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What a feeling?
The role of emotion processing and social cognition in patients with medically unexplained symptoms

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LIST OF ABBREVATIONS

BDI	Beck Depression Inventory
CBT	Cognitive Behavior Therapy
CIMH	Central Institute of Mental Health
DEP	Depression
DSM	Diagnostic and Statistical Manual of Mental Disorders
ENCERT	Enriching Cognitive Behavior Therapy with Emotion Regulation Training
ERQ	Emotion Regulation Questionnaire
HC	Healthy Controls
HYP	Hypochondriasis
IAD	Illness Anxiety Disorder
IAPS	International Affective Picture System
MUS	Medically Unexplained Symptoms
PDI	Pain Disability Index
PHQ	Patient Health Questionnaire
SCID	Structured Clinical Interview for DSM-IV
SFD	Somatoform Disorders
SHAI	Short Health Anxiety Inventory
SOMS	Screening for somatic symptom disorders
SPF	Saarbrücker Persönlichkeitsfragebogen
SSD	Somatic Symptom Disorder
TAS	Toronto Alexithymia Scale
ToM	Theory of Mind

1 INTRODUCTION

The processing of own emotional experiences as well as the ability to understand the feelings of others is an essential prerequisite in social interactions. Emotional cues communicated through different modalities, like verbal or facial expressions, intonation, or behaviours, serve us to understand others and predict their actions (Gross, 1998a). Simultaneously, own emotions have to be identified and interpreted correctly in order to enable a person to express feelings, while the ability to regulate emotions is needed to form socially appropriate behaviours (Gross, 1998a).

Amongst others, somatic symptom disorder (SSD) and health anxiety or illness anxiety disorder (IAD) are mental disorders that are not only characterized by experiencing medically unexplained symptoms (MUS) but also by difficulties in understanding own feelings (Nemiah & Sifneos, 1970; Waller & Scheidt, 2004). Patients with MUS persistently experience distressing physical symptoms accompanied by excessive thoughts about the seriousness of these symptoms, high levels of health related anxiety, and behaviours that consume a lot of time and energy and serve to cope with these health concerns (DSM-5; American Psychiatric Association, 2013).

Furthermore, MUS is associated with high levels of alexithymia, a concept that has been introduced to describe the disability to identify and describe own feelings (Nemiah & Sifneos, 1970). It has been suggested, that alexithymia is linked to somatic symptoms via somatosensory amplification and that it fosters the incorrect attribution of physiological aspects of emotional arousal as signs of disease (Lumley et al., 1996). In addition, high levels of alexithymia have been associated with maladaptive emotion regulation strategies, such as expressive suppression, which enhance physiological aspects of emotional experience (Alexander, 1950; Laloyaux et al., 2015; Pennebaker & Seagal, 1999; Swart et al., 2009).

While numerous studies reinforce that patients with MUS have difficulties understanding own feelings (Bailer et al., 2017; Bankier et al., 2001; De Gucht & Heiser, 2003; Deary et al., 1997; MacLean, 1949; Pedrosa Gil et al., 2009; Waller & Scheidt, 2004), the findings regarding their ability to understand emotions of others and to empathize with them are heterogeneous. Some studies revealed difficulties in understanding the emotions of others in patients with MUS and especially in those with high levels of alexithymia (Beck et al., 2013;

Pedrosa Gil et al., 2009). Nevertheless, other studies have shown that patients with MUS have an intact perception of others' emotions and even a heightened sensitivity towards negative emotions has been suggested (Buhlmann et al., 2006; Schönenberg et al., 2014).

This dissertation is aimed at improving the understanding of the processing of emotions in patients with MUS. Besides investigating the difficulties in understanding own emotions, specific patterns of emotion regulation as well as social cognitive processes are of highest interest. This doctoral thesis is supposed to shed light on potential maintaining factors and to provide suggestions on the improvement of psychotherapeutic interventions. In order to provide a comprehensive picture of the subject, a brief overview of the characteristics and diagnostic specificities of the examined disorders will be presented. In the following, this dissertation will give an introduction to emotion recognition, emotion regulation and the findings on these processes in patients with MUS. Hereinafter, our empirical data on dysfunctional emotion regulation and social cognition investigated within the scope of this dissertation will be presented. The doctoral thesis will conclude with a general discussion of the potential role of social cognition and especially trust, with regard to extensive help seeking behavior and implications for psychotherapeutic interventions.

