning, was found to have no association with the degree of physiological reactivity that a native speaker of Russian indicates during speaking. Nevertheless, attention was drawn to the three semantic classes of pronouns which indicated the highest value of adjusted residuals, or, in other words, the higher discrepancy between their observed and expected counts than in the other pronominal classes. These three semantic classes were (i) indefinite pronouns, which had an adjusted residual of 1.8 when HR was equal to or more than 94 bpm, (ii) negative pronouns, which had an adjusted residual of 1.4 when HR was equal to or more than 94 bpm, and (iii) demonstrative pronouns, which had an adjusted residual of -1.4 when HR was equal to or more than 94 bpm. From this it follows that the subjects produced more negative and indefinite pronouns, but fewer demonstrative pronouns than one would expect, when their HR was increased. In the following, an interpretation of these findings will be provided.

With respect to the demonstrative pronouns, following the Givenness Hierarchy and the Accessibility theory (see section 4.2.), it is proposed that increased load might have led the speakers to think that the hearer would experience more difficulty in decoding those entities that had been previously mentioned in the discourse. Therefore, the speaker would prefer to specify the nominal phrase (which can be filled by a demonstrative pronoun) by means of, for

variables within a contingency table is statistically significant according to a chi-square test (cf. Sharpe 2015). Therefore, the present data interpretation relies heavily on qualitative observation while adopting a quantitative approach to the data at hand.

instance, a subordinate clause (as facilitated by a relative pronoun). Consider the example from the data set when the HR was equal to or more than 94 bpm:

[*Nu, u menja bəl prioritetə bez učeta*][172] ***toj*** *informačii,* ***kotoruju*** *mə seičas polučili.*

[Well by me was priorities without consideration] **that** information, **which** we now received.

'Well, I have had the priorities without the consideration of **that** information **which** we have now received.'

Instead of:

Nu, u menja bəl prioritetə bez učeta ***toj*** *informačii.*

Well by me was priorities without consideration **that** information.

'Well, I have had the priorities without the consideration of **that** information.'

In this example, the demonstrative *toj* ('that') might have been perceived by the speaker as not being precise enough for the hearer to be able to safely decode the reference 'information'. Thus, the speaker chose to facilitate the reference decoding by additionally producing the subordinate clause to specify the same referent 'information' – 'which we have now received'. The subordinate clause was therefore redundant in terms of its propositional value to the discourse and could, thus, have been omitted. The importance of the repetition lies in its cognitive function; due to their high HR levels (HR was equal to or more than 94 bpm) and hence increased load, the subject might have perceived the demonstrative pronoun to be insufficient for the hearer to safely decode it, so it was "assured" by the over-specification by means of the subordinate clause. The opposite is true for the speech during HR under the resting state. Here, demonstrative pronouns seemed to be preferred because the speakers assumed that the hearers possessed sufficient mental capacity to safely decode the reference expressed by demonstrative pronouns alone (cf. "audience design" (Bell 1984), following which "[s]peakers are designing their [linguistic] style for their audience" (ibid.: 197)).

As to negative pronouns, which were used with a greater than expected frequency during the elevated HR level, it can be assumed that this was related to the subjects' emotional state and their willingness to categorically assert a statement. Such assertiveness was "preferred" over milder ways of expressing statements. Compare a sentence with two negative pronouns used simultaneously:

Zdes' ***nikto ni na kogo*** *ne davit.*

Here **no one not on some** not pressures.

'Here, **no one** puts pressure on **anyone**.'

Or a sentence with one negative pronoun:

[172] This part of the utterance was not uttered during the periods in which HR was equal to or more than 94 bpm.

Nu, mozno togda tam vam eto, tam prizemlit'sja, potomu što, jesli ne prizemljat'sja, umrut, potom ***nikto*** *ne budet vydjeljat'den'gi na sljedujušii missii.*

Well can then there you this, there land, because, if not land, will die, then **no one** not will allocate money on next missions.

'Well then, you can that, land there, because if not to land, they will die and **no one** would allocate budget to next missions.'

It is conceivable that the propositions of these sentences could have been expressed in a more subtle way, such as:

(1)

Zdes' ***my*** (a personal pronoun) *otkryty dlja* ***vsekh*** (a determinative pronoun) *mnenji.*

Here **we** (a personal pronoun) open for **all** (a determinative pronoun) opinions.

'Here, **we** are open to **all** opinions.'

(2)

Nu, mozno togda tam vam eto, tam prizemlit'sja, potomu što, jesli ne prizemljat'sja, umrut, potom vrjadli ***kto-to*** (an indefinite pronoun) *budet vydjeljat'den'gi na sljedujušii missii.*

Well can then there you this, there land, because, if not land, will die, then unlikely **someone** (an indefinite pronoun) will allocate money on next missions.

'Well then, you can that, land there, because if not to land, they will die and hardly **anyone** would allocate budget to next missions.'

As was illustrated with the help of the above examples, the negative pronouns could have been "replaced" by pronouns of different semantic classes to lend the same proposition a slightly different illocution (cf. section 3.1. for discussion of illocutionary acts).

Considering the use of indefinite pronouns, they were used more frequently than statistically expected when the subjects experienced increased levels of stress, i.e. during the periods when HR was equal to or more than 94 bpm. Similarly to the use of negative pronouns, it is assumed that the increased frequency of indefinite pronouns in the subjects' speech is owed to pragmatic aspects. Unlike the above-mentioned assumption made with the help of the use of negative pronouns, the use of indefinite pronouns suggests that the subjects might have been less certain and more cautious when speaking. Consider the following examples:

Ja tak ponjal prosto vot, što korabl' v porjadke tam, oborudovanie ***kakoe-to****.*

I so understood just well that ship in order there, equipment **some**.

> 'I have understood it like, well, that the ship is safe there, **some** equipment (will be damaged)[173]'.

In this utterance and given the present discoursal context, the speaker had the option to express the proposition differently and, in particular, more precisely:

> *Ja tak ponjal prosto vot, što korabl' v porjadke tam,* ***necritičeskoe*** *oborudovanie.*
>
> I so understood just well that ship in order there, **not critical** equipment.
>
> 'I have understood it like, well, that the ship is safe there, **not critical** equipment (will be damaged)'.

It is important to mention that, prior to the introduced utterance, the subject had been corrected by their colleague on the severity of the consequences of damaging the equipment. It is likely that the instructions the subject had received did not include this piece of information; rather, they varied from subject to subject on the individual pieces of information. Alternatively, the subject might simply have disregarded some piece of information in the instructions. Hence, it is conceivable that, by means of the indefinite pronoun *kakoe-to* ('some'), the subject aimed to highlight their uncertainty (or ignorance) in describing the item (*oborudovanie* – 'equipment'), i.e. that the equipment was not critical. It is also worth mentioning that the subject's HR increased only after being corrected by the colleague while their HR was not increased during the previous period of speaking in which the subject expressed their choice, given the instructions originally received / initially understood. Therefore, the increased usage of indefinite pronouns during the periods of elevated HR can be explained by increased levels of anxiety that is often caused by experience of stress, e.g. when one is being corrected. In a more general sense, such frequent usage of indefinite pronouns under stress can also serve as an indicator of confusion experienced by a speaker.

To conclude, the association of the semantic classes of the Russian pronouns and the physiological state of a speaker was found not to be statistically significant. Thus, the above-outlined interpretations must be taken with great caution. Nevertheless, it is assumed that the association of the Russian pronouns and cardiovascular response in a native speaker can exist and can be experimentally corroborated, given that there are stricter experimental conditions and more data. In particular, in future studies it should be avoided that subjects experience fatigue, which is an inherent factor in any long-term experience of isolation (cf. section 8.4.2. for the present isolation experiment and the discussion of emerged fatigue), in addition to acute psycho-emotional stress, e.g. emotional stressors that naturally emerge in a conversation. These two psycho-physiological states, fatigue and acute stress, might result in atypical HR (cf. section 2.2. where it was noted that prolonged stress can be indicated by decreased HR). This interpretation of the physiological data might be another factor that took effect in the present analyses. Hence, in the study, instances of resting HR, i.e. in which the HR ranges from 40 bpm to 80 bpm (a similar argument can be applied when HR is below 94 bpm), might coincide with instances of fatigue; consequently, speech patterns that are assessed as taking place during "un-stressed" periods can rather be – at least partially – due to fatigue and thus prolonged stress. This might explain why the attempt to find a dependency of the distribution of the context-sensitive linguistic categories (i.e. the aspectual and grammatical voice systems as well as pronouns) and extralinguistic context (such as stress measured through HR) was, statistically speaking, not successful. This consideration makes an analysis of speech patterns solely under

[173] The passage in the round brackets offers one of the most likely continuations of the utterance.

increased levels of HR, which can prove a "pure" indication of stress without possible aberrating HR characteristics due to fatigue, especially desirable. Such an analysis has already been attempted for negative, indefinite, and demonstrative pronouns and will be concluded in the following inductive approach.

11.3. Inductive approach

In this last section, an inductive approach to the linguistic data at hand will be attempted. Unlike the previous analyses, no comparison of speech patterns under varying degrees of stress will be given. All linguistic materials assessed in the present section are obtained from the subjects' speech when their HR was increased, i.e. equal to or more than 94 bpm. The present inductive analysis offers a brief overview of selected passages marked by instances of repetitive statements, self-repairs, and irregular word order in the subjects' spontaneous L1 Russian speech. These patterns of linguistic behavior were studied because they were frequent in the analyzed discussions during increased HR as well as because these patterns of communicative behavior are known to be characteristic of dysfluent speech in general (cf. e.g. Zhabin 2009: 78f.; Bock 1996).

It is important to mention that the following inductive analysis is not intended to address all possible linguistic features which might reflect fluctuations of stress perceived by a speaker. The analysis is primarily concerned with summarizing the most conspicuous instances of dysfluent speech according to the presently available data. The inductive analysis is not constrained by any predefined hypothesis, as in the case of the previous analyses.

The first finding was that repetitive statements were quite frequent in the corpus of speech under the increased HR levels. The sentences with repetitions are listed below, with the repetitions highlighted in bold:

(1) ***Eše*** *v Biancini tam ze skaly* ***eše.***

Also in Biancini there well cliffs **also**.

'There are also cliffs at Bianchini (a name of a crater).'

(2) *Esli* ***jest'*** *jadernyi reaktor, togda ne problema,no ja ne znaju,* ***jest'*** *li on.*

If **is** nuclear reactor, then not problem, but I do not know, **is** whether he.

'If there is a nuclear reactor, then it is not a problem, but I don't know, whether there is one.'

(3) *Vot* ***zdes'*** *pišetsja da, što* ***zdes'*** *gorazdo men'še mesta na ošibok dlja posadki, čem na drugikh.*

Well **here** is being written yes, that **here** by far less room for mistakes for landing, than on others.

'Well, it is written here, yes, that here is by far less room for mistakes while landing than on other (craters).'

(4) *Nu, mozno togda tam vam əto, tam* ***prizemlit'sja***-PFV*, potomu što, jesli ne* ***prizemljat'sja***-IPFV*, umrut.*

Well, can then there you it, there **land**-PFV, because if not **land**-IPFV, die.

'Well then, you can do that, land there, because if no one lands, they will die.'

(5) *Po krajnej mere oni pro verojatnost' avarii ne* ***govorjat****.* ***Govorjat****, što slozno i opasno, no što vot prjam pjat'desjat* [*prožentov*][174].

On least extent they about possibility accident do not **say**. **Say** that difficult and dangerous, but that this exactly fifty [percent].

'At least they don't say anything about the possibility of an accident. They say that it is difficult and dangerous, but not that it is exactly fifty [percent].'

(6) *Nu, opasnye* ***oba****, oni* ***oba****, da.*

Well, dangerous **both**, they **both**, yes.

'Well, both are dangerous, they both are, yes.'

(7) *Glavnoe sest'. Tam* ***sjadem****, my* ***sjadem****, i dal'še čo budem delat'?*

Important land. There **will land**, we **will land**, and further what will be doing?

'The main thing is to land. There, we will land, we will land, and what are we going to do next?'

(8) ***Avrora pervaja, Avrora pervaja.*** *Kamilla, navernoe, vsjo-taki vtoraja.*

Aurora first, **Aurora first**. Camilla, perhaps, still second.

'Aurora (a name of an asteroid) is number one, Aurora is number one. Camilla (a name of an asteroid) is, perhaps, number two anyway.'

As can be seen in the above examples, different parts of speech were used as repetitions: verbs (e.g. *sjadem* '(we will) land'), adverbs (e.g. *zdes'* 'here'), and nouns (e.g. *Avrora* 'Aurora'), as well as numerals (e.g. *oba* 'both'). As was discussed in section 2.1.2., stress negatively influences working memory capacity in speakers, meaning that repetitions might take place due to deficiency in working memory capacity under increased load. Alternatively, repetitions in healthy speakers, as in the present study, can be "used" (non-consciously) to fill in slots with any linguistic material while the speaker is searching for the next piece of information to be encoded and spelled out (cf. Levelt's (1989) model of speech production). Having once encoded and spelled out a word, it becomes activated[175]. Thereafter this word is used repeatedly because it requires the least amount of mental resources (cf. the phenomenon of "priming" (e.g. Bock

[174] This part of the utterance was not uttered during the periods in which HR was equal to or more than 94 bpm.

[175] Cf. Dell's (1986) model, according to which the activation level of an item decays after its initial selection to inhibit its repetitive selection, i.e. "to prevent its being selected over and over again" (ibid.: 288). Nevertheless, at a fast speaking rate, errors are more likely to take place, since "[t]he old items are still activated because they have not had enough time to decay, and the new correct items have not received enough activation from the higher representations to compete successfully" (ibid.: 293). Increased psychological stress can also probably be compared with the demands during fast speaking so that they both might lead to errors or repetitions.

1996: 398)) which are needed for the "searching" process. Nevertheless, it is important to mention that some instances of repetitions might carry additional information which "justifies" their usage, e.g. in order to express a contrast between two propositions, as might be the case in example (5).

The second observation were self-repairs. Self-repairs were found in the subjects' speech when their HR was equal to or more than 94 bpm. The sentences with self-repairs are listed below, with the self-repairs highlighted in bold:

(9) *Nu, da,* ***ja, u menja*** *tut točno Antoniada.*

Well, yes, **I**, **by me** here surely Antoniada.

'Well yes, I, in my case, here must be Antoniadi (a name of a crater).'

(10) *Nu, mozno togda tam vam* ***əto***, ***tam prizjemlits'ja****, potomu što, jesli ne prizemljat'sja, umrut.*

Well, can then there you **it**, **there land**, because if not land, die.

'Well then, you can do that, land there, because if no one lands, they will die.'

In the first excerpt, *u menja* ('by me') is a repair of *ja* ('I'). Presumably, the subject initially wanted to utter *ja vybral(a) Antoniadu* ('I have chosen Antoniadi') but then decided that the focus should be shifted away from himself/herself, as an active decision maker ('I'), to a more "unbiased" depiction of the crater's characteristics and, hence, its position in the ranking. In the latter case, the role of the subject as a decision-maker is weaker, and the utterance sounds less direct and more polite: *u menja tut točno Antoniada* ('in my case, here must be Antoniada').

In the second utterance, *əto* ('it') is used to initiate a self-repair *tam prizemlit'sja* ('there land'). The repair was necessary because *vam* ('you') interrupts a "typical" word order and makes it sound unusual, although not incorrect:

(10a) *?Nu, mozno togda* ***tam vam*** *prizemlit'sja.*

Well, can then **there you** land.

'Well then, you can land there'.

An unmarked way to build such an indicative sentence would be with the indirect object *vam* ('you' in the dative case) preceding the modal *mozno* ('can', 'it is possible') and the demonstrative *tam* ('there')[176]:

(10b) *Nu,* ***vam*** *mozno togda* ***tam*** *prizemlit'sja.*

Well, **you** can then **there** land.