1.1 Characteristics of MUS

The reorganized DSM-5 category *somatic symptom and related disorders* has replaced the DSM-IV category of *somatoform disorders*, which included, inter alia, the diagnoses somatization disorder and hypochondriasis. In contrast to the former diagnosis somatization disorder, which was mainly characterized by multiple physical complaints without a medical explanation, SSD is defined by the actual presence of concrete symptoms: The experience of distressing somatic symptoms accompanied by abnormal thoughts, feelings and behaviours, while the presence of medical factors is no longer an exclusion criterion. Hypochondriasis has been divided into a group of patients who experience somatic symptoms and are therefore diagnosed with SSD and another group of patients, who might report some mild physical complaints but suffers mainly from health anxiety itself instead of physical discomfort. Henceforth, the latter group is diagnosed with *illness anxiety disorder* (IAD). While the reorganization of the category of somatoform disorders was meant to improve the diagnostic process in general practice, where about 16 % to 31 % of consultations are based on MUS (Sauer & Eich, 2007), the new defined diagnostic criteria have been discussed controversially.

Regarding IAD, the benefit from this new diagnosis has been questioned, since most patients with health anxiety also experience multiple physical complaints and there are already established effective therapeutic interventions that apply regardless of the presence or absence of physical symptoms (Hiller & Rief, 2014). Moreover, it is disputed whether the new criteria for SSD might enhance the misdiagnosis of patients with serious or chronic medical conditions, who worry about their health, as psychiatrically ill (Frances & Chapman, 2013).

A common characteristic of both disorders, SSD and IAD, are certain patterns of perception and evaluation of physiological sensations and their potential consequences. More precisely, patients with somatic symptoms have been associated with difficulties to distinguish affective arousal and physical symptoms, resulting in the misinterpretation of emotion-related physiological sensations as indicators of illness (Burton et al., 2009; Subic-Wrana et al., 2010; Taylor, 2000), as well as with impairments in affect perception and expression (MacLean, 1949). Moreover, it has been suggested, that patients with MUS fail in applying cognitive regulation mechanisms in order to regulate affective arousal, which results in a missing connection of the accompanying physiological sensation to the corresponding cognition and to a specific emotion (Bucci, 1997; Taylor et al., 1997). This might not only result in a persistent physiological activation (Bucci, 1997), but also amplify physiological perceptions and foster the misinterpretation of such sensations as signs of disease (Taylor et al., 1997). Thus, while there are only few studies examining explicit emotion regulation strategies in this group of patients, the results indicate deficits when it comes to coping with own feelings and a preference for rather maladaptive strategies like symptom focused rumination (Bailer et al., 2017) which promotes physiological aspects of emotional experiences (Alexander, 1950; Pennebaker & Seagal, 1999; Traue, 1998). This is also reflected in high levels of alexithymia, which have been observed in these patients (Nemiah & Sifneos, 1970; Waller & Scheidt, 2004).

Another commonality of SSD and IAD are coping strategies that include constant checking behavior as well as help seeking in terms of numerous medical consultations (de Zwaan & Müller, 2006). Constant checking behavior favors an attention shift towards changes in physiological sensations and reinforces the perception of bodily symptoms, which again fosters the focusing on these symptoms and increases discomfort and anxiety (Barsky et al., 1988). Besides the difficulties in general practice to identify patients with MUS as such (Sauer & Eich, 2007), these patients also tend to hold on to a somatic disease model and to continue

looking for a medical explanation for their symptoms. The persistent help-seeking behavior might provoke negative reactions from physicians and relatives, who feel increasingly overstrained (Kirmayer et al., 1994), which in turn might maintain negative feelings and the accompanying bodily sensations and further enhance the probability of false alarms in patients with MUS.

While only small to medium effect sizes were reported, a meta-analysis showed that CBT had the best evidence of efficacy and is the treatment of choice for patients with MUS (van Dessel et al., 2014). In order to improve the effects of CBT, recent studies aim at identifying additional beneficial strategies. Especially the processing of negative emotions and its role in eliciting, enhancing and maintaining somatic symptoms has come into focus. Negative emotions have been demonstrated to increase the sensitivity towards somatic symptoms, which in turn again elicit negative emotions (Bogaerts et al., 2010). Furthermore, feelings of depression and negative emotions have been suggested to mediate the relationship between difficulties in emotion processing and somatization (Shibata et al., 2014). In order to distinguish the specific patterns of emotion dysregulation in depression and hypochondriasis, Bailer and colleagues investigated alexithymia and rumination in those two groups (2017). They demonstrated that the degree of somatization, health anxiety and illness behavior was specifically predicted by more difficulties in identifying feelings, while increased rumination scores predicted higher levels of depressive symptoms. Nevertheless, it has been suggested that the deficits in identifying feelings make patients with hypochondriasis more prone to experiencing and intensively ruminating about bodily discomfort and thus increase attention on physical sensations and eventually result in misinterpreting these sensations as menacing signs of disease (Bailer et al., 2017). It is therefore indispensable to further investigate the role of emotion processing and emotion regulation in the context of MUS.

1.2 Processing of emotions and specificities in patients with MUS

While emotions are helpful in many ways, like through facilitating the memory consolidation of important events (Phelps, 2006) or forming interactions with others (Keltner & Kring, 1998), they can also be painful, for example when they occur in an inappropriate social context, at the wrong time or an improper intensity (Gross, 2002). In that case, adequate emotion regulation abilities are highly relevant. As an emotional experience manifests itself at various levels, such as the mere feeling, accompanying thoughts, physiological sensations

and behaviors that are evoked, the attempts to regulate which emotion is experienced in which intensity and how it is expressed may vary as well. Gross proposes the distinction of antecedent-focused and response-focused emotion regulation (Gross, 2002; Gross & Muñoz, 1995). While antecedent-focused strategies involve behaviors that are meant to regulate which emotion response tendencies occur, response-focused emotion regulation aims at modulating the experiential, behavioral or physiological response, once an emotion is already generated (Gross, 2002). Gross further specifies that conscious as well as unconscious steps like selecting a situation, modifying it, shifting attention towards certain aspects and away from others and changing the meaning of the situation are components of antecedent-focused strategies that influence which response tendencies occur, even before behavioral and physiological responses are elicited. An emotion regulation strategy that is effective in this stage of the emotion-generative process would be cognitive reappraisal (Gross, 2001). In contrast, response-focused strategies refer to the modification of the emotional response, which is the alteration of experiential, behavioral or physiological aspects of the elicited emotion. In this stage of the process, expressive suppression would be an effective emotion regulation strategy (Gross, 2001).

However, it has to be noted, that expressive suppression is associated with an increased response of the sympathetic nervous system (Gross, 1998b, 2002) and it is believed to promote a persistent attention shift towards and thereby enhancement of bodily sensations, that occur as an accompaniment of emotional experiences (Alexander, 1950; Pennebaker & Seagal, 1999). It is therefore assumed to be a rather maladaptive emotion regulation strategy. Cognitive reappraisal on the other hand, is believed to be more adaptive, since it affects the valuation of a situation even before an emotional response is fully evolved, so that not only the visible expression is influenced but also the emotional experience itself (Gross, 2013). As proposed within the response styles theory by Nolen-Hoeksema (1991), another rather maladaptive strategy is rumination about symptoms or oneself, since it maintains negative mood and thereby interferes with the development of helpful behaviors and problem-solving (Huffziger et al., 2009; Li et al., 2006; Nolen-Hoeksema, 1991; Witthöft et al., 2013).

Emotion dysregulation has been investigated in a variety of mental disorders during the past decades and its impact on the development and maintenance of different disorders

has been shown repeatedly (Aldao et al., 2010; Sloan et al., 2017), like in borderline personality disorder (Carpenter & Trull, 2013), anxiety and mood disorders (Mennin et al., 2007), and eating disorders (Lavender et al., 2015). A recent review demonstrated the association of a decrease in the use of maladaptive strategies and overall emotion dysregulation with a reduction in symptoms of psychopathology regardless of the mental disorder or intervention applied, supporting the role of emotion regulation as a transdiagnostic construct (Sloan et al., 2017). Regarding patients with MUS, emotion dysregulation has been demonstrated in terms of high levels of alexithymia and especially difficulties understanding own feelings (Bailer et al., 2017; Nemiah & Sifneos, 1970; Waller & Scheidt, 2004). It has been suggested that such a lack of emotional awareness results in the disability to distinguish between emotional arousal and physical symptoms and thereby promotes the misinterpretation of physiological aspects of emotional experience as bodily complaints (Burton et al., 2009; Subic-Wrana et al., 2010; Taylor, 2000). Alexithymia has also been associated with somatic amplification, which defines the process of reinforcing bodily sensations by maintaining a focus onto physiological aspects of emotional experience (Barsky et al., 1988; Nakao & Barsky, 2007; Wise & Mann, 1994). Moreover, alexithymia has been linked to the application of emotion regulation styles that further enhance physiological aspects of the emotional experience and are therefore rather maladaptive (Laloyaux et al., 2015; Swart et al., 2009). More precisely, associations of expressive suppression and higher levels of alexithymia have been demonstrated (Kessler et al., 2010; Nemiah & Sifneos, 1970), and expressive suppression has also been linked to the increase of physiological aspects of emotional experience (Alexander, 1950; Gross, 2002; Pennebaker & Seagal, 1999).

Witthöft and colleagues investigated the association between the experience of somatoform symptoms in the general population with the functional emotion regulation strategies reappraisal and distraction, and the dysfunctional strategies expressive suppression and rumination (2013). They found that the experience of somatoform symptoms is associated with higher levels of symptom related rumination and less distraction. They further suggested that the use of functional strategies might have an indirect beneficial influence on the experience of somatoform symptoms, which could be mediated by depression (Witthöft et al., 2013). Then again, depression has not only been linked to alexithymia as well (Bailer et al., 2017), but it has also been demonstrated to be strongly associated with rumination (Aldao et al., 2010), suggesting that therapeutic interventions for patients with comorbid depression

would benefit from integrating strategies that help disengaging from worrying processes, like applied in the treatment for generalized anxiety disorder (Bailer et al., 2017).