'Well then, you can land there'.

[176] Cf. the notion that Russian is an SVO language (e.g. Bailyn 2001: 280); in the particular utterance, "vam" is a subject-like non-nominative (cf. Sigurðsson 2002) or a dative experiencer that requires an initial position before the main verb within an inversion construction (see Bailyn 2001: 282f.).

Hence, the observed self-repairs can be accounted for by pragmatic considerations of the discourse participants, e.g. to make their own judgments appear more objective and so polite (as in (9)). Alternatively, self-repairs can be dysfluencies that occurred due to the depletion of available cognitive resources, which is required for fluent speaking (as in (10)) The latter can be also studied in the context of instances of irregular word order, which will be addressed next.

The third observation of speech under stress deals with utterances containing irregular word order. The sentences with irregular word order are listed below, with the instances of irregular word order highlighted in bold:

(11) *Nu, i **zatjagivat'** do šesti mesjačev **bol'no** ne budem.*

Well, and **delay** till six months **much** not will.

'Well, we also certainly won't wait around for six months.'

(12) *Daze jesli oni prizemljatsja, uze əto **uspekh krutoj**.*

Even if they will land, already this **success cool**.

'Even if they land, it will already be a big success.'

(13) *Ja tak ponjal prosto vot, što korabl' v porjadke tam, **oborudovanie kakoe-to**.*

I have this way understood just well that ship in order there, **equipment some**.

'I have understood it like, well, that the ship is safe there, some equipment (will be damaged)[177]'.

In the first utterance, the verb *zatjagivat'* ('delay') and adverb *bol'no* ('much') should have been used adjacently to each other while the adverb would normally, in an unmarked case, precede a verb (cf. e.g. Dyakonova 2009: 5). In the second utterance, the adjective *krutoj* ('big', 'cool') follows the noun *uspekh* ('success') which is a marked word order in Russian because adjectives tend to precede the head noun they modify (cf. e.g. Comrie 2018: 294; Lyovin 1997: 70). Similarly, in the last excerpt, the indefinite pronoun *kakoe-to* ('some') is uttered after the noun it refers to, i.e. *oborudovanie* ('equipment') which is a marked word order in Russian (cf. e.g. Comrie 2018: 294; Lyovin 1997: 70f.).

To conclude the inductive analysis of the linguistic material produced by the native speakers of Russian during increased levels of HR, three aspects stood out: instances of repetitions, self-repairs, and irregular word order. However, it ought to be noted again that the present inductive approach rests on descriptive accounts so that it is not intended to describe all linguistic patterns that are susceptible to stress, nor to derive conclusions which would be generalizable to the population at large other than the current sample of five subjects. Furthermore, the findings described in the present study were not juxtaposed against the speech samples during HR in its resting state because it was suggested (cf. section 11.2.6.) that the periods of the HR at rest (i.e. from 40 bpm to 80 bpm) can be concurrent with the periods of fatigue. Therefore, such a juxtaposition would not be justifiable in light of the lack of evidence that the periods of the HR at rest solely exemplify speech under non-stress. Nevertheless, the

[177] The passage in the round brackets offers one of the most likely continuations of the utterance.

inductive approach allows to draw several hypotheses which can then be addressed and tested in future experiments:

- The first hypothesis is that repetitions emerged due to the speaker's depleted mental resources which would be required during the word finding process and construction of a well-formed TCU (cf. section 3.2. for the discussion of TCUs). Thus, a speaker aims to "gain time" by repeating a part of an utterance in order to allocate the limited amount of mental (or scarce due to high stress) resources to complete the initiated utterance (cf. *filled pauses* ("gefüllte Pausen" in Hofferberth (2021: 56)) which, among other functions, help speakers to gain time to redesign the utterance ("Neuplanung" in ibid.)).
- Self-repairs arise during the process of self-monitoring of one's own speech (cf. Levelt's (1989) model of language production) and become more frequent when a speaker is under stress due to the depletion of available cognitive resources required for fluent speech. Nevertheless, because "self-monitoring requires attentional resources, which are limited" (Zuniga & Simard 2022: 2), it is also possible that, when stress is too high or prolonged and the amount of available attentional resources is critically scarce, no self-repairs take place (cf. the Yerkes-Dodson law discussed in section 2.1.; cf. also Hohenberger (2007: 92) who argues that probability of monitoring, in the form of a feedback from a lexeme to a lemma, relies on the time dimension during speaking, e.g. slow vs. quick speaking).
- Irregular word order arises due to deviations during linearization process which depends on working memory capacity (cf. Levelt 1981). In particular, such irregularity of word order takes place during the positional processing which is "the creation of an ordered set of word slots (constituent assembly)" (Bock & Levelt 1994: 946) during the grammatical encoding (ibid.). As was discussed previously (see section 2.1.2.), working memory is negatively affected by stress. Hence, perceiving stress should lead to unconventionally ordered word slots during grammatical encoding (cf. "[m]emory pressures […] can impact the extent of advance planning in [language] production […]" (Slevc 2023: 19)).

On this note, the analysis of the language under stress is completed. In this chapter, several questions have been addressed. First, it was discussed whether speakers tend to produce linguistic structures that are assumed to be cognitively less demanding, when they are exposed to higher levels of stress. To investigate this, a statistical analysis was conducted to determine whether the distribution of (i) Pfv. verbs to Ipfv. verbs and (ii) passive clauses to active clauses would be significantly different in L1 Russian spontaneous speech of five subjects under varying degrees of stress, which was measured through their HR. This turned out not to be the case. Therefore, the aspectual and grammatical voice systems of Russian can be seen as *symmetrical* in terms of the cognitive resources they require from the speaker in this study.

Second, it was considered whether there is an association between a speaker's choice among the semantic classes of the Russian pronouns, as well as instances of pro-drop, and his/her HR reactivity. According to the two-sided Fisher-Freeman-Halton and the two-sided Fisher's exact tests, there was no association between the instances of pronouns and pro-drop and the physiological parameter, respectively. Nevertheless, it was argued that the frequency of demonstrative, negative, and indefinite pronouns should be taken into consideration, since, under increased levels of HR, the subject produced more negative and indefinite pronouns but fewer demonstrative pronouns than would have been expected. Compliant with the Givenness Hierarchy and Accessibility theory, the subjects were assumed to perceive demonstrative pronouns as "less easily decodable" by their hearer(s) and so preferred to produce more explicit references, for instance by means of subordinate clauses, to make it "easier" to the hearer to

decode the reference (cf. “audience design” in Bell 1984). Thus, the speaker projects his/her mental state, i.e. his/her depletion of cognitive resources due to stress, onto the hearer. Furthermore, the increased usage of negative pronouns was assumed to reflect the subjects’ emotional state of nervousness – and possibly annoyance – that interfered with a possibility of conveying a more neutral and diplomatic manner to express an intended proposition. Similarly, the increased usage of indefinite pronouns during the periods of elevated stress was accounted for by the subjects’ assumed emotional state and, in particular, their state of anxiety. Feeling anxious might have caused the subjects to be more doubtful in their manner of speaking. Therefore, on the one hand, the subjects tended to become more assertive (i.e. due to the increased use of negative pronouns), and, on the other hand, the subjects tended to articulate more uncertainty (i.e. due to the increased use of indefinite pronouns). Considering both cases, stress tended to be reflected in “linguistic surplus” in terms of pragmatics. In other words, speech under stress tended to be either stridently assertive or full of hesitations. These interpretations, however, warrant further investigation and hence have to be considered with great caution.

Third, the inductive analysis of the present linguistic data during increased HR levels revealed three major hallmarks: the speech under stress entails instances of repetitions, self-repairs, and irregular word order. In the framework of the inductive analysis, an explanation was offered for why the discovered instances of repetition, self-repair, and irregular word order occurred. Furthermore, an attempt was made to theoretically ground these anecdotal observations.

In the following chapter, the research at hand including both empirical parts, i.e. the content-oriented analysis and analysis of context-sensitive categories, will be summarized. General conclusions and suggestions for future research of language in use under stress will be given.

12. General conclusion

Currently, manned space exploration is enjoying a new surge. Nations worldwide are making arrangements for returning humans back to the Moon and even colonizing Mars. To succeed in these arduous efforts, the safety of future space missions must be ensured. This makes concerns regarding human factors especially relevant and the means to prevent their detrimental effects on a space mission success worthy of close investigation. Stress that astronauts and cosmonauts experience is one of the major psychological affairs of space travel that has the potential to significantly impair the performance of space travelers and thus compromise the safety of a space flight in general. Stress, as a scientific notion, has a broad definition and can emerge due to a great number of factors, be they physiological or psychological; furthermore, stress can denote both "positive" stress (eustress) and "negative" stress (distress). The present research was occupied with the effects of "negative" stress that was caused by the psychological conditions of isolation in space. Thus, being under a prolonged or considerable amount of stress leads to a myriad of negative manifestations in human cognitive behavior, such as decline in working memory capacity, shrinkage of attention span, and the like. Furthermore, stress can be associated with changes in human social behavior, such as, for instance, interpersonal conflicts. Needless to state, such effects of stress compromise the efficient and reliable performance of space travelers. Hence, it appears necessary and essential to elaborate a method to assess stress. Linguistic data, being always available during a space flight, e.g. due to communication with MCC or interpersonal interactions onboard a spacecraft, provide an apt data source in this regard; linguistic patterns have been known to reflect fluctuations of mental states in a speaker (cf. e.g. Yusupova et al. 2019: 710).

The present research aimed to address quite a sweeping question about the influence of distress on spontaneous speech. The goal was to find evidence of stress that a speaker was experiencing through their way of speaking. The linguistic material of a six-person mixed gendered Russian-American group, who was sealed in an isolation chamber for four months, was obtained during five decision-making discussions and analyzed from two broad perspectives:

- Content-oriented analysis: the methodology of this analysis was based on a synergistic approach which relied on a number of existing studies on the effects of stress, e.g. due to high levels of workload, on communicative behavior. Furthermore, the theoretical foundation of the content-oriented analysis at hand was enabled by such concepts as linguistic pragmatics (the philosophy of language, i.e. the theory of Speech acts, in particular), conversation analysis, and the method of content analysis. The obtained linguistic data were also correlated with the physiological data (i.e. heart rate) and juxtaposed with sociometric findings.
- Analysis of context-sensitive linguistic categories: the methodology of this analysis had a more quantitative orientation to the obtained linguistic data and was based on a statistical analysis of the distribution of selected linguistic categories that were assumed to involve varying degrees of cognitive resources, on the side of either a speaker (the Markedness theory) or a hearer (the Accessibility theory and Givenness Hierarchy). The degree of perceived stress in speakers was measured through physiological data (i.e. heart rate) and then brought into the statistical analysis with the collected linguistic data.

The four-month period of physical and social isolation, SIRIUS-19, took place in a unique facility at IBMP (Moscow, Russian Federation) and simulated conditions of a real space flight of a six-person crew to the Moon, followed by its return to Earth. Apart from the stressor of long-term isolation as such, the subjects were imposed to additional stressors, namely sleep deprivation and the requirement to conduct part of one of the discussions in English, which was a foreign language for the majority of the crew. An unplanned stressor was furthermore identified; this factor was related to social tension that emerged while the isolation progressed.

The content-oriented analysis of the linguistic material proceeded on three separate levels: a holistic analysis of the crew's communicative behavior on the group level, an analysis of individual communicative characteristics, i.e. the intra-individual level, and a comparison of the subjects' communicative characteristics, i.e. the inter-individual level. The content-oriented analysis on the group level addressed the following question:

> How did the communicative behavior of the crew, as a coherent body, change across the entire isolation period, under the "normal" isolation conditions[178], and during the discussions with the additionally designed stressors[179]?

With respect to the crew communicative behavior assessed on the group level, two observations were found. First, the quantitative formal-linguistic categories (i.e. number of words and number of turns) were reliable indicators of load, overlooking the nature of a demanding factor, i.e. isolation progression, interpersonal tension, an L2, or sleep deprivation. Thus, the prominent decrease of the metrics of the two categories was associated with an increase in perceived load in the crew in the discussions with the additional stressors, while the slighter decrease of the respective metrics during the discussions without such additional stressors was associated with less load (cf. the Yerkes-Dodson law which was outlined in section 2.1. as well as the findings in Zhabin (2009) which were summarized in section 3.4.3.). Second, the category "Receptiveness", which focuses on the frequency with which one speaks a respective L2, was also an apt indicator of changing demands on the group level. According to this category, the crew tended to be more receptive in response to demanding discussions. Yet, this category was less reliable than the quantitative categories because it did not account for the factor of sleep deprivation[180]; the crew turned out to be less receptive to L2 during the phase of sleep deprivation than in the very first discussion in isolation which did not entail any additional demands. Nevertheless, the metric on the category "Receptiveness" was higher in the discussion during sleep deprivation than in the discussion that preceded it, which was without additional demands[181].

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[178] Discussions without designed stressors, i.e. D1, D2, and D4, were originally considered as the "normal" isolation conditions (see section 5.4.).

[179] The discussions with the additionally designed stressors were D3 (a discussion in English) and D5 (a discussion that took place during sleep deprivation) (see section 5.4.).

[180] It is important to mention that the interpretation of the category "Receptiveness" was limited to four discussions because D3 was excluded (see n. 121 in section 8.4.1.).

[181] It was assumed that the evolution of the categories in the discussions without additional stressors would proceed linearly (see chapter 6). One might, however, argue that the categories do not have to evolve linearly in response to isolation progression even without additional stressors. First, one might state that isolation as such is subdivided into stages which carry varying degrees of load to the crew (see section 2.1.1.); these stages alone can lead to a non-linear character of the evolution of the categories throughout isolation. This argument is certainly fair and also aligns with the expectation of a "deviant" character of the evolution of the categories in response to the discussions with additional demands (cf. also the Yerkes-Dodson law, see section 2.1.). As a matter of fact, it was the rationale for separating D2 from other discussions without additionally designed stressors. Second, it is possible that the qualitative characteristics of an individual category might govern the predisposition of this category to evolve non-consistently in response to demands in general; this aspect was not in the focus of the present study. Nevertheless, the initial assumption, and thus the subsequent data interpretation, regarding the consistency (and oftentimes

When comparing the results of the present analysis with the seminal study by Silberstein & Dietrich (2003; see section 3.4.1. for a summary of the study), the present results on the category "Receptiveness" correspond to those of Silberstein & Dietrich (2003: 31f.) with respect to the value "[focused]", which signifies concentration on crucial information channels (ibid. 19) during periods of high workload in comparison to low workload. However, the conclusions made on the quantitative categories, i.e. the number of words and number of turns, contradict the results in Silberstein & Dietrich (ibid.: 28f.) with respect to the category "Information Sharing"[182]. One can assume that the differences in communication environments – within isolation, as in the research at hand, and in the cockpit, as in the study by Silberstein & Dietrich (2003) – are crucial. In the cockpit, pilots are instructed to go through checklists during situations with increased safety risks, which are inevitably associated with increased load imposed on the crew (e.g. during a take-off or landing). This leads to a more intensive exchange of information. However, during the isolation experiment, there were no such checklists so that the decrease in communication activity under increased demands should be interpreted as a decline in group capacity, or intrinsic motivation, to develop an exhaustive group discussion. Therefore, the results of the present study might point at the general predisposition of a small group to react towards increasing demands by shortening the length of a discussion. To sum up, on a group – macro – level[183], the willingness to engage in intensive lengthy discussion tended to diminish, whereas it was aimed to make the discussion comprehensive for all participants in terms of increased usage of an L2. Hence, the discussions with additional stressors tended to be shorter but more "linguistically inclusive" under increased load, while the discussions without extra stressors tended to be longer but still "linguistically inclusive" under increased load.