Social cognition describes the processes that are required to understand emotional and mental states of others and to use this information successfully in social interactions (Brothers, 1990, 1996). Facial expressions contribute the highest level of information and therefore represent the main source on feelings and intensions of others (Paulmann & Pell, 2011). Thus, emotion recognition is an essential requirement for social functioning and impairments in social cognitive abilities have enormous effects on the social integration and quality of life (Fett et al., 2011; Lazarus et al., 2014). Though there are some findings suggesting difficulties in recognizing emotional states of others in patients with MUS (Beck et al., 2013; De Greck et al., 2012; Pedrosa Gil et al., 2009), other studies report an intact perception of others' emotions but impaired mentalizing abilities (Schönenberg et al., 2014) and a negative bias in self-referential emotion recognition has been presumed (Buhlmann et al., 2006). Beyond the mere recognition of others' emotions, mentalizing, also referred to as Theory of Mind (ToM), includes the ability to attribute mental states to others and thus to anticipate their intentions (Frith & Frith, 1999; Premack & Woodruff, 1978). So, while there are only few studies on mentalizing in patients with MUS so far, they suggest impairments in these abilities (Schönenberg et al., 2014; Stonnington et al., 2013; Subic-Wrana et al., 2010; Zunhammer et al., 2015). Furthermore, in the course of experiencing empathy, it is not only required to recognize another person's mental states and feelings, but it is also mandatory to generate a congruent feeling within oneself (De Greck et al., 2012). De Greck and colleagues argue that, as a result of experiencing more distress, patients with MUS suppress specific emotions and thereby inhibit processes required for the generation of congruent emotions, which might hamper their mentalizing abilities and adversely affect social interactions (2012). This is in line with the assumption that patients with MUS suppress specific emotions in order to protect social relationships, resulting from a dismissing attachment style (Waller & Scheidt, 2006). Nevertheless, the frequent use of expressive suppression of feelings is not only believed to enhance physiological sensations by increasing the response of the sympathetic nervous system (Gross, 2002), but has also been linked to several adverse outcomes regarding social relationships, like more distress in social interactions (Gross, 2013), less liking from interaction partners (Butler et al., 2003), less positive relationships and less emotional

closeness (English et al., 2012; Gross & John, 2003) as well as negative impacts on well-being (Gross & John, 2003).

It has been suggested that patients with MUS exhibit impairments in cognitive emotion processing mechanisms, which result in the experience of physiological sensations without the connection to a related cognition (Bucci, 1997). Furthermore, the inability to link affective arousal to specific emotions is believed to increase the focus on isolated physiological aspects of emotional experience (Taylor et al., 1997), which has been associated with somatic amplification (Barsky et al., 1988). Given that emotion regulation presumes the identification of an emotion that has to be changed (Gross, 2013), this gives rise to the question if enhancing emotional awareness should precede attempts to improve actual emotion regulation.

Furthermore, while the results regarding their emotion recognition abilities are inconclusive (Bailer et al., 2017; Beck et al., 2013; Pedrosa Gil et al., 2009; Schönenberg et al., 2014), there is evidence for a negative bias in self-referential emotion recognition (Buhlmann et al., 2006). This points to the necessity to further investigate this subject and raises the question, whether patients with MUS differ in how they perceive others and if this influences their interaction with them. To address this question, a trust game combined with ratings of sympathy and fairness of co-players was applied in the course of the first study of this dissertation.

In sum, the processing of own as well as others' emotions is a crucial factor regarding mental health, social functioning and well-being in general and has therefore gained increasing attention in research on the understanding and treatment of mental disorders. The first study of this dissertation aimed at investigating whether patients with SSD actually exhibit impairments in identifying own as well as understanding others' feelings. Therefore, alexithymia was assessed by questionnaire and an emotion recognition task was applied in the first study. Besides the assessment of potential difficulties in these aspects of emotion processing, the first study also aimed at investigating how patients with SSD cope with aversive feelings and if they actually rely more than healthy controls on maladaptive emotion regulation strategies. For this purpose, data on the habitual use of either cognitive reappraisal or expressive suppression was acquired using an emotion regulation questionnaire. In the scope of the second study, another subgroup of patients with MUS came into focus, which is hypochondriasis. Since it is rather aversive feelings of health anxiety than actual physical

complaints that are highly pronounced in this group of patients, it is particularly interesting to investigate potential deficits in social cognition and emotion processing in hypochondriasis and to shed light on the role of emotional distress in these processes. Thus, besides an experimental task investigating the processing of others' emotions and intentions, a self-report questionnaire on interpersonal reactivity was used to assess if patients with hypochondriasis experience more distress in the course of empathy. Taken together, the findings of the two studies in the scope of this thesis ought to shed light onto emotion processing and potential consequences for social functioning in patients with MUS. Therefore, both studies examined emotion recognition, while the first study additionally focused on the habitual coping with own feelings as well as on trust as an indicator for the perception of others and the second study aimed at investigating the interplay of recognition of emotions and intentions of others and own feelings of distress elicited in the course of empathy.