Other formal-linguistic and pragmatic categories were less informative in terms of a holistic approach to load assessment on the group level. Nevertheless, their analysis is meaningful for characterizing individual discussions with the additional taxing conditions as the isolation period progressed. So, the discussion with the stressor of interpersonal tension (the second discussion, i.e. D2) was marked with substantially fewer utterances which were novel and relevant for the resolution of a conversational goal (i.e. information-shift utterances), while an increase in such utterances was interpreted as an indication of increased load in the other two discussions with the pre-designed stressors, i.e. speaking English (the third discussion, i.e. D3) and being deprived of sleep (the fifth discussion, i.e. D5). D2 was also a turning point with respect to the frequency of parallel discussions, where they were recorded with the lowest frequency. Furthermore, all the subordinate quaestiones were initiated to coordinate teamwork. These findings suggest that the crew was less interested in communicating with each other in general and were more inclined to quickly agree on the resolution of the conversational goal while their communicative style could not be described as efficient. Additionally, their communicative behavior was emotional and contained instances of negative connotations. These observations emphasize the type of the underlying stressor during D2, namely the emerging in-group discord that was also evident as assessed by the "leisure" criterion of the sociometric study, that was conducted by IBMP (Gushin & Vinokhodova 2020) and thus was independent of the psycholinguistic analysis (cf. Anikushina et al. 2022).

linearity) of the evolutions of all categories in response to demands finds support using the triangulation approach by means of a number of independent studies on the same subjects (see section 8.4.2.).

[182] The reader can be reminded that the present research only considered [yes] values in terms of Silberstein & Dietrich (2003) (see section 7.1.1.); Silberstein & Dietrich (2003: 28f.), however, also found an increase of [no] values in the conditions of danger according to their category "Information Sharing".

[183] The analysis on the group level furthermore did not exclude the factor of isolation progression that put additional demands on the already demanding discussions (cf. the approaches on the intra-individual and inter-individual levels that are discussed later).

Speaking English, an L2 for the majority of the crew, was characterized by a shift in the qualitative character of the subordinate quaestiones. In D3, the subjects not only initiated these quaestiones to coordinate teamwork, which was the only reason that the crew initiated subordinate quaestiones in other discussions with the additional demands, but were also open to conversations on side topics and, considerably less frequently, to articulating their own opinions. Noteworthy is that responsiveness to new quaestiones achieved its highest value in D3. Furthermore, D3 was a discussion with the lowest frequency of directive and commissive IAs; after D3, both types of IAs gradually increased. Hence, the attempt to relocate the group's focus to issues not related to the main conversational goal, e.g. jokes, can be interpreted as a strategy to avoid the linguistic uneasiness due to English which represented a difficulty for half of the crew[184].

The communicative behavior of the crew during sleep deprivation is noteworthy too. In D5, responsiveness to new subordinate quaestiones decreased drastically, while the frequency of utterances related to the representative IA decreased slightly for the first time during isolation. Furthermore, the crew was quite eager to participate in parallel discussions. These findings can be explained by the fact that the subjects were less willing to process or produce new discoursal information and more prone to be distracted. However, if they did speak, their input efficiently contributed to the conversational goal which was assessed by means of the information-movements (in particular, by means of information-shift utterances). They also avoided emotional expressions and preferred directive expressions; furthermore, all initiated subordinate quaestiones were aimed to coordinate teamwork. Consequently, under the condition of sleep deprivation, the crew's communicative behavior became more efficient and straightforward. On the other hand, the crew tended to be easily disturbed and sidetracked from the main discussion thread.

The second approach to the linguistic material within the content-oriented analysis was based on the intra-individual overview of the evolution of the elaborated categories. The analysis on the intra-individual level addressed the following questions:

> Did the communicative behavior of individual subjects change across the entire isolation period under the "normal" isolation conditions and during the discussions with the additionally designed stressors? Does one's communicative behavior correlate with the character of his / her heart rate? How common were these individual types of communicative behavior among the subjects?

By assessing the evolution of the formal-linguistic and pragmatic categories, attention was directed to two patterns: (i) when an evolution of a category is consistently increasing / decreasing throughout all stressors, and (ii) when an evolution of a category is consistently increasing / decreasing throughout all stressors in the discussions with additional demands and indicates the opposite dynamic in the stressor of the isolation progression. The selection of these two patterns was justified by the fact that only the dynamics of the evolution of the categories – as either increasing or decreasing – were considered. Therefore, conclusions based on less consistent patterns of the evolution of the categories (e.g. an evolution of a category *tends* to be increasing / decreasing during the discussions with the additional demands; see section 9.7.) appeared too fuzzy and vague. Therefore, the latter were ignored.

According to the analysis on the intra-individual level, all formal-linguistic and pragmatic categories (the latter were assessed by means of IAs) indicated a pattern of consistent evolution (i.e. (i) according to the above-mentioned description) by at least one subject. Furthermore, all subjects, except for subject 5, showed such a pattern of communicative

[184] This assumption is based on pre-isolation interviews in a respective L2 with each isolation participant. The interviews were conducted by V.A..

behavior. On the other hand, only the communicative behavior of subject 6 was identified as featuring a consistent pattern of the opposite character of communicative behavior under exposure to additional demands in comparison to the discussions without such extra demands (i.e. (ii) according to the above-mentioned description). Subject 6 produced *fewer* turns in all discussions with the additional stressors in comparison to the mean quotient of this value during the "normal" discussions. This dynamic also differed from the evolution of the value under the time stressor, with subject 6 producing *more* turns by the end of isolation than in its beginning under the "normal" isolation conditions. Hence, the production of fewer turns can be considered as the subject's specific communicative coping strategy to extra load. Notably, this communicative behavior corresponds to the findings on the group level – the crew produced fewer turns during the discussions with the additional demands, as well as fewer turns at the end of the "normal" isolation. Given that the latter contradicts the findings of the intra-individual analysis for subject 6 (i.e. subject 6 produced more turns by the end of isolation during its "normal" condition), it has to be noted that individual communicative behavior can deviate from the holistically assessed communicative behavior of a group. This was illustrated with the help of the above-mentioned example.

To sum up, the same pattern of communicative behavior tended to be applied by the subjects to all demanding factors, i.e. the time progression in isolation as a stressor, interpersonal tension (D2), speaking English (D3), and sleep deprivation (D5). In other words, the subjects tended to adapt their communicative behavior to all stressors in the same way (e.g. by increasing the frequency of information-shift utterances), disregarding the nature and, probably, the intensity of distress. This is in consonance with the findings in psychology (cf. Satir's theory on the manifestation of typical communicative reactions of humans under stress mentioned in Yusupova et al. (2019) and outlined in section 3.4.2.1.).

As to the frequency of the intra-individual "strategies" in the subjects' communicative behavior, only the utterances of the commissive IA decreased in the communicative behavior of three subjects, i.e. for half of the crew, throughout the period of "normal isolation" as well as throughout all discussions with the additional stressors. The evolution of other categories indicated a similarity in the subjects' communicative behavior less frequently. The decreased frequency of commissive utterance was the most common pattern to "respond linguistically" to distress among the subjects. Other analyzed categories indicated a less persistent character in the subjects' speech, e.g. the category "Interpreting" decreased and the category "Responsiveness" increased in the communicative behavior of two subjects.

Considering the correlation between the formal-linguistic / pragmatic categories and cardiovascular reactivity, there were thirteen statistically significant correlations that were identified in the speech of five subjects. A statistically significant correlation of HR and a category / value was usually identified in only one subject for the respective category / value, whereas few correlations based on the same categories / values were found in communicative behavior of more than one subject. Among these, there was the correlation of expressive utterances with HR in subject 1 and subject 6[185], the correlation of commissive utterances with HR in subject 2 and subject 6, and the correlation of utterances labeled as [- task-related] with HR in subject 4 and subject 6.

The distribution of the thirteen statistically significant correlations with the categories, according to their belonging to either pragmatic (i.e. pragmatic values, which were grouped under four IAs, as well as types of subordinate quaestiones) or formal-linguistic categories /

[185] The correlations, however, were expressed in opposite directions: a positive correlation in subject 1 and a negative in subject 6.

values (number of words and turns, proportion of information-shift utterances, etc.)[186], was as follows:

- expressive (subject 1 and subject 6), directive (subject 4), commissive IAs (subject 2 and subject 6), as well as values [providing feedback] (subject 2), [- task-related] (subject 4 and subject 6), [acknowledging linguistic dominance] (subject 5), [verifying] (subject 5), initiated quaestiones ("coordination" and "side structure" in subject 1);
- category "Responsiveness" (subject 4).

From this overview it may be concluded that physiological reactivity was more frequently correlated with the pragmatic categories than with the formal-linguistic ones.

The third approach to the linguistic material within the content-oriented analysis was based on a comparison of the evolution of the categories between the subjects. The analysis on the inter-individual level addressed the following questions:

> Were there any similarities in the patterns of communicative behavior among the subjects? Can such similarities in the patterns of communicative behavior be considered a consequence of sympathy and affinity between the crew members?

The comparison of the subjects' communicative behavior rested on the analysis of the evolution (either increasing or decreasing) of the elaborated categories. The inter-individual comparison differentiated between the evolutions of the formal-linguistic and pragmatic categories. Two subject dyads – subject 1 and subject 3 as well as subject 2 and subject 4 – were identified as the most similar subject pairs. The evolution of the formal-linguistic categories turned out to be more informative than that of the pragmatic categories in terms of establishing patterns of similarity in the subjects' communicative behavior. Specifically, the two above-mentioned subject pairs were noticeably similar with respect to two discussions according to the formal-linguistic categories and in one discussion according to the pragmatic categories, which was also characterized as similar following the formal-linguistic categories in each respective subject dyad.

Given that the formal-linguistic categories were more illuminating for drawing comparisons between the subjects' communicative behavior, the findings of this category type were applied to juxtapose the similarities in the communicative behavior with the sociometric data. The sociometric data, which was obtained and analyzed by IBMP (Gushin & Vinokhodova 2020), was collected by means of a recurrent questionnaire comprising two questions that each subject had to answer: (i) With whom of the crew would you participate again in a similar isolation? (ii) With whom of the crew would you depart onto an uninhabited island? (ibid.). The parallel comparison of the communicative data, grounded on the formal-linguistic categories, with the evolution of sociometric changes on both criteria revealed that a mutual affinity on the work-related criterion (i.e. question (i)) tended to coincide with high degrees of similarity in the communicative behavior; furthermore, the affinity on the leisure-related criterion (i.e. question (ii)) tended to inhibit such communicative similarity. In other words, the subjects appeared to develop similar communicative behavior, expressed in the evolution of the formal-linguistic categories, if they sympathized with each other as colleagues but not as friends. This inference was supported by anecdotal pieces of evidence. One of the explanations of such a finding in the frame of the present study might be that those subjects that were bonded as friends did not necessarily adjust their behavior to the behavior of their "peer-friend"; they maintained their "authentic" manner of communicative behavior because one is

[186] Cf. sections 7.1.3. and 7.1.4. for the detailed description of the categories.

usually accepted as one is by one's friends. Conversely, those subjects who only preferred to work together "tuned up" their communicative behavior – unconsciously, certainly – with one another, presumably to enhance efficient work because they were not able to rely on the unequivocal acceptance of the respective subject, as would normally be the case among friends[187].

In general, if one compares the findings on the inter-individual level of analysis with that on the intra-individual level, then HR characteristics should be more interrelated with the *pragmatic* categories, whereas changes in sociometric group structure should be more interrelated with the *formal-linguistic* categories. Thus, among the thirteen statistically significant correlations between the subjects' communicative behavior and physiological reactivity (cf. the analysis on the intra-individual level discussed above), there were twelve correlations with the pragmatic categories / values but only one with the formal-linguistic category. The formal-linguistic categories / values, however, were found to correspond with the sociometric data, in particular the work-related criterion. In other words, physiological state, which was measured by means of heart rate, tended to be associated with the pragmatic aspects of speech, while formal aspects of speech were more likely to reflect social relations among the subjects.

To conclude the discussion of the content-oriented approach, the elaborated taxonomy of the pragmatic and formal-linguistic categories can be considered effective to evaluate the communicative behavior of the subjects in the four-month social and physical isolation conditions with respect to (i) stress they perceive as a group (the group level of analysis), (ii) defining a typical communicative behavior of individual subjects under increased demands (the intra-individual level of analysis), and (iii) providing grounds for notable similarities in the communicative behavior of the subjects based on their interpersonal relationships (inter-individual level of analysis).

There are some limitations that have to be kept in mind when considering the findings in the present content-oriented analysis. To start with, the present research is the first attempt to employ the outlined methodology; therefore, it requires further validation. Secondly, the analysis was based on a case study. The data were collected on six subjects who were carefully selected to meet the strict requirements of the experiment organizers; thus, the subject sample was neither randomized nor extensive. However, these shortcomings can be justified by the fact that they are intrinsic to any case study which looks at data qualitatively rather than quantitatively. Further, studies of this type (investigations of human behavior in the context of space exploration) can only be case studies. Thirdly, on rare occasions one turn was coded by more than one pragmatic value which both fall under one IA; thus, it might have slightly affected the quantitatively represented results of the coding procedure, especially those grounded on the IAs as a superordinate category. Fourthly, the intra-individual and inter-individual analyses were performed by considering the evolution of the elaborated categories (i.e. increasing or decreasing) but not considering their absolute numbers. To compensate for this possible deficiency, the data on the individual communicative behavior, with indications of the respective absolute values, are provided in the Appendix (Table 62 – Table 67). Fifthly, after accounting for the multiple comparisons problem with help of the Bonferroni correction, none of the outlined statistically significant correlations on the intra-individual level remains statistically significant according to the adjusted *p*-value. Nevertheless, it was argued that the present research is an explorative case study so its main purpose is to outline all possible correlations which should be examined using more stringent methods in further studies / experiments. Furthermore, the material of the present analysis was authentic, spontaneous, unconstrained communication, which also hinders statistical testing. Finally, the context of the

[187] These interpretations however should be limited to the present study since it is possible – and even expected – that friends tend to become alike in their communicative behavior with time in real life.

present study was quite specific – the long-term isolation of a small mixed-gender international group. Despite this fact, the study can be considered important in the realm of manned space exploration and thus should justify its unique framework.

As an alternative approach to look at the present linguistic data, it was suggested to consider context-sensitive categories of language that imply that certain grammatical entities require more cognitive resources than others. The choice among such context-sensitive categories was analyzed on the corpus of the spontaneous speech by the five Russian native speakers within the isolation experiment. As a theoretical background for the relation between the choice among available linguistic options and the required cognitive resources, the Markedness theory, the Accessibility theory, and the Givenness Hierarchy were introduced in the theoretical part of the dissertation. Following the Markedness theory, the grammatical voice and aspectual systems of Russian dispose over grammatical oppositions (i.e. active vs. passive voice and Ipfv. vs. Pfv. aspect) that should differ with respect to the cognitive demands they impose on a speaker: (i) passive voice is assumed to be cognitively "more demanding" than active voice and (ii) Pfv. aspect is assumed to be cognitively "more demanding" than Ipfv. aspect. Following the Accessibility theory and Givenness Hierarchy, referring expressions also vary in terms of the cognitive resources they require from a hearer so that, for instance, demonstrative or personal pronouns are cognitively "less demanding" than instances of pro-drop. All these theoretical assumptions were unified for testing with the help of the following hypothesis:

> When the subjects' level of perceived stress increases, those linguistic structures are preferred by the speakers that require fewer cognitive resources.

To test this hypothesis, speech excerpts of five native speakers of Russian were classified with respect to whether they were uttered during the periods of stress or not. Following the study by Saslow et al. (2014; see section 3.4.3. where the study was outlined and in which the lowest linguistic cognitive complexity took place in the subjects' speech when their mean HR was 93.46 bpm), HR being equal to or more than 94 bpm was defined as a threshold of high stress relevant for linguistic performance. Thus, it was expected to see a statistically significant difference in the distribution of the members of the grammatical oppositions, according to the Markedness theory (i.e. active vs. passive voice and Ipfv. vs. Pfv. aspect), in the subjects' spontaneous speech when their HR was equal to or more than 94 bpm in comparison to their HR being below 94 bpm. This turned out not to be the case. In the next step, the physiological parameters were restricted by considering only HR in its resting state (i.e. from 40 bpm to 80 bpm) as a marker of a non-stress state. Nevertheless, this stricter approach did not result in any statistical significance of the distribution of the grammatical oppositions (i.e. active vs. passive voice and Ipfv. vs. Pfv. aspect). Thus, it was concluded that the Markedness theory assumption on the asymmetrical cognitive status of the grammatical members was not supported in the present study.

The analysis of the distribution of Russian referring expressions, which was in the present case nine semantic classes of pronouns and instances of pro-drop, was performed by considering two physiological parameters: (i) in which HR was from 40 bpm to 80 bpm, i.e. HR was in the resting state, and (ii) in which HR was equal to or more than 94 bpm, which indicated a high level of stress relevant for linguistic performance, following Saslow et al. (2014). In the first step, a statistical analysis was conducted to evaluate whether the distribution of the semantic classes of pronouns were susceptible to changes due to the speakers' level of stress. Despite the lack of the statistical significance, it was noticed that demonstrative, negative, and indefinite pronouns demonstrated the greatest difference between the actual and expected counts. Thus, there were fewer than statistically expected instances of demonstrative

pronouns and more instances of negative and indefinite pronouns, when the subjects' HR was equal to or more than 94 bpm (or, in other words, when the subjects experienced substantial amounts of psychological stress). Concerning the demonstrative pronouns, this seemed to agree with the Givenness Hierarchy and Accessibility theory (see section 4.2. for the explanation of the respective theoretical accounts). It was suggested that increased load led the speakers to assume that the entities that had been previously mentioned in the discourse are difficult to the hearer to decode. Therefore, the speaker would prefer to specify them, for instance by means of subordinate clauses. To prove this assumption, an anecdotal example was provided.

With regard to the distribution of negative pronouns, it was concluded that they were produced more frequently during the periods of elevated stress than it was statistically expected, because the subjects felt the urge to express themselves categorically due to the emotional distress they were perceiving. Thus, the subjects were not open to more subtle and, perhaps, polite ways of communication when under stress.

With respect to the distribution of indefinite pronouns, it was suggested that their increased frequency in speech under stress was owed to the subjects' feeling anxious and uncertain. Therefore, they tended to be less specific. Considering the usage of both negative and indefinite pronouns together, the frequency of which was higher during stress than statistically expected, it was concluded that stress can result in "linguistic surplus" in terms of pragmatics; a speaker would prefer not to be neutral in the manner of speaking so that their speech was either "too assertive" or "too hesitant".

As to the analysis of the distribution of the instances of pro-drop, their "usage" was compared to the sum of instances of personal and demonstrative pronouns. It was posited that personal and demonstrative pronouns do not introduce additional semantic characteristics to discourse, other than a "mere" reference to the previously introduced entity; other pronouns, e.g. negative or indefinite pronouns, always entail further semantic characteristics so that omitting these pronouns would violate the well-formed nature of the discourse. According to the statistical analysis, no statistically significant differences in the distribution of the instances of pro-drop and the sum of the instances of personal and demonstrative pronouns were evident.

To conclude the discussion on the analysis of speech patterns with the help of the context-sensitive categories, some limitations have to be addressed. First, it was not controlled for potential causes of physiological arousal. It was assumed that high HR levels were associated with an increase in *mental* load and *negative* changes of emotional state for the following reasons:

I. The subjects, when they were speaking, were not physically moving, which could have led to increase in HR. They were sitting at a table while partaking in the discussions.
II. Increased HR is usually linked with distress ('bad' stress) rather than with eustress ('good' stress) (cf. Saslow et al. 2014; see section 2.2.). Nevertheless, following the inverted U-shaped pattern of interrelation between performance and demands (see section 2.1.), even 'good' stress can negatively influence performance once it surpasses the optimal level of arousal/stimulation.

In a similar vein, future research should better control for further factors which can be linked to differences in physiological reactivity, for instance the subject's age or periods of laughter during speaking.

Secondly, the HR data were analyzed without consideration of the isolation progression, i.e. disregarding whether the elevated HR was observed in the first (D1) or the fourth (D4) month. Hence, the state of fatigue was not controlled for, which can be expressed in decreased HR (see section 2.2.); therefore, speech patterns during "normal" HR (i.e. either (i) when it is below 94 bpm or (ii) in which it ranges from 40 bpm to 80 bpm) can coincide with periods of

fatigue. This consideration seems corroborated by the findings of the context-oriented analysis which pointed out that fatigue should have emerged from around the second month of isolation (see section 8.4.2.; also Anikushina et al. 2022; cf. Supolkina et al. 2021). Hence, this is probably one of the reasons why there were not enough linguistic data of speech under stress in D2, D3, and D5. The subjects should have been overloaded by the conjunction of the emerged fatigue and the additional demanding factors that were attributes for these discussions; therefore, they did not respond with increased HR.

Third, it is possible that the difference in the distribution of *full NPs* and pronouns (together with the instances of pro-drop) would be statistically significant. In the present research, however, the focus was directed towards the usage of pronouns only. Furthermore, in future studies, it should be better differentiated between pronouns in their adjectival function (e.g. *some observations*) and pronouns in nominal function (e.g. *some said*) that solely possess a referring function; only nominal pronouns should be analyzed (cf. the analysis in this dissertation which was carried out on the distribution of personal and demonstrative pronouns vs. the instances of pro-drop).

In general, the linguistic data were scarce; there were only five decision-making discussions in which six subjects took part, among which only five subjects were considered for the analysis. Further, and partially due to this limitation, there were even more scarce linguistic data for the measure of elevated HR. Instances of speech during the elevated HR were found in only two discussions.

The empirical part of the present research was concluded with the inductive analysis of speech patterns during increased HR. Instances of repetition, self-repair, and irregular word order were expounded and it was explained regarding why such dysfluencies might have taken place. It was furthermore attempted to theoretically ground the anecdotal observations.

To sum up the research at hand – both with respect to the content-oriented approach to the linguistic data and context-sensitive linguistic categories – it is important to emphasize that the research was a case-study. Despite its possible shortcomings, for instance, the difficulty of generalizing the findings, any case-study – including the present one – enables a meticulous analysis of complex aspects of human language and communication as its direct product (cf. Cummings (2022: 2ff.) for a discussion on the advantages and disadvantages of a case-study based on linguistic data). Hence, the present research included components of a number of scientific disciplines other than (cognitive) linguistics, drawing from physiology, psychology, sociology, and philosophy. It was attempted to apply the knowledge derived from these disciplines to understand what factors can influence human language. A further considerable advantage of the present research lies in its non-constrained and authentic settings[188]. In the present study, it is arguably possible to speak about *uncontrolled* human speech, as opposed to that which usually takes place during constructed experimental environments in a laboratory. Even though one can still argue about the extent to which physical and social isolation can be treated as a "normal" and authentic environment, the freedom of what to speak about and how to speak was neither pre-defined nor influenced by any factor (apart from the factors which directly constituted the design of the decision-making tasks, for instance the limited time allocated for the task completion or the task to rank several options as such, cf. section 5.4.), which, for instance, would be more of a concern with visual stimuli that oftentimes aim at triggering priming effects. In the present study, the subjects were merely asked to solve a problem by communicating with each other. These communication patterns were the data.

To conclude, analysis of linguistic data appears to be meaningful in the context of demanding and stress-inducing situations to which manned space exploration undoubtedly belongs. Linguistic data are always present during a space mission, such as through the

[188] Cf. Nießen (1977: 49) on a group discussion facilitating a relaxed atmosphere.

communication of astronauts / cosmonauts with each other or with mission control, and are thus easily available. Moreover, no further equipment for their collection is required than those already present during a space flight, e.g. communication channels with earth. This makes the implementation of language analysis particularly suitable in the realm of manned space missions. It appears feasible, cheap, and valid to assess the mental states of speakers non-invasively. Language is a sensitive measure of one's psycho-physiological state and thus reliably reflects its dynamics. As a scientific method, language analysis can vary in terms of its focus. In this dissertation, it was suggested to study linguistic materials from two perspectives: (i) the content side of uttered communication and (ii) examination of the linguistic choices that a speaker makes when confronting the available options of the given language. By analyzing the content side of communication with help of an elaborated methodology, it was differentiated between levels on which communication can be studied. First, communication of a six-person mixed-gender group was examined as a holistic entity. It was possible to show that this level of analysis reveals signs of stress, as perceived by the group; a demanding factor, that was unplanned and unexpected, was also identified. This factor was of a social nature and related to group dynamics which was validated by the juxtaposition with sociometric data. In general, it was shown that the group tended to speak more under moderate stress (i.e. during the first discussion compared to the fourth discussion) and less under more intense stress (i.e. during the discussions with the additional demands), as well as it was apt to be more receptive to all available languages in the given communicative situation, Russian and English in the present research, when under stress.

Further, it was attempted to study the communicative behavior of individual subjects as a response to four different kinds of distress: (i) long-term isolation progression, (ii) interpersonal discord within the group, (iii) speaking a foreign language (which was applicable to the majority of the subjects), and (iv) sleep deprivation. It was found that the subjects tended to apply the same pattern of communicative behavior during all demanding situations. For instance, three out of the total of six subjects produced fewer utterances that revealed their point of view regarding the problem under discussion (i.e. commissive utterances, according to the terminology of the present work) as a response to all stressors in the study. The correlation of the physiological indications of stress – heart rate, in the present research – and communicative behavior in the subjects was also studied. Thirteen statistically significant correlations were found, among which the great majority (i.e. twelve instances) were correlations with the pragmatic aspects of speech, such as, for instance, expressivity of speech (i.e. measured by values [- task-related] utterances, utterances that belong to expressive illocutionary acts, as well as number of initiated topics unrelated to the main discussion), which was correlated with physiological level of stress in three subjects.

The concluding level of the content-oriented analysis was dedicated to a comparison of the subjects' communicative behavior. It was found that affinity between crew members, as either work colleagues or friends, can influence how similar speech patterns are within these subject dyads. In particular, subjects who prefer to work together tended to elaborate similar communicative behavior; on the other hand, subjects who were friends were less likely to be similar in the way that they communicate. Similarity in communicative behavior was established with help of the formal-linguistic aspects of speech, such as, for instance, the number of produced words or the number of initiated discoursal topics. From this it was concluded that subjects who indicated similar communicative strategies to demanding situations prefer to work together while not being bonded as friends. What is more, it was suggested that, within the frame of the present study, "being friends" rather contributes to dissimilar communicative strategies to distress, probably due to the expectation that friends accept each other for who they are. Therefore, there is no need to (unconsciously) adapt to one's communicative behavior to be heard and understood.

Linguistic materials were also examined in considering the choices a speaker makes when having at their disposal linguistic alternatives available in the given language, in the present study Russian. It was hypothesized that some linguistic elements are cognitively "easier" than others and therefore the "easier" ones should be preferred during periods of distress. The level of stress was measured through heart rate. First, it was analyzed whether the choice among aspectual forms (i.e imperfective and perfective aspect), and grammatical voice (i.e. active and passive clauses) depended on the level of physiological stress in five native Russian speakers. No relation of this kind was found. Second, referring expressions under varying degrees of stress were analyzed. Despite the lack of statistical significance in the association between kinds of referring expressions and physiological level of stress, indefinite, negative, and demonstrative pronouns were suggested to be considered sensitive to the change in the speakers' cardiovascular reactivity to the greatest extent. The subjects tended to produce fewer demonstrative and more indefinite and negative pronouns than statistically expected, under increased levels of stress. These observations were interpreted by means of social aspects of language use (the subjects were more categorical while at the same time uncertain when under stress, thus they uttered more negative and indefinite pronouns) and considering the cognitive nature of language (the decreased use of demonstrative pronouns under stress was associated with their difficulty for hearers during decoding processes that speakers attempted to avoid; hence, one can speak about a projection on the part of a speaker regarding their mental state on the hearers).

The analysis of language during distress was concluded with an inductive approach to the linguistic materials of Russian. Three hallmarks of language use by five Russian native speakers during elevated levels of stress were described: instances of repetitions, self-repairs, and irregular word order. Hence, these characteristics of dysfluent speech were typical features of spontaneous speech among native speakers of Russian under stress in the framework of the present study.

The overall question that this research was concerned with was the influence of stress on human language and communication as its product. The relevance of this inquiry was justified by current attempts of society worldwide to bring humans back to the Moon and, in the near future, to colonize Mars. The present research was carried out in the framework of a four-month human isolation study that recreated the conditions of a real space flight to the Moon and return back to Earth. Therefore, it is hoped that the present dissertation can be helpful in executing such an ambitious and inspiring endeavor as human space exploration.

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Appendix

		Discussion 1		Discussion 2		Discussion 3		Discussion 4		Discussion 5	
		Absolute number	**[%] of total instances**	**Absolute number**	**[%] of total instances**	**Absolute number**	**[%] of total instances**	**Absolute number**	**[%] of total instances**	**Absolute number**	**[%] of total instances**
Pragmatic categories	**Representative illocutionary acts**	156.00	44.83	69.00	47.92	118.00	54.88	153.00	55.84	79.00	52.67
	[adding information]	45.00	12.93	24.00	16.67	33.00	15.35	67.00	24.45	35.00	23.33
	[providing feedback]	22.00	6.32	3.00	2.08	3.00	1.40	12.00	4.38	6.00	4.00
	[listening "actively"]	61.00	17.53	33.00	22.92	51.00	23.72	50.00	18.25	21.00	14.00
	[acknowledging confusion]	11.00	3.16	1.00	0.69	6.00	2.79	9.00	3.28	3.00	2.00
	[acknowledging linguistic dominance]	1.00	0.29	0	-	10.00	4.65	2.00	0.73	2.00	1.33
	[verifying]	16.00	4.60	8.00	5.56	15.00	6.98	13.00	4.74	12.00	8.00
	Directive illocutionary acts	67.00	19.25	26.00	18.06	38.00	17.67	51.00	18.61	31.00	20.67
	[activate resources]	9.00	2.59	6.00	4.17	0	-	7.00	2.55	6.00	4.00
	[seeking information]	19.00	5.46	8.00	5.56	22.00	10.23	20.00	7.30	13.00	8.67
	[order]	21.00	6.03	7.00	4.86	14.00	6.51	13.00	4.74	6.00	4.00
	[persisting]	18.00	5.17	5.00	3.47	2.00	0.93	11.00	4.01	6.00	4.00
	Commissive illocutionary acts	66.00	18.97	15.00	10.42	15.00	6.98	24.00	8.76	16.00	10.67
	[own opinion]	26.00	7.47	5.00	3.47	12.00	5.58	7.00	2.55	5.00	3.33
	[react]	15.00	4.31	8.00	5.56	0	-	7.00	2.55	7.00	4.67
	[supporting]	7.00	2.01	0	-	0	-	1.00	0.36	0	-
	[agreeing]	9.00	2.59	1.00	0.69	3.00	1.40	7.00	2.55	3.00	2.00
	[raising concerns]	1.00	0.29	1.00	0.69	0	-	2.00	0.73	1.00	0.67
	[disagreeing]	8.00	2.30	0	-	0	-	0	-	0	-
	Expressive illocutionary acts	47.00	13.51	28.00	19.44	40.00	18.60	37.00	13.50	19.00	12.67
	[- task-related]	12.00	3.45	18.00	12.50	20.00	9.30	12.00	4.38	7.00	4.67
	[comment]	35.00	10.06	11.00	7.64	20.00	9.30	25.00	9.12	12.00	8.00
	Interpreting	12.00	3.45	5.00	3.47	4.00	1.86	9.00	3.28	5.00	3.33
	Subordinate quaestio: own opinion	8.00	32.00	0	-	1.00	9.09	0	-	0	-
	Subordinate quaestio: coordination	13.00	52.00	7.00	100	6.00	54.55	6.00	75.00	6.00	100
	Subordinate quaestio: side structure	4.00	16.00	0	-	4.00	36.36	2.00	25.00	0	-

		Discussion 1		Discussion 2		Discussion 3		Discussion 4		Discussion 5	
		Absolute number	**[%] of total instances**	**Absolute number**	**[%] of total instances**	**Absolute number**	**[%] of total instances**	**Absolute number**	**[%] of total instances**	**Absolute number**	**[%] of total instances**
Formal-linguistic categories	Information-shift	189.00	61.36	74.00	56.92	120.00	66.30	151.00	64.26	88.00	68.22
	Information-maintenance	119.00	38.64	56.00	43.08	61.00	33.70	84.00	35.74	41.00	31.78
	Receptiveness	34.00	11.00	20.00	15.38	N/A	N/A	22.00	9.28	13.50	10.38
	Responsiveness (average across the subjects)		72.00		73.81		84.85		83.33		69.44
	Parallel discussions	17.00	5.50	5.00	3.85	7.00	3.87	10.00	4.22	6.00	4.62
	The number of words	2.355.00	100.00	1.077.00	100.00	1.024.00	100.00	1.845.00	100.00	829.00	100.00
	The number of turns	309.00	100.00	130.00	100.00	181.00	100.00	237.00	100.00	130.00	100.00

Table 61: Formal-linguistic and pragmatic categories on group level assessed in each discussion.