2 STUDY 1 | Impaired emotion processing and a reduction in trust in patients with somatic symptom disorder[1]

2.1 Abstract

There is accumulating evidence for deficits in the perception and regulation of one's own emotions, as well as the recognition of others' emotions in somatic symptom disorder (SSD). However, investigations of SSD focusing on specific aspects of emotion processing and how these might interact are missing. We included 35 patients with SSD and 35 healthy controls who completed questionnaires on the perception and regulation of their own emotions, as well as experimental investigations of emotion recognition and trust. In line with previous studies, our results show that SSD patients in comparison to healthy controls have difficulties in the identification and description of own feelings (η_p^2 = .381 and η_p^2 = .315). Furthermore, we found that patients apply less cognitive reappraisal (η_p^2 = .185) but tend to use more expressive suppression (η_p^2 = .047). In contrast to previous studies, we found SSD patients to perform superior in emotion recognition, in particular for anger (*d* = 0.40). In addition, patients with SSD invested less in a trust game (*d* = 0.73). These results point to a higher sensitivity for negative emotions and less trust in others. Further, these findings suggest a dissociation between the ability to recognize one's own emotions versus others' emotions in SSD. Future interventions targeting emotion processing in SSD might focus on the identification of one's own emotions, prior to the training of emotion regulation.

2.2 Introduction

Although the key features of somatic symptom disorders (SSD) are prominent somatic symptoms, patients with unexplained somatic symptoms also experience a decrease in quality of life, including high frequency of absence rates at work, limitations in daily activities, and a lower general health perception (Hanssen et al., 2016; Leonidou et al., 2016; Rask et al., 2017; Spitzer et al., 1995). In addition, SSD is associated with high levels of negative affective states and alexithymia (Waller & Scheidt, 2004). At present, cognitive behavioural therapy (CBT) is the method of choice in the treatment of SSD (Gottschalk & Rief, 2012). However, CBT has

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been shown to be less effective in SSD than in other mental disorders, raising the question which specific characteristics of SSD patients are not completely addressed by CBT (Gottschalk et al., 2015). Therefore, recent approaches in psychotherapy have started addressing the improvement of emotion processing abilities in somatoform patients (Gottschalk et al., 2015; Kleinstäuber et al., 2016). To support the further development of emotion focused therapies for SSD, it is necessary to get a deeper understanding of emotion processing impairments in SSD.

Medically unexplained physical symptoms are a common problem in primary care patients (Rief & Martin, 2014). About 16% to 31% of consultations in general practice are based on somatic symptoms with- out adequate medical explanation (Sauer & Eich, 2007). About 26% to 35% of these patients fulfil the diagnostic criteria for a Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV somatoform disorder (SFD; Haller et al., 2015; Saß et al., 1996). According to the German Health Interview and Examination Survey, SFD has a 12-month prevalence of 11% and a lifetime prevalence of 16.2% (Wittchen & Jacobi, 2001). The reorganized DSM-5 category somatic symptom and related disorders, which replaces SFD, is defined by positive symptoms, that is, distressing somatic complaints accompanied by abnormal thoughts, feelings, and behaviours, emphasizing the role of psychological factors. Further, in comparison to DSM-IV, the presence of a medical disorder is no longer an exclusion criterion. For easier reference, we will present earlier studies on patients with medially unexplained symptoms under the umbrella of SSD, albeit is has to be kept in mind that these studies relied on former classifications of SSD patients with slightly divergent diagnostic criteria.

Early characterizations of patients with somatic symptoms report impairments in affect perception and expression (MacLean, 1949). Based on the descriptions of patients with reduced abilities to experience and describe their emotions, the concept of alexithymia was introduced (Nemiah & Sifneos, 1970). The authors used this term to describe a group of patients who are unable to understand their own feelings and to link the resulting bodily sensations to affective arousal, which makes them prone to develop physical complaints, and to attribute bodily sensations as signs of disease. Further, such a decreased emotional awareness has been associated with difficulties to differentiate bodily sensations and to distinguish between affective arousal and physical symptoms (Burton et al., 2009; Subic-

Wrana et al., 2010; Taylor, 2000). Recent studies have shown that patients with medically unexplained somatic symptoms fail to link their emotions to experienced physical complaints and misinterpret physiological aspects of affective arousal as bodily symptoms (Burton et al., 2009; Subic-Wrana et al., 2010). Moreover, the disability to understand and express one's own feelings was linked to immune alterations, a negative impact on health, and has been assumed to rep- resent a risk factor for psychosomatic and stress-related illness (de Timary et al., 2008; Lumley et al., 1996; Uher, 2010). Regarding symptom reports, especially self-reported difficulties in identifying feelings, as measured with the Toronto Alexithymia Scale (TAS; Bagby et al., 1994), show strong correlations with the number of somatic symptoms (Bailer et al., 2017; De Gucht & Heiser, 2003; Deary et al., 1997).

Furthermore, individuals with high levels of alexithymia seem to use maladaptive emotion regulation strategies enhancing physiological aspects of emotional experience, suggesting that patients with SSD might also rely on dysfunctional emotion regulation styles (Laloyaux et al., 2015; Swart et al., 2009). Traue (1998) postulates that somatization is promoted by the suppression of negative feelings, which is in accordance with studies that have shown that suppression enhances physiological aspects of emotional experience (Alexander, 1950; Pennebaker & Seagal, 1999). Moreover, the usage of suppression as emotion regulation strategy was shown to be associated with higher levels of alexithymia (Kessler et al., 2010; Nemiah & Sifneos, 1970). Bucci (1997) argued that patients with SSD exhibit impaired cognitive regulation of affective arousal and therefore experience isolated somatic sensations without intact connection to the corresponding cognition, which leads to a persistent physical activation and promotes psychosomatic disorders. Taylor, Bagby, and Parker (1997) also assumed that this patient group is impaired in using cognitive mechanisms in order to identify and regulate emotions, resulting in enhanced focus on physiological sensations that accompany affective arousal without linking them to a specific emotion. This might further enhance the bodily perceptions and lead to a misinterpretation of bodily sensations as indicators of illness. However until now, the number of studies applying questionnaires or experimental designs to investigate the way of coping with negative emotions in somatoform patients is still limited.

Interestingly, it was shown that especially in those SSD patients with higher alexithymia scores, not only the ability to recognize one's own emotions seemed to be impaired but also

the ability to adequately identify others' emotions (Pedrosa Gil et al., 2009). Congruently, the recognition of others' emotions is becoming a field of interest in SSD as well, because it is an important skill regarding interpersonal interactions and interpersonal emotion regulation (Zaki & Williams, 2013). It might therefore have an impact on social functioning in general, as well as on the course of disease (Schönenberg et al., 2014; Waller & Scheidt, 2006). Indeed, it has been shown that SSD patients perform worse than individuals without somatic symptoms on emotion recognition tasks (Beck et al., 2013). Buhlmann, Etcoff, and Wilhelm (2006) investigated self-referential emotion recognition in patients with body dysmorphic disorder and found patients having a negative bias. Beck et al. (2013) also showed impaired emotion recognition abilities in SSD patients and stressed the importance of therapeutic interventions aiming at the improvement of emotion recognition and regulation. Schönenberg et al. (2014) found intact facial affect perception in patients with persistent somatoform pain disorder. However, by using videos of social scenes, they observed impaired mentalizing abilities in the patient group. The authors further argued that due to this deficit, SSD patients might tend to misinterpret social signals that can cause distress in social interactions. Considering that SSD patients might tend to label affective expressions of others as negative in a self-referential context (Buhlmann et al., 2006), interactions with physicians during medical examinations and social interactions in general are predisposed to evoke negative feelings, resulting in less trust. This might contribute to the high number of medical consultations with frequently changing physicians, as often observed in patients with SSD (de Zwaan & Müller, 2006).

Taken together, patients with SSD seem to be affected in various facets of emotion processing and social cognition, ranging from deficits in the perception and regulation of their own emotions to the recognition of others' emotions and intentions. We assume to find the deficits in emotion processing that were reported for patients diagnosed with former versions of the DSM also in patients with SSD.

We expect that patients with SSD use significantly more expressive suppression than healthy controls. Further, we hypothesize that patients with SSD are impaired in identifying and describing their own feelings and show deficits in recognizing feelings of others. With regard to social interactions, we expect patients with SSD to show less trust than healthy controls.

Further, we were interested in investigating the interplay of the emotion processing deficits and how they contribute to the medically unexplained bodily symptoms in SSD. We assumed that alexithymia and emotion regulation deficits both contribute to impaired recognition of others' emotions in SSD. Finally, we were interested whether alexithymia mediates the influence of emotion regulation skills on medically unexplained bodily symptoms.

2.3 Methods

2.3.1 Sample

In total, 35 patients with SSD and 35 healthy controls participated in the study. The group of SSD patients was recruited in the context of an ongoing multicenter therapy study, which was designed to compare the efficacy of conventional CBT with CBT enriched with strategies addressing emotion processing and regulation (ENCERT; Kleinstäuber et al., 2016).

We asked those patients of the ENCERT study enrolled for a treatment in the outpatient clinics of the University of Koblenz-Landau or the Central Institute for Mental Health Mannheim (CIMH) to take part in our study. In sum, 14 patients from Landau and 21 patients from the CIMH agreed to participate. Patients were on average 42 years old (standard deviation [SD] = 13), and 57.1% were female. Thirty-five healthy control subjects, who were matched by age, gender, and years of education, were included in the study. Table 1 shows a detailed description of the characteristics of both groups.