	Subject 1	Discussion 1		Discussion 2		Discussion 3		Discussion 4		Discussion 5	
		Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total
Pragmatic categories	**Representative illocutionary acts**	14.00	30.43	12.00	46.15	35.00	57.38	27.00	49.09	13.00	44.83
	[adding information]	3.00	6.52	5.00	19.23	13.00	21.31	15.00	27.27	6.00	20.69
	[providing feedback]	1.00	2.17	1.00	3.85	0	-	1.00	1.82	0	-
	[listening "actively"]	6.00	13.04	2.00	7.69	15.00	24.59	4.00	7.27	3.00	10.34
	[acknowledging confusion]	2.00	4.35	1.00	3.85	2.00	3.28	2.00	3.64	0	-
	[acknowledging linguistic dominance]	0	-	0	-	1.00	1.64	0	-	1.00	3.45
	[verifying]	2.00	4.35	3.00	11.54	4.00	6.56	5.00	9.09	3.00	10.34
	Directive illocutionary acts	7.00	15.22	3.00	11.54	11.00	18.03	7.00	12.73	4.00	13.79
	[activate resources]	1.00	2.17	0	-	0	-	0	-	1.00	3.45
	[seeking information]	4.00	8.70	3.00	11.54	7.00	11.48	2.00	3.64	1.00	3.45
	[order]	1.00	2.17	0	-	4.00	6.56	3.00	5.45	1.00	3.45
	[persisting]	1.00	2.17	0	-	0	-	2.00	3.64	1.00	3.45
	Commissive illocutionary acts	6.00	13.04	3.00	11.54	2.00	3.28	4.00	7.27	4.00	13.79
	[own opinion]	1.00	2.17	0	-	2.00	3.28	3.00	5.45	2.00	6.90
	[react]	3.00	6.52	2.00	7.69	0	-	0	-	1.00	3.45
	[supporting]	0	-	0	-	0	-	1.00	1.82	0	-
	[agreeing]	2.00	4.35	1.00	3.85	0	-	0	-	1.00	3.45
	[raising concerns]	0	-	0	-	0	-	0	-	0	-
	[disagreeing]	0	-	0	-	0	-	0	-	0	-
	Expressive illocutionary acts	9.00	19.57	4.00	15.38	10.00	16.39	9.00	16.36	3.00	10.34
	[- task-related]	3.00	6.52	3.00	11.54	4.00	6.56	0	-	1.00	3.45
	[comment]	6.00	13.04	1.00	3.85	6.00	9.84	9.00	16.36	2.00	6.90
	Interpreting	10.00	21.74	4.00	15.38	3.00	4.92	8.00	14.55	5.00	17.24
	Total	*46.00*	*100.00*	*26.00*	*100.00*	*61.00*	*100.00*	*55.00*	*100.00*	*29.00*	*100.00*
	Quaestio: own opinion	0	-	0	-	0	-	0	-	0	-
	Quaestio: coordination	1.00	50.00	2.00	100.00	1.00	50.00	2.00	66.67	2.00	100.00
	Quaestio: side structure	1.00	50.00	0	-	1.00	50.00	1.00	33.33	0	-
Formal-linguistic categories	Information-shift	29.00	63.04	18	69.23	36	73.47	34	68.00	16	61.54
	Information-maintenance	17.00	36.96	8	30.77	13	26.53	16	32.00	10	38.46
	Receptiveness	20	43.48	7.5	28.85	N/A	N/A	15	30.00	7.5	28.85
	Responsiveness	18	72.00	7	100.00	10	90.91	8	100.00	6	100.00
	Parallel discussions	7	15.22	3	11.54	2	4.08	4	8.00	2	7.69
	Number of words	266.00	11.30	136.00	12.63	324.00	31.64	419.00	22.71	177.00	21.35
	Number of turns	46.00	14.89	26.00	20.00	49.00	27.07	50.00	21.10	26.00	20.00

Table 62: Formal-linguistic and pragmatic categories produced by subject 1 and assessed in each discussion.

	Subject 2	Discussion 1		Discussion 2		Discussion 3		Discussion 4		Discussion 5	
		Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total
Pragmatic categories	**Representative illocutionary acts**	39.00	57.35	8.00	42.11	28.00	68.29	20.00	54.05	14.00	56.00
	[adding information]	12.00	17.65	3.00	15.79	9.00	21.95	11.00	29.73	7.00	28.00
	[providing feedback]	4.00	5.88	1.00	5.26	1.00	2.44	1.00	2.70	0	-
	[listening "actively"]	19.00	27.94	3.00	15.79	11.00	26.83	4.00	10.81	7.00	28.00
	[acknowledging confusion]	2.00	2.94	0	-	2.00	4.88	2.00	5.41	0	-
	[acknowledging linguistic dominance]	0	-	0	-	0	-	0	-	0	-
	[verifying]	2.00	2.94	1.00	5.26	5.00	12.20	2.00	5.41	0	-
	Directive illocutionary acts	7.00	10.29	1.00	5.26	7.00	17.07	5.00	13.51	7.00	28.00
	[activate resources]	1.00	1.47	0	-	0	-	0	-	1.00	4.00
	[seeking information]	3.00	4.41	1.00	5.26	2.00	4.88	3.00	8.11	4.00	16.00
	[order]	2.00	2.94	0	-	4.00	9.76	1.00	2.70	1.00	4.00
	[persisting]	1.00	1.47	0	-	1.00	2.44	1.00	2.70	1.00	4.00
	Commissive illocutionary acts	12.00	17.65	2.00	10.53	3.00	7.32	6.00	16.22	2.00	8.00
	[own opinion]	6.00	8.82	1.00	5.26	3.00	7.32	1.00	2.70	1.00	4.00
	[react]	1.00	1.47	1.00	5.26	0	-	1.00	2.70	1.00	4.00
	[supporting]	3.00	4.41	0	-	0	-	0	-	0	-
	[agreeing]	2.00	2.94	0	-	0	-	3.00	8.11	0	-
	[raising concerns]	0	-	0	-	0	-	1.00	2.70	0	-
	[disagreeing]	0	-	0	-	0	-	0	-	0	-
	Expressive illocutionary acts	9.00	13.24	7.00	36.84	2.00	4.88	5.00	13.51	2.00	8.00
	[- task-related]	2.00	2.94	5.00	26.32	0	-	0	-	0	-
	[comment]	7.00	10.29	2.00	10.53	2.00	4.88	5.00	13.51	2.00	8.00
	Interpreting	1.00	1.47	1.00	5.26	1.00	2.44	1.00	2.70	0	-
	Total	*68.00*	*100.00*	*19.00*	*100.00*	*41.00*	*100.00*	*37.00*	*100.00*	*25.00*	*100.00*
	Quaestio: own opinion	4.00	66.67	0	-	0	-	0	-	0	-
	Quaestio: coordination	2.00	33.33	0	-	3.00	100.00	0	0.00	1.00	100.00
	Quaestio: side structure	0	-	0	-	0	-	0	-	0	-
Formal-linguistic categories	Information-shift	33	55.00	13	76.47	25	69.44	23	67.65	14	63.64
	Information-maintenance	27	45.00	4	23.53	11	30.56	11	32.35	8	36.36
	Receptiveness	4	6.67	3.5	20.59	N/A	N/A	1	2.94	1	4.35
	Responsiveness	18	72.00	4	57.14	9	81.82	5	62.50	4	66.67
	Parallel discussions	1	1.67	0	-	2	5.56	0	-	0	-
	Number of words	450.00	19.11	129.00	11.98	277.00	27.05	161.00	8.73	71.00	8.56
	Number of turns	60.00	19.42	17.00	13.08	36.00	19.89	34.00	14.35	23.00	17.69

Table 63: Formal-linguistic and pragmatic categories produced by subject 2 and assessed in each discussion.

	Subject 3	Discussion 1		Discussion 2		Discussion 3		Discussion 4		Discussion 5	
		Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total
Pragmatic categories	**Representative illocutionary acts**	34.00	43.04	27.00	57.45	14.00	43.75	38.00	53.52	23.00	47.92
	[adding information]	3	3.80	5	10.64	2	6.25	12	16.90	8	16.67
	[providing feedback]	5	6.33	0	-	1	3.13	3	4.23	1	2.08
	[listening "actively"]	17	21.52	20	42.55	8	25.00	15	21.13	9	18.75
	[acknowledging confusion]	5	6.33	0	-	1	3.13	3	4.23	1	2.08
	[acknowledging linguistic dominance]	0	-	0	-	2	6.25	2	2.82	0	-
	[verifying]	4	5.06	2	4.26	0	-	3	4.23	4	8.33
	Directive illocutionary acts	22.00	27.85	16.00	34.04	6.00	18.75	20.00	28.17	13.00	27.08
	[activate resources]	3	3.80	6	12.77	0	-	2	2.82	2	4.17
	[seeking information]	3	3.80	3	6.38	4	12.50	8	11.27	5	10.42
	[order]	8	10.13	6	12.77	1	3.13	7	9.86	4	8.33
	[persisting]	8	10.13	1	2.13	1	3.13	3	4.23	2	4.17
	Commissive illocutionary acts	15.00	18.99	3.00	6.38	3.00	9.38	5.00	7.04	5.00	10.42
	[own opinion]	5	6.33	2	4.26	2	6.25	2	2.82	2	4.17
	[react]	1	1.27	0	-	0	-	1	1.41	2	4.17
	[supporting]	2	2.53	0	-	0	-	0	-	0	-
	[agreeing]	1	1.27	0	-	1	3.13	2	2.82	0	-
	[raising concerns]	1	1.27	1	2.13	0	-	0	-	1	2.08
	[disagreeing]	5	6.33	0	-	0	-	0	-	0	-
	Expressive illocutionary acts	7.00	8.86	1.00	2.13	9.00	28.13	8.00	11.27	7.00	14.58
	[- task-related]	2	2.53	1	2.13	5	15.63	2	2.82	1	2.08
	[comment]	5	6.33	0	-	4	12.50	6	8.45	6	12.50
	Interpreting	1	1.27	0	-	0	-	0	-		-
	Total	*79.00*	*100.00*	*47.00*	*100.00*	*32.00*	*100.00*	*71.00*	*100.00*	*48.00*	*100.00*
	Quaestio: own opinion	1.00	11.11	0	-	1.00	100.00	0	-	0	-
	Quaestio: coordination	6.00	66.67	4.00	100.00	0	-	3.00	75.00	3.00	100.00
	Quaestio: side structure	2.00	22.22	0	-	0	-	1.00	25.00	0	-
Formal-linguistic categories	Information-shift	37	55.22	21	48.84	16	59.26	34	59.65	27	69.23
	Information-maintenance	30	44.78	22	51.16	11	40.74	23	40.35	12	30.77
	Receptiveness	2	2.99	8.5	19.77	N/A	N/A	1.5	2.63	1	2.56
	Responsiveness	18	72.00	6	85.71	10	90.91	7	87.50	5	83.33
	Parallel discussions	0	-	0	-	1	3.70	0	-	0	-
	Number of words	535.00	22.72	255.00	23.68	125.00	12.21	458.00	24.82	363.00	43.79
	Number of turns	67.00	21.68	43.00	33.08	27.00	14.92	57.00	24.05	39.00	30.00

Table 64: Formal-linguistic and pragmatic categories produced by subject 3 and assessed in each discussion.

	Subject 4	Discussion 1		Discussion 2		Discussion 3		Discussion 4		Discussion 5	
		Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total
Pragmatic categories	**Representative illocutionary acts**	25.00	39.06	6.00	30.00	7.00	53.85	18.00	56.25	5.00	41.67
	[adding information]	10	15.63	2	10.00	2	15.38	6	18.75	2	16.67
	[providing feedback]	5	7.81	0	-	1	7.69	4	12.50	2	16.67
	[listening "actively"]	6	9.38	3	15.00	3	23.08	7	21.88	0	-
	[acknowledging confusion]	1	1.56	0	-	0	-	1	3.13	0	-
	[acknowledging linguistic dominance]	1	1.56	0	-	0	-	0	-	0	-
	[verifying]	2	3.13	1	5.00	1	7.69	0	-	1	8.33
	Directive illocutionary acts	18.00	28.13	0	-	2.00	15.38	5.00	15.63	1.00	8.33
	[activate resources]	2	3.13	0	-	0	-	0	-	0	-
	[seeking information]	3	4.69	0	-	0	-	3	9.38	1	8.33
	[order]	9	14.06	0	-	2	15.38	0	-	0	-
	[persisting]	4	6.25	0	-	0	-	2	6.25	0	-
	Commissive illocutionary acts	10.00	15.63	2.00	10.00	2.00	15.38	2.00	6.25	2.00	16.67
	[own opinion]	6	9.38	1	5.00	1	7.69	0	-	0	-
	[react]	0	-	1	5.00	0	-	1	3.13	1	8.33
	[supporting]	1	1.56	0	-	0	-	0	-	0	-
	[agreeing]	0	-	0	-	1	7.69	1	3.13	1	8.33
	[raising concerns]	0	-	0	-	0	-	0	-	0	-
	[disagreeing]	3	4.69	0	-	0	-	0	-	0	-
	Expressive illocutionary acts	11.00	17.19	12.00	60.00	2.00	15.38	7.00	21.88	4.00	33.33
	[- task-related]	2	3.13	5	25.00	2	15.38	4	12.50	2	16.67
	[comment]	9	14.06	7	35.00	0	-	3	9.38	2	16.67
	Interpreting	0	-	0	-	0	-	0	-	0	-
	Total	*64.00*	*100.00*	*20.00*	*100.00*	*13.00*	*100.00*	*32.00*	*100.00*	*12.00*	*100.00*
	Quaestio: own opinion	2.00	33.33	0	-	0	-	0	-	0	-
	Quaestio: coordination	4.00	66.67	0	-	0	-	0	-	0	-
	Quaestio: side structure	0	-	0	-	1.00	100.00	0	-	0	-
Formal-linguistic categories	Information-shift	29	55.77	7	36.84	6	46.15	15	60.00	8	72.73
	Information-maintenance	23	44.23	12	63.16	7	53.85	10	40.00	3	27.27
	Receptiveness	1	1.89	0.5	2.63	N/A	N/A	0	-	0	-
	Responsiveness	19	76.00	5	71.43	7	63.64	6	75.00	3	50.00
	Parallel discussions	1	1.89	0	-	0	-	2	7.69	2	18.18
	Number of words	506.00	21.49	146.00	13.56	46.00	4.49	291.00	15.77	64.00	7.72
	Number of turns	53.00	17.15	19.00	14.62	13.00	7.18	26.00	10.97	11.00	8.46

Table 65: Formal-linguistic and pragmatic categories produced by subject 4 and assessed in each discussion.

	Subject 5	Discussion 1		Discussion 2		Discussion 3		Discussion 4		Discussion 5	
		Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total
Pragmatic categories	**Representative illocutionary acts**	15.00	46.88	4.00	33.33	24.00	57.14	16.00	76.19	9.00	75.00
	[adding information]	5.00	15.63	3.00	25.00	4.00	9.52	10.00	47.62	3.00	25.00
	[providing feedback]	1.00	3.13	0	-	0	-	1.00	4.76	1.00	8.33
	[listening "actively"]	5.00	15.63	0	-	14.00	33.33	5.00	23.81	2.00	16.67
	[acknowledging confusion]	1.00	3.13	0	-	0	-	0	-	0	-
	[acknowledging linguistic dominance]	0	-	0	-	1.00	2.38	0	-	1.00	8.33
	[verifying]	3.00	9.38	1.00	8.33	5.00	11.90	0	-	2.00	16.67
	Directive illocutionary acts	3.00	9.38	4.00	33.33	6.00	14.29	2.00	9.52	1.00	8.33
	[activate resources]	0	-	0	-	0	-	0	-	0	-
	[seeking information]	2.00	6.25	1.00	8.33	6.00	14.29	0	-	1.00	8.33
	[order]	0	-		-	0	-	2.00	9.52	0	-
	[persisting]	1.00	3.13	3.00	25.00	0	-	0	-	0	-
	Commissive illocutionary acts	10.00	31.25	3.00	25.00	4.00	9.52	2.00	9.52	2.00	16.67
	[own opinion]	2.00	6.25	0	-	3.00	7.14	0	-	0	-
	[react]	5.00	15.63	3.00	25.00	0	-	2.00	9.52	2.00	16.67
	[supporting]	0	-	0	-	0	-	0	-	0	-
	[agreeing]	3.00	9.38	0	-	1.00	2.38	0	-	0	-
	[raising concerns]	0	-	0	-	0	-	0	-	0	-
	[disagreeing]	0	-	0	-	0	-	0	-	0	-
	Expressive illocutionary acts	4.00	12.50	1.00	8.33	8.00	19.05	1.00	4.76	0	-
	[- task-related]	0	-	1.00	8.33	3.00	7.14	1.00	4.76	0	-
	[comment]	4.00	12.50	0	-	5.00	11.90	0	-	0	-
	Interpreting	0	-	0	-	0	-	0	-	0	-
	Total	*32.00*	*100.00*	*12.00*	*100.00*	*42.00*	*100.00*	*21.00*	*100.00*	*12.00*	*100.00*
	Quaestio: own opinion	0	-	0	-	0	-	0	-	0	-
	Quaestio: coordination	0	-	0	-	0	-	0	-	0	-
	Quaestio: side structure	0	-	0	-	0	-	0	-	0	-
Formal-linguistic categories	Information-shift	22	73.33	8	100.00	18	50.00	15	75.00	7	70.00
	Information-maintenance	8	26.67	0	-	18	50.00	5	25.00	3	30.00
	Receptiveness	7	23.33	0	-	N/A	N/A	4.5	22.50	4	40.00
	Responsiveness	10	40.00	3	42.86	10	90.91	6	75.00	3	50.00
	Parallel discussions	8	26.67	2	25.00	1	2.78	3	15.00	1	10.00
	Number of words	225.00	9.55	162.00	15.04	143.00	13.96	128.00	6.94	31.00	3.74
	Number of turns	30.00	9.71	8.00	6.15	36.00	19.89	20.00	8.44	10.00	7.69

Table 66: Formal-linguistic and pragmatic categories produced by subject 5 and assessed in each discussion.

	Subject 6	Discussion 1		Discussion 2		Discussion 3		Discussion 4		Discussion 5	
		Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total	Absolute number	[%] of total
Pragmatic categories	**Representative illocutionary acts**	29.00	49.15	12.00	60.00	10.00	38.46	34.00	58.62	15.00	62.50
	[adding information]	12.00	20.34	6.00	30.00	3.00	11.54	13.00	22.41	9.00	37.50
	[providing feedback]	6.00	10.17	1.00	5.00	0	-	2.00	3.45	2.00	8.33
	[listening "actively"]	8.00	13.56	5.00	25.00	0	-	15.00	25.86	0	-
	[acknowledging confusion]	0	-	0	-	1.00	3.85	1.00	1.72	2.00	8.33
	[acknowledging linguistic dominance]	0	-	0	-	6.00	23.08	0	-	0	-
	[verifying]	3.00	5.08	0	-	0	-	3.00	5.17	2.00	8.33
	Directive illocutionary acts	10.00	16.95	2.00	10.00	6.00	23.08	12.00	20.69	5.00	20.83
	[activate resources]	2.00	3.39	0	-	0	-	5.00	8.62	2.00	8.33
	[seeking information]	4.00	6.78	0	-	3.00	11.54	4.00	6.90	1.00	4.17
	[order]	1.00	1.69	1.00	5.00	3.00	11.54	0	-	0	-
	[persisting]	3.00	5.08	1.00	5.00	0	-	3.00	5.17	2.00	8.33
	Commissive illocutionary acts	13.00	22.03	2.00	10.00	1.00	3.85	5.00	8.62	1.00	4.17
	[own opinion]	6.00	10.17	1.00	5.00	1.00	3.85	1.00	1.72	0	-
	[react]	5.00	8.47	1.00	5.00	0	-	2.00	3.45	0	-
	[supporting]	1.00	1.69	0	-	0	-	0	-	0	-
	[agreeing]	1.00	1.69	0	-	0	-	1.00	1.72	1.00	4.17
	[raising concerns]	0	-	0	-	0	-	1.00	1.72	0	-
	[disagreeing]	0	-	0	-	0	-	0	-	0	-
	Expressive illocutionary acts	7.00	11.86	4.00	20.00	9.00	34.62	7.00	12.07	3.00	12.50
	[- task-related]	3.00	5.08	3.00	15.00	6.00	23.08	5.00	8.62	3.00	12.50
	[comment]	4.00	6.78	1.00	5.00	3.00	11.54	2.00	3.45	0	-
	Interpreting	0	-	0	-	0	-	0	-	0	-
	Total	*59.00*	*100.00*	*20.00*	*100.00*	*26.00*	*100.00*	*58.00*	*100.00*	*24.00*	*100.00*
	Quaestio: own opinion	1.00	50.00	0	-	0	-	0	-	0	-
	Quaestio: coordination	0	-	1.00	100.00	2.00	50.00	1.00	100.00	0	-
	Quaestio: side structure	1.00	50.00	0	-	2.00	50.00	0	-	0	-
Formal-linguistic categories	Information-shift	39	73.58	7	41.18	19	95.00	30	61.22	16	76.19
	Information-maintenance	14	26.42	10	58.82	1	5.00	19	38.78	5	23.81
	Receptiveness	0	-	0	-	N/A	N/A	0	-	0	-
	Responsiveness	18	72.00	6	85.71	10	90.91	8	100.00	4	66.67
	Parallel discussions	0	-	0	-	1	5.00	1	2.00	1	4.76
	Number of words	373.00	15.84	249.00	23.12	109.00	10.64	388.00	21.03	123.00	14.84
	Number of turns	53.00	17.15	17.00	13.08	20.00	11.05	50.00	21.10	21.00	16.15

Table 67: Formal-linguistic and pragmatic categories produced by subject 6 and assessed in each discussion.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
D1	,165	689	,000	,857	689	,000
D2	,129	393	,000	,908	393	,000
D3	,137	442	,000	,967	442	,000
D4	,134	614	,000	,919	614	,000
D5	,165	308	,000	,905	308	,000

a. Lilliefors Significance Correction

Table 68: Test of Normality of heart rate values of subject 1.

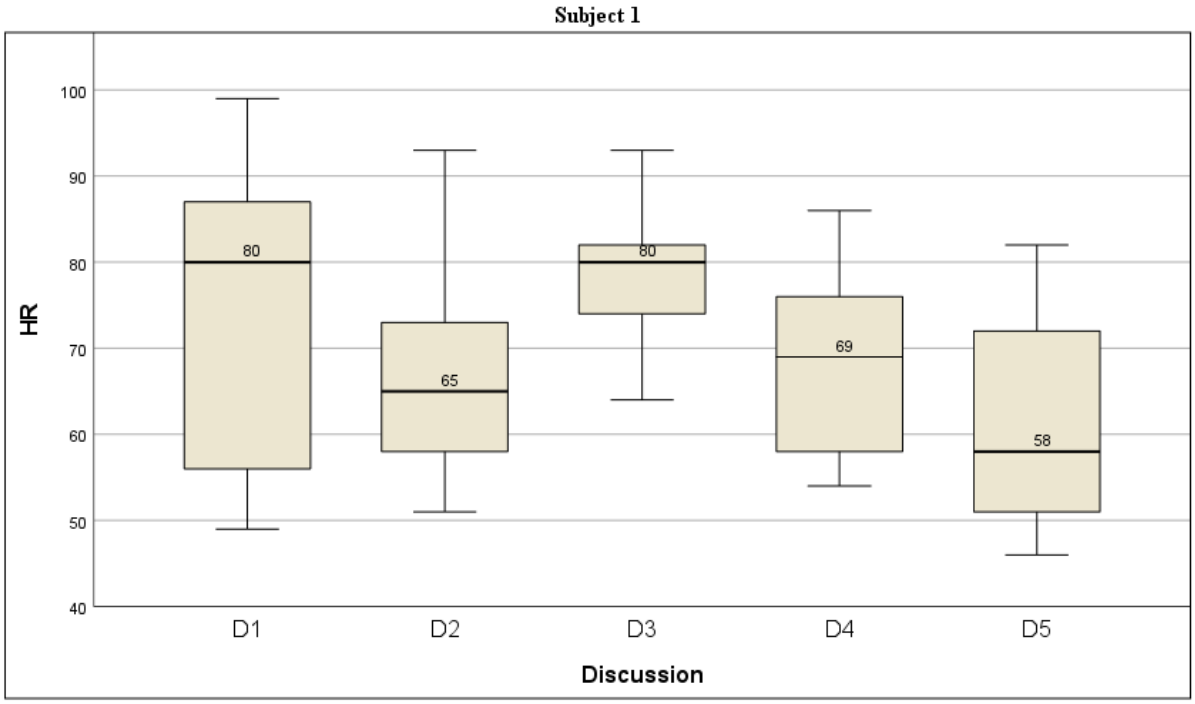

Figure 19: Boxplots of heart rate values of subject 1. The median heart rate value is shown within the interquartile range.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
D1	,216	824	,000	,829	824	,000
D2	,188	438	,000	,902	438	,000
D3	,134	394	,000	,937	394	,000
D4	,147	633	,000	,918	633	,000
D5	,155	409	,000	,911	409	,000

a. Lilliefors Significance Correction

Table 69: Test of Normality of heart rate values of subject 2.

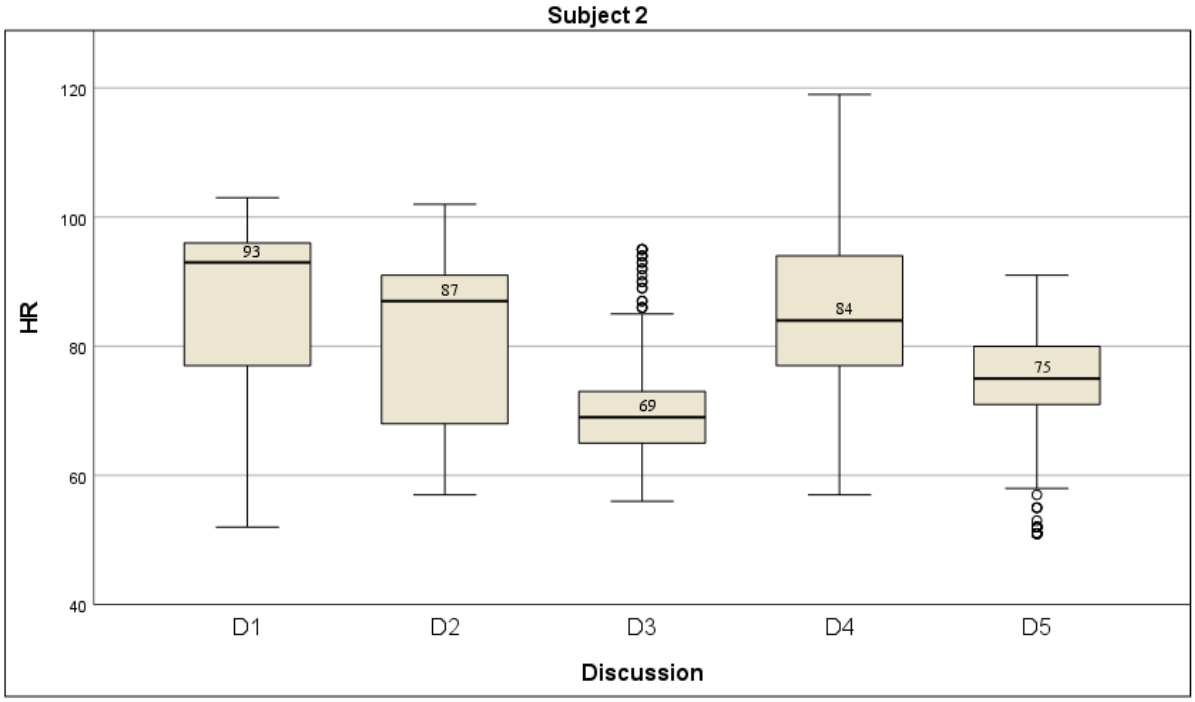

Figure 20: Boxplots of heart rate values of subject 2. The median heart rate value is shown within the interquartile range.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
D1	,161	712	,000	,929	712	,000
D2	,080	496	,000	,976	496	,000
D3	,078	392	,000	,972	392	,000
D4	,213	795	,000	,750	795	,000
D5	,271	314	,000	,806	314	,000

a. Lilliefors Significance Correction

Table 70: Test of Normality of heart rate values of subject 3.