TABLE 1 Sample characteristics and symptom measures (*M* ± *SD*)

	1 SSD (*n* = 35)	2 HC (*n* = 35)	*t* test/χ^2 test *t*/χ^2 value
Age in years (*M* ± *SD*)	42.4 ± 12.9	41.1 ± 12.1	*t*(68) = .430
Gender: female (%)	57.1	57.1	$\chi^2(1, N = 70) < .001$
School education (≥12 years; %)	45.7	51.4	*t*(68) = .431
Somatoform symptoms			
PHQ-15 (*M* ± *SD*)	13.5 ± 5.1	1.7 ± 1.9	*t*(68) = 12.837, *p* < .001
SOMS number of symptoms (*M* ± *SD*)	12.4 ± 8.8	3.4 ± 4.8	*t*(68) = 5.303, *p* < .001
SOMS intensity of symptoms (*M* ± *SD*)	0.8 ± 0.59	0.1 ± 0.12	*t*(68) = 7.165, *p* < .001
Depressive symptoms			
BDI (*M* ± *SD*)	21.6 ± 11	2.5 ± 4.3	*t*(68) = 9.576, *p* < .001
Current DSM-IV diagnosis *n* (%)			
Any somatoform disorder[a]	35 (100)	0	
Somatization disorder[a]	6 (17.1)	0	
Undifferentiated somatoform disorder[a]	24 (68.6)	0	
Pain disorder[a]	5 (14.3)	0	
Any co-morbid mental disorder[a]	19 (54.3)	0	
Current depression[a]	12 (34.3)	0	
Current anxiety disorder[a]	8 (22.9)	0	
Any personality disorder[a]	5 (14.3)	0	

Note. SSD = somatic symptom disorder group; HC = healthy control group; PHQ-15 = Patient Health Questionnaire; SOMS = Screening for Somatoform Disorders; BDI = Beck Depression Inventory; *M* = mean; SD = standard deviation; DSM = Diagnostic and Statistical Manual of Mental Disorders.

[a]According to the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.).

2.3.2 Study design and procedures

If patients had given written consent during the diagnostic phase of the ENCERT study, we contacted them, explained the study objective and procedures, and arranged an appointment. Healthy controls were recruited with advertisements on the website of the CIMH and information flyers on billboards in Mannheim. Interested participants were included if they did not fulfil the criteria of any mental disorder, currently or in the past, as assessed by a telephone version of the Structured Clinical Interview for DSM-IV Axis I and II (Wittchen, Zaudig, & Fydrich, 1997). The procedure was approved by the local ethics board of the Medical Faculty Mannheim of the University of Heidelberg. Before being enrolled in the study, participants gave written informed consent.

Diagnoses in the patient group were assessed by applying the Structured Clinical Interview for DSM-IV, too. The inclusion criteria for the patients were based on the diagnoses of somatization disorder and undifferentiated somatoform disorder according to DSM-IV as well as on the DSM-5 diagnosis of SSD. According to Kleinstäuber and colleagues (2016), the DSM-5 criteria for SSD are better suited to detect patients in need for treatment, but additional criteria should be applied to ensure symptom severity. Therefore, the DSM-5 criteria were adapted to the presence of at least three distressing physical symptoms with duration of at least 6 months. Following the criteria for SSD, at least one of three psychological

criteria had to be fulfilled as well: disproportionate thoughts, persistently high level of anxiety, or excessive time and energy devoted in regard to symptoms or health concerns (see DSM-5, American Psychiatric Association, 2013).

In addition, as empirically proven cut-off criteria (Mewes et al., 2009), a self-reported Pain Disability Index (PDI) score ≥4 (Dillmann et al., 1994) and a Patient Health Questionnaire (PHQ)-15 total score ≥5 were applied to confirm symptom severity (Kroenke et al., 2002). Patients with alcohol, drug, or substance addiction, psychosis, or acquired brain injuries were excluded. Other co-morbid mental disorders were allowed, unless the co-morbid disorder was considered to be the major problem. Further, patients were excluded from the study if symptoms could be fully explained by a medical disease, which had to be verified by a medical report.

2.3.3 Self-report questionnaires

Difficulties in the processing of one's own emotions were measured with the TAS-20, containing the subscales difficulties identifying feelings (DIF, 7 items), difficulties describing feelings (DDF, 5 items), and externally oriented thinking (EOT, 8 items) as well as a total score (TAS-20; Bagby et al., 1994). Reliability estimates in the current study were high for the two subscales DIF and DDF (Cronbach's α = .87 and .80) but lower for the subscale EOT (α = .52). Deficits in the ability to cope with emotions were assessed with the Emotion Regulation Questionnaire, which distinguishes the subscales cognitive reappraisal (6 items) and expressive suppression (4 items; Abler & Kessler, 2009). In our sample, Cronbach's α was .85 for cognitive reappraisal and .75 for expressive suppression. Additional questionnaires were used to assess: The number and intensity of somatic symptoms during the past 7 days (Screening for Somatoform Disorders-7T; Rief & Hiller, 2008), symptom severity (PHQ-15; Kroenke et al., 2002), the degree to which different aspects of life are disrupted by pain (PDI; Dillmann et al., 1994), as well as depressive symptoms (Beck Depression Inventory Revised-II; Hautzinger et al., 2006). These instruments had good reliabilities in our sample, with α coefficients for Screening for Somatoform Disorders-7T (47 items) .94 for the number and .97 for the intensity of symptoms, PHQ-15 (15 items) .89, PDI (7 items) .94, and Beck Depression Inventory (21 items) .96. Means and SDs of the questionnaire scores are shown in Table 1 and Figures 2 and 3.