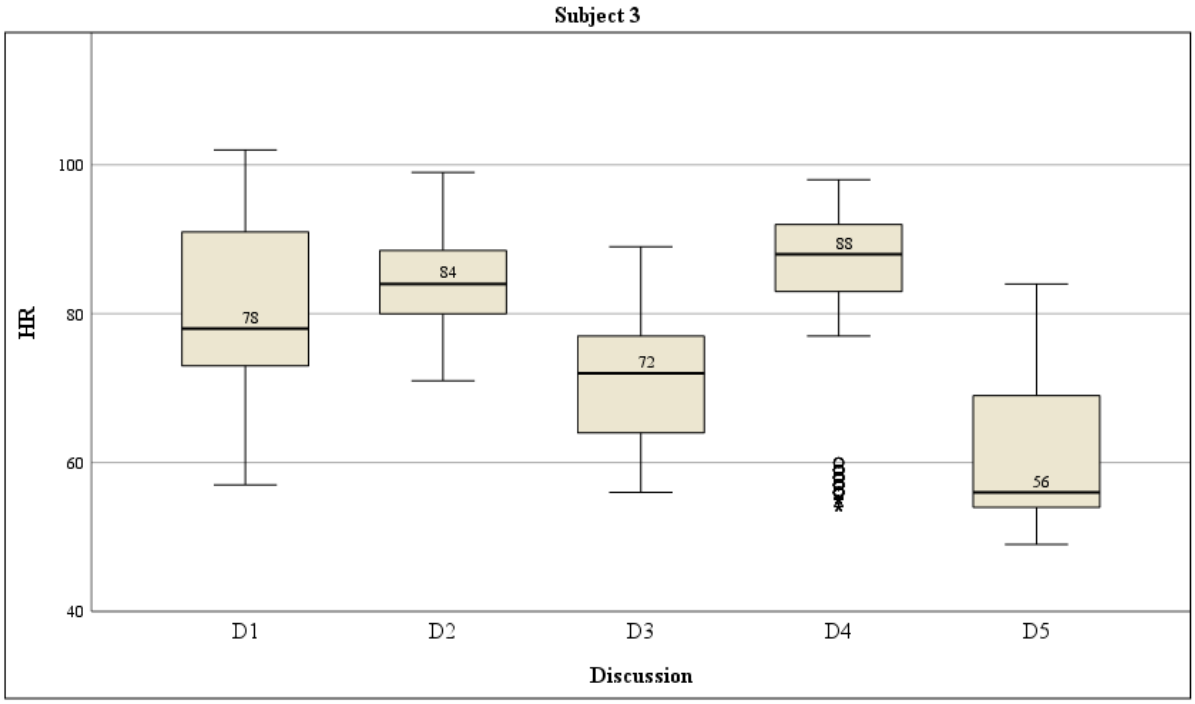

Figure 21: Boxplots of heart rate values of subject 3. The median heart rate value is shown within the interquartile range.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
D1	,166	791	,000	,862	791	,000
D2	,130	371	,000	,872	371	,000
D3	,124	347	,000	,945	347	,000
D4	,150	524	,000	,931	524	,000
D5	,134	364	,000	,957	364	,000

a. Lilliefors Significance Correction

Table 71: Test of Normality of heart rate values of subject 4.

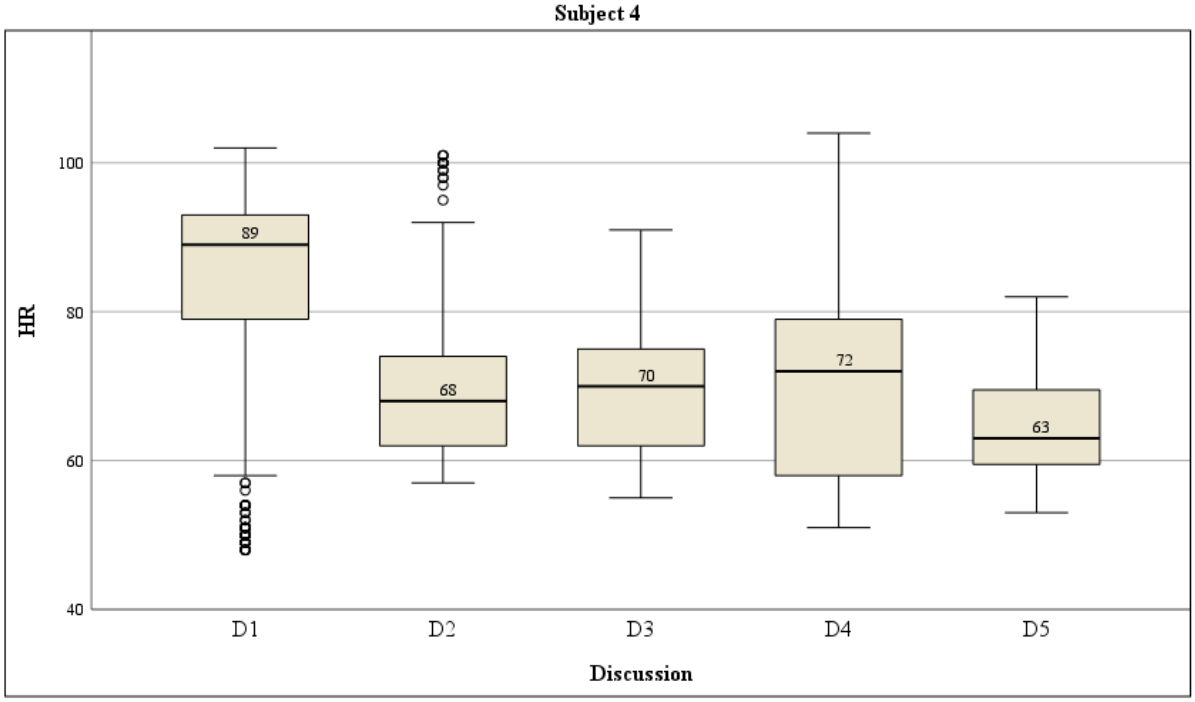

Figure 22: Boxplots of heart rate values of subject 4. The median heart rate value is shown within the interquartile range.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
D1	,140	780	,000	,880	780	,000
D2	,161	403	,000	,921	403	,000
D3	,179	392	,000	,860	392	,000
D4	,174	482	,000	,895	482	,000
D5	,189	306	,000	,892	306	,000

a. Lilliefors Significance Correction

Table 72: Test of Normality of heart rate values of subject 5.

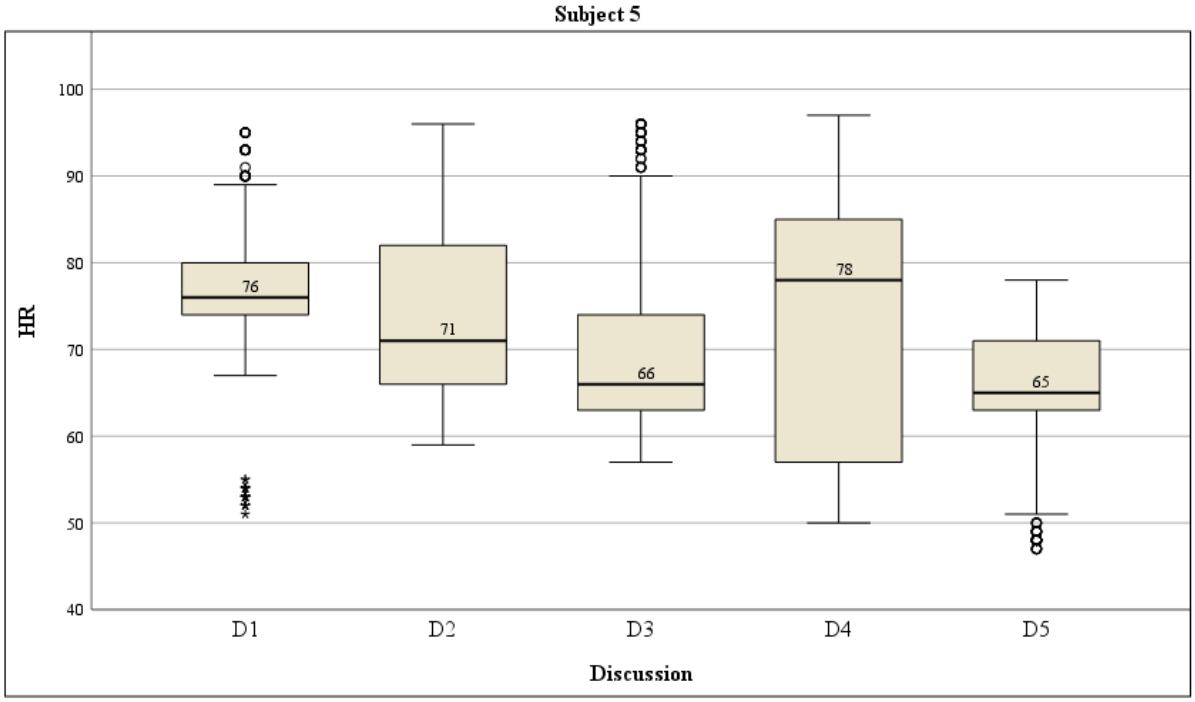

Figure 23: Boxplots of heart rate values of subject 5. The median heart rate value is shown within the interquartile range.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
D1	,064	790	,000	,989	790	,000
D2	,122	351	,000	,948	351	,000
D3	,219	386	,000	,859	386	,000
D4	,133	691	,000	,919	691	,000
D5	,099	347	,000	,974	347	,000

a. Lilliefors Significance Correction

Table 73: Test of Normality of heart rate values of subject 6.

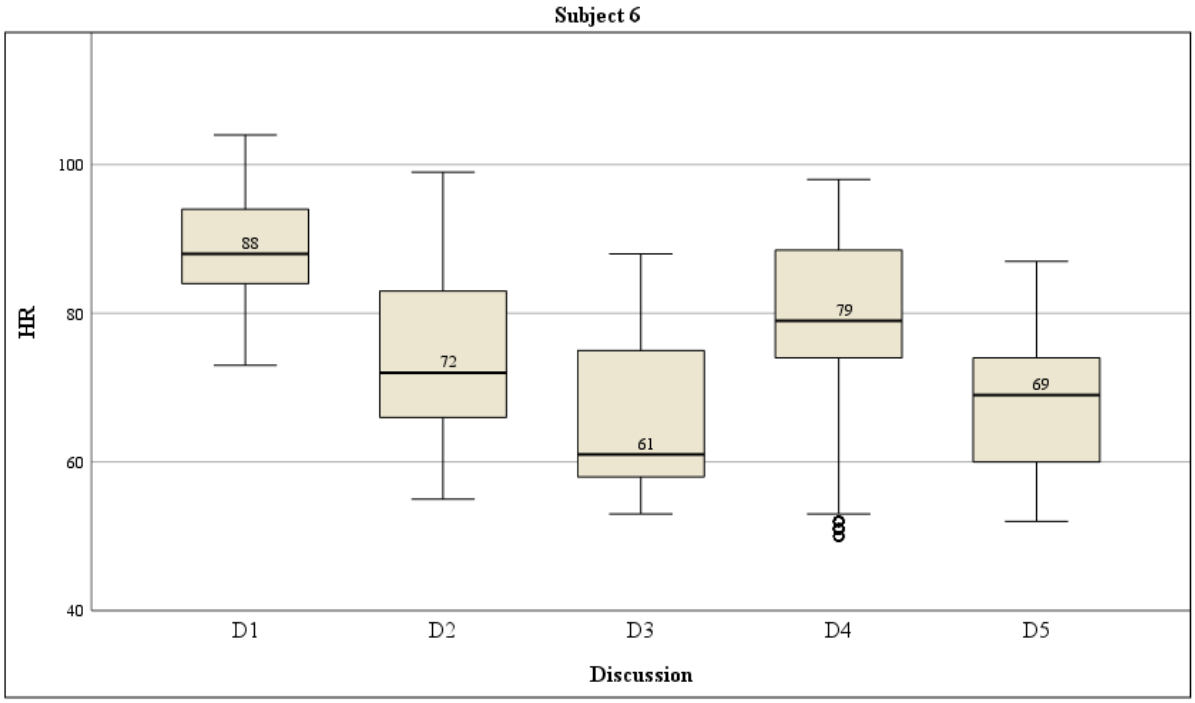

Figure 24: Boxplots of heart rate values of subject 6. The median heart rate value is shown within the interquartile range.

Subject 1			Pulse median
Spearman's rho	Representative illocutionary acts	Correlation Coefficient	,205
		Sig. (2-tailed)	,741
		N	5
	[adding information]	Correlation Coefficient	-,051
		Sig. (2-tailed)	,935
		N	5
	[providing feedback]	Correlation Coefficient	,026
		Sig. (2-tailed)	,966
		N	5
	[listening "actively"]	Correlation Coefficient	,564
		Sig. (2-tailed)	,322
		N	5
	[acknowledging confusion]	Correlation Coefficient	,462
		Sig. (2-tailed)	,434
		N	5
	[acknowledging linguistic dominance]	Correlation Coefficient	-,344
		Sig. (2-tailed)	,571
		N	5
	[verifying]	Correlation Coefficient	-,872
		Sig. (2-tailed)	,054
		N	5
	Directive illocutionary acts	Correlation Coefficient	,667
		Sig. (2-tailed)	,219
		N	5
	[activate resources]	Correlation Coefficient	-,344
		Sig. (2-tailed)	,571
		N	5
	[seeking information]	Correlation Coefficient	,359
		Sig. (2-tailed)	,553
		N	5
	[order]	Correlation Coefficient	,359
		Sig. (2-tailed)	,553
		N	5
	[persisting]	Correlation Coefficient	-,289
		Sig. (2-tailed)	,637
		N	5
	Commissive illocutionary acts	Correlation Coefficient	-,564
		Sig. (2-tailed)	,322
		N	5
	[own opinion]	Correlation Coefficient	-,359
		Sig. (2-tailed)	,553
		N	5
	[react]	Correlation Coefficient	-,289
		Sig. (2-tailed)	,637
		N	5
	[supporting]	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	[agreeing]	Correlation Coefficient	-,026
		Sig. (2-tailed)	,966
		N	5
	[raising concerns]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	[disagreeing]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	Expressive illocutionary acts	Correlation Coefficient	**,975****
		Sig. (2-tailed)	,005
		N	5
	[- task-related]	Correlation Coefficient	,154
		Sig. (2-tailed)	,805
		N	5
	[comment]	Correlation Coefficient	,564
		Sig. (2-tailed)	,322
		N	5
	Interpreting	Correlation Coefficient	-,205

		Sig. (2-tailed)	,741
		N	5
	information-shift	Correlation Coefficient	,462
		Sig. (2-tailed)	,434
		N	5
	information-maintenance	Correlation Coefficient	-,462
		Sig. (2-tailed)	,434
		N	5
	quaestio: own opinion	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	quaestio: coordination	Correlation Coefficient	**-,973****
		Sig. (2-tailed)	,005
		N	5
	quaestio: side structure	Correlation Coefficient	**,973****
		Sig. (2-tailed)	,005
		N	5
	Responsiveness	Correlation Coefficient	-,860
		Sig. (2-tailed)	,061
		N	5
	Parallel discussions	Correlation Coefficient	,103
		Sig. (2-tailed)	,870
		N	5
	Number of words	Correlation Coefficient	,103
		Sig. (2-tailed)	,870
		N	5
	Number of turns	Correlation Coefficient	,158
		Sig. (2-tailed)	,800
		N	5

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 74: Spearman's correlation calculated between the proportions of the formal-linguistic and pragmatic categories / values in the speech of subject 1 and the subject's median heart rate. The correlations are based on five discussions.

Subject 1			Receptiveness
Spearman's rho	Pulse median	Correlation Coefficient	,949
		Sig. (2-tailed)	,051
		N	4

Table 75: Spearman's correlation between the proportions of the category "Receptiveness" in the speech of subject 1 and the subject's median heart rate. The category "Receptiveness" is reported separately since it excludes the analysis of D3.