2.3.4 Experimental task

In the emotion recognition task (Fenske et al., 2015), face stimuli with angry, neutral, or happy facial expressions were presented following positive, neutral, or negative pictures of scenes. This task was selected, because it can be assumed to combine emotion recognition with emotion regulation (Fenske et al., 2015). Participants were instructed to pay attention to both pictures, but to indicate the face valence only, by pressing the appropriate key on a standard computer keyboard as fast as possible. The pictures of scenes were taken from the International Affective Picture System (IAPS; Lang et al., 1999) and combined either positive valence and high arousal (e.g., sport activities), negative valence and high arousal (e.g., crime scenes), or neutral valence and low arousal (e.g., daily situations). Pictures of negative and positive scenes were matched for arousal, which was significantly higher than in neutral pictures. Positive and negative pictures were also matched to have a similar difference in valence compared to pictures of neutral scenes (Fenske et al., 2015). The facial stimuli were taken from the "NimStim set of facial expressions" (Tottenham et al., 2009) and consisted of 5 male and 5 female faces. To avoid ceiling effects, the facial stimuli were morphed according to a 60% emotional and 40% neutral ratio, as provided by Matzke, Herpertz, Berger, Fleischer, and Domes (2014). IAPS pictures were presented for 3 s, and the immediately following facial expressions were shown until the response key was pressed but for 3 s at most (Figure 1). The facial expression was followed by a masking stimulus consisting of a pattern of random black and white pixels, which was presented for 500 ms. The task included 90 trials consisting of 10 trials for each of the 9 combinations of each IAPS category (positive, neutral, and negative) with each face category (happy, neutral, and angry) and took about 11 min.

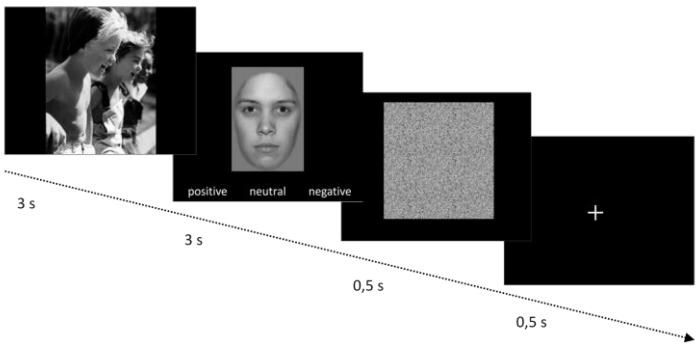

FIGURE 1 Emotion recognition task. Pictures of scenes are presented first, followed by pictures of happy, neutral or angry facial expressions, a masking stimulus and a fixation cross. Numbers represent the duration of the stimulus presentation. Example with positive scene and neutral facial expression.

In the adapted Trust Game (Franzen et al., 2011; Lis et al., 2011), participants were first shown the portrait pictures of four coplayers (i.e., trustees) on a computer screen and were asked to rate how likeable they seem to them ("sympathy rating" from "1 = not at all likeable" to "9 = very likeable"). Participants were in the role of the investor. They were given 90 monetary units at the beginning of each round. The picture of a trustee was presented, and the participants had to decide how many of their 90 monetary units (10 units at least) they would like to transfer to the trustee. The chosen amount could be logged in by moving the mouse cursor to the according value presented on the screen. The transferred monetary units were tripled and credited to the trustee, who in return could transfer an amount of monetary units back to the participant, finishing one round. Return values of the trustees were enquired previously in an independent experimental setting. Therefore, no cover story was needed in the present experiment. They played four rounds, and in each round, the participants gained the sum of monetary units they kept plus the monetary units they reobtained from the trustee. Afterwards, one of the four rounds was selected randomly, and the gained monetary units were converted into money, which the participants actually received at the end of the experiment. Finally, the participants were asked to rate their coplayers once more. The questions were to rate again how likeable the trustees seemed to them after having played together, and in addition, how fair the trustees acted during the trust game ("fairness rating" from "1 = not at all fair" to "9 = very fair"). Giving instructions, performing the task and the ratings took about 5 min.

Due to delays in preparing the trust game and the necessity to start the project in the realms of the ENCERT study, the trust game was implemented later on. Thus, for the analyses, data from only 18 patients and 31 healthy control participants is available. In this sub- group, 55.6% of the participating patients and 54.5% of the healthy