Subject 2			Pulse median
Spearman's rho	Representative illocutionary acts	Correlation Coefficient	-,400
		Sig. (2-tailed)	,505
		N	5
	[adding information]	Correlation Coefficient	-,500
		Sig. (2-tailed)	,391
		N	5
	[providing feedback]	Correlation Coefficient	**,900***
		Sig. (2-tailed)	,037
		N	5
	[listening "actively"]	Correlation Coefficient	-,100
		Sig. (2-tailed)	,873
		N	5
	[acknowledging confusion]	Correlation Coefficient	-,205
		Sig. (2-tailed)	,741
		N	5
	[acknowledging linguistic dominance]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	[verifying]	Correlation Coefficient	-,400
		Sig. (2-tailed)	,505
		N	5
	Directive illocutionary acts	Correlation Coefficient	-,800
		Sig. (2-tailed)	,104
		N	5
	[activate resources]	Correlation Coefficient	,112
		Sig. (2-tailed)	,858
		N	5
	[seeking information]	Correlation Coefficient	-,400
		Sig. (2-tailed)	,505
		N	5
	[order]	Correlation Coefficient	-,700
		Sig. (2-tailed)	,188
		N	5
	[persisting]	Correlation Coefficient	-,600
		Sig. (2-tailed)	,285
		N	5
	Commissive illocutionary acts	Correlation Coefficient	**,900***
		Sig. (2-tailed)	,037
		N	5
	[own opinion]	Correlation Coefficient	,300
		Sig. (2-tailed)	,624
		N	5
	[react]	Correlation Coefficient	,300
		Sig. (2-tailed)	,624
		N	5
	[supporting]	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	[agreeing]	Correlation Coefficient	,447
		Sig. (2-tailed)	,450
		N	5
	[raising concerns]	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	[disagreeing]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	Expressive illocutionary acts	Correlation Coefficient	,700
		Sig. (2-tailed)	,188
		N	5
	[- task-related]	Correlation Coefficient	,783
		Sig. (2-tailed)	,118
		N	5
	[comment]	Correlation Coefficient	,600
		Sig. (2-tailed)	,285
		N	5

	Interpreting	Correlation Coefficient	,200
		Sig. (2-tailed)	,747
		N	5
	information-shift	Correlation Coefficient	-,300
		Sig. (2-tailed)	,624
		N	5
	information-maintenance	Correlation Coefficient	,300
		Sig. (2-tailed)	,624
		N	5
	quaestio: own opinion	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	quaestio: coordination	Correlation Coefficient	-,632
		Sig. (2-tailed)	,252
		N	5
	quaestio: side structure	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	Responsiveness	Correlation Coefficient	-,400
		Sig. (2-tailed)	,505
		N	5
	Parallel discussions	Correlation Coefficient	-,224
		Sig. (2-tailed)	,718
		N	5
	Number of words	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	Number of turns	Correlation Coefficient	-,400
		Sig. (2-tailed)	,505
		N	5

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 76: Spearman's correlation calculated between the proportions of the formal-linguistic and pragmatic categories / values in the speech of subject 2 and the subject's median heart rate. The correlations are based on five discussions.

Subject 2			Receptiveness
Spearman's rho	Pulse median	Correlation Coefficient	,600
		Sig. (2-tailed)	,400
		N	4

Table 77: Spearman's correlation between the proportions of the category "Receptiveness" in the speech of subject 2 and the subject's median heart rate. The category "Receptiveness" is reported separately since it excludes the analysis of D3.

Subject 3			Pulse median
Spearman's rho	Representative illocutionary acts	Correlation Coefficient	,500
		Sig. (2-tailed)	,391
		N	5
	[adding information]	Correlation Coefficient	,300
		Sig. (2-tailed)	,624
		N	5
	[providing feedback]	Correlation Coefficient	,200
		Sig. (2-tailed)	,747
		N	5
	[listening "actively"]	Correlation Coefficient	,300
		Sig. (2-tailed)	,624
		N	5
	[acknowledging confusion]	Correlation Coefficient	,200
		Sig. (2-tailed)	,747
		N	5
	[acknowledging linguistic dominance]	Correlation Coefficient	,112
		Sig. (2-tailed)	,858
		N	5
	[verifying]	Correlation Coefficient	-,400
		Sig. (2-tailed)	,505
		N	5
	Directive illocutionary acts	Correlation Coefficient	,800
		Sig. (2-tailed)	,104
		N	5
	[activate resources]	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	[seeking information]	Correlation Coefficient	-,100
		Sig. (2-tailed)	,873
		N	5
	[order]	Correlation Coefficient	,600
		Sig. (2-tailed)	,285
		N	5
	[persisting]	Correlation Coefficient	,100
		Sig. (2-tailed)	,873
		N	5
	Commissive illocutionary acts	Correlation Coefficient	-,600
		Sig. (2-tailed)	,285
		N	5
	[own opinion]	Correlation Coefficient	-,300
		Sig. (2-tailed)	,624
		N	5
	[react]	Correlation Coefficient	-,205
		Sig. (2-tailed)	,741
		N	5
	[supporting]	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	[agreeing]	Correlation Coefficient	,154
		Sig. (2-tailed)	,805
		N	5
	[raising concerns]	Correlation Coefficient	-,154
		Sig. (2-tailed)	,805
		N	5
	[disagreeing]	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	Expressive illocutionary acts	Correlation Coefficient	-,600
		Sig. (2-tailed)	,285
		N	5
	[- task-related]	Correlation Coefficient	,300
		Sig. (2-tailed)	,624
		N	5
	[comment]	Correlation Coefficient	-,667
		Sig. (2-tailed)	,219
		N	5
	Interpreting	Correlation Coefficient	,000

		Sig. (2-tailed)	1,000
		N	5
	information-shift	Correlation Coefficient	-,400
		Sig. (2-tailed)	,505
		N	5
	information-maintenance	Correlation Coefficient	,400
		Sig. (2-tailed)	,505
		N	5
	quaestio: own opinion	Correlation Coefficient	-,335
		Sig. (2-tailed)	,581
		N	5
	quaestio: coordination	Correlation Coefficient	,051
		Sig. (2-tailed)	,935
		N	5
	quaestio: side structure	Correlation Coefficient	,671
		Sig. (2-tailed)	,215
		N	5
	Responsiveness	Correlation Coefficient	,200
		Sig. (2-tailed)	,747
		N	5
	Parallel discussions	Correlation Coefficient	-,354
		Sig. (2-tailed)	,559
		N	5
	Number of words	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	Number of turns	Correlation Coefficient	,200
		Sig. (2-tailed)	,747
		N	5

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 78: Spearman's correlation calculated between the proportions of the formal-linguistic and pragmatic categories / values in the speech of subject 3 and the subject' median heart rate. The correlations are based on five discussions.

Subject 3			Receptiveness
Spearman's rho	Pulse median	Correlation Coefficient	,400
		Sig. (2-tailed)	,600
		N	4

Table 79: Spearman's correlation between the proportions of the category "Receptiveness" in the speech of subject 3 and the subject's median heart rate. The category "Receptiveness" is reported separately since it excludes the analysis of D3.

Subject 4			Pulse median
Spearman's rho	Representative illocutionary acts	Correlation Coefficient	,200
		Sig. (2-tailed)	,747
		N	5
	[adding information]	Correlation Coefficient	,200
		Sig. (2-tailed)	,747
		N	5
	[providing feedback]	Correlation Coefficient	-,100
		Sig. (2-tailed)	,873
		N	5
	[listening "actively"]	Correlation Coefficient	,300
		Sig. (2-tailed)	,624
		N	5
	[acknowledging confusion]	Correlation Coefficient	,783
		Sig. (2-tailed)	,118
		N	5
	[acknowledging linguistic dominance]	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	[verifying]	Correlation Coefficient	-,800
		Sig. (2-tailed)	,104
		N	5
	Directive illocutionary acts	Correlation Coefficient	**,900***
		Sig. (2-tailed)	,037
		N	5
	[activate resources]	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	[seeking information]	Correlation Coefficient	,154
		Sig. (2-tailed)	,805
		N	5
	[order]	Correlation Coefficient	,447
		Sig. (2-tailed)	,450
		N	5
	[persisting]	Correlation Coefficient	,866
		Sig. (2-tailed)	,058
		N	5
	Commissive illocutionary acts	Correlation Coefficient	-,300
		Sig. (2-tailed)	,624
		N	5
	[own opinion]	Correlation Coefficient	,564
		Sig. (2-tailed)	,322
		N	5
	[react]	Correlation Coefficient	-,821
		Sig. (2-tailed)	,089
		N	5
	[supporting]	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	[agreeing]	Correlation Coefficient	-,564
		Sig. (2-tailed)	,322
		N	5
	[raising concerns]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	[disagreeing]	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	Expressive illocutionary acts	Correlation Coefficient	-,600
		Sig. (2-tailed)	,285
		N	5
	[- task-related]	Correlation Coefficient	**-,900***
		Sig. (2-tailed)	,037
		N	5
	[comment]	Correlation Coefficient	-,500
		Sig. (2-tailed)	,391
		N	5
	Interpreting	Correlation Coefficient	.

		Sig. (2-tailed)	.
		N	5
	information-shift	Correlation Coefficient	-,100
		Sig. (2-tailed)	,873
		N	5
	information-maintenance	Correlation Coefficient	,100
		Sig. (2-tailed)	,873
		N	5
	quaestio: own opinion	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	quaestio: coordination	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	quaestio: side structure	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	Responsiveness	Correlation Coefficient	**,900***
		Sig. (2-tailed)	,037
		N	5
	Parallel discussions	Correlation Coefficient	-,154
		Sig. (2-tailed)	,805
		N	5
	Number of words	Correlation Coefficient	,700
		Sig. (2-tailed)	,188
		N	5
	Number of turns	Correlation Coefficient	,500
		Sig. (2-tailed)	,391
		N	5

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 80: Spearman's correlation calculated between the proportions of the formal-linguistic and pragmatic categories / values in the speech of subject 4 and the subject' median heart rate. The correlations are based on five discussions.

Subject 4			Receptiveness
Spearman's rho	Pulse median	Correlation Coefficient	,211
		Sig. (2-tailed)	,789
		N	4

Table 81: Spearman's correlation between the proportions of the category "Receptiveness" in the speech of subject 4 and the subject's median heart rate. The category "Receptiveness" is reported separately since it excludes the analysis of D3.

Subject 5			Pulse median
Spearman's rho	Representative illocutionary acts	Correlation Coefficient	,100
		Sig. (2-tailed)	,873
		N	5
	[adding information]	Correlation Coefficient	,410
		Sig. (2-tailed)	,493
		N	5
	[providing feedback]	Correlation Coefficient	-,051
		Sig. (2-tailed)	,935
		N	5
	[listening "actively"]	Correlation Coefficient	-,100
		Sig. (2-tailed)	,873
		N	5
	[acknowledging confusion]	Correlation Coefficient	,354
		Sig. (2-tailed)	,559
		N	5
	[acknowledging linguistic dominance]	Correlation Coefficient	**-,894***
		Sig. (2-tailed)	,041
		N	5
	[verifying]	Correlation Coefficient	**-,900***
		Sig. (2-tailed)	,037
		N	5
	Directive illocutionary acts	Correlation Coefficient	,200
		Sig. (2-tailed)	,747
		N	5
	[activate resources]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	[seeking information]	Correlation Coefficient	-,821
		Sig. (2-tailed)	,089
		N	5
	[order]	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	[persisting]	Correlation Coefficient	,224
		Sig. (2-tailed)	,718
		N	5
	Commissive illocutionary acts	Correlation Coefficient	,051
		Sig. (2-tailed)	,935
		N	5
	[own opinion]	Correlation Coefficient	-,112
		Sig. (2-tailed)	,858
		N	5
	[react]	Correlation Coefficient	-,200
		Sig. (2-tailed)	,747
		N	5
	[supporting]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	[agreeing]	Correlation Coefficient	,112
		Sig. (2-tailed)	,858
		N	5
	[raising concerns]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	[disagreeing]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	Expressive illocutionary acts	Correlation Coefficient	,100
		Sig. (2-tailed)	,873
		N	5
	[- task-related]	Correlation Coefficient	,051
		Sig. (2-tailed)	,935
		N	5
	[comment]	Correlation Coefficient	,112
		Sig. (2-tailed)	,858
		N	5
	Interpreting	Correlation Coefficient	.

		Sig. (2-tailed)	.
		N	5
	information-shift	Correlation Coefficient	,600
		Sig. (2-tailed)	,285
		N	5
	information-maintenance	Correlation Coefficient	-,600
		Sig. (2-tailed)	,285
		N	5
	quaestio: own opinion	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	quaestio: coordination	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	quaestio: side structure	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	Responsiveness	Correlation Coefficient	-,200
		Sig. (2-tailed)	,747
		N	5
	Parallel discussions	Correlation Coefficient	,600
		Sig. (2-tailed)	,285
		N	5
	Number of words	Correlation Coefficient	,100
		Sig. (2-tailed)	,873
		N	5
	Number of turns	Correlation Coefficient	,100
		Sig. (2-tailed)	,873
		N	5

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 82: Spearman's correlation calculated between the proportions of the formal-linguistic and pragmatic categories / values in the speech of subject 5 and the subject' median heart rate. The correlations are based on five discussions.

Subject 5			Receptiveness
Spearman's rho	Pulse median	Correlation Coefficient	-,400
		Sig. (2-tailed)	,600
		N	4

Table 83: Spearman's correlation between the proportions of the category "Receptiveness" in the speech of subject 5 and the subject's median heart rate. The category "Receptiveness" is reported separately since it excludes the analysis of D3.

Subject 6			Pulse median
Spearman's rho	Representative illocutionary acts	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	[adding information]	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	[providing feedback]	Correlation Coefficient	,600
		Sig. (2-tailed)	,285
		N	5
	[listening "actively"]	Correlation Coefficient	,667
		Sig. (2-tailed)	,219
		N	5
	[acknowledging confusion]	Correlation Coefficient	-,718
		Sig. (2-tailed)	,172
		N	5
	[acknowledging linguistic dominance]	Correlation Coefficient	-,707
		Sig. (2-tailed)	,182
		N	5
	[verifying]	Correlation Coefficient	,205
		Sig. (2-tailed)	,741
		N	5
	Directive illocutionary acts	Correlation Coefficient	-,700
		Sig. (2-tailed)	,188
		N	5
	[activate resources]	Correlation Coefficient	,410
		Sig. (2-tailed)	,493
		N	5
	[seeking information]	Correlation Coefficient	-,200
		Sig. (2-tailed)	,747
		N	5
	[order]	Correlation Coefficient	-,410
		Sig. (2-tailed)	,493
		N	5
	[persisting]	Correlation Coefficient	,300
		Sig. (2-tailed)	,624
		N	5
	Commissive illocutionary acts	Correlation Coefficient	**,900***
		Sig. (2-tailed)	,037
		N	5
	[own opinion]	Correlation Coefficient	,500
		Sig. (2-tailed)	,391
		N	5
	[react]	Correlation Coefficient	,872
		Sig. (2-tailed)	,054
		N	5
	[supporting]	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	[agreeing]	Correlation Coefficient	,205
		Sig. (2-tailed)	,741
		N	5
	[raising concerns]	Correlation Coefficient	,354
		Sig. (2-tailed)	,559
		N	5
	[disagreeing]	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	5
	Expressive illocutionary acts	Correlation Coefficient	**-,900***
		Sig. (2-tailed)	,037
		N	5
	[- task-related]	Correlation Coefficient	**-,900***
		Sig. (2-tailed)	,037
		N	5
	[comment]	Correlation Coefficient	-,100
		Sig. (2-tailed)	,873
		N	5
	Interpreting	Correlation Coefficient	.

		Sig. (2-tailed)	.
		N	5
	information-shift	Correlation Coefficient	-,600
		Sig. (2-tailed)	,285
		N	5
	information-maintenance	Correlation Coefficient	,600
		Sig. (2-tailed)	,285
		N	5
	quaestio: own opinion	Correlation Coefficient	,707
		Sig. (2-tailed)	,182
		N	5
	quaestio: coordination	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	quaestio: side structure	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	Responsiveness	Correlation Coefficient	,000
		Sig. (2-tailed)	1,000
		N	5
	Parallel discussions	Correlation Coefficient	-,821
		Sig. (2-tailed)	,089
		N	5
	Number of words	Correlation Coefficient	,600
		Sig. (2-tailed)	,285
		N	5
	Number of turns	Correlation Coefficient	,800
		Sig. (2-tailed)	,104
		N	5

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 84: Spearman's correlation calculated between the proportions of the formal-linguistic and pragmatic categories / values in the speech of subject 6 and the subject' median heart rate. The correlations are based on five discussions.

Subject 6			Receptiveness
Spearman's rho	Pulse median	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	4

Table 85: Spearman's correlation between the proportions of the category "Receptiveness" in the speech of subject 6 and the subject's median heart rate. The category "Receptiveness" is reported separately since it excludes the analysis of D3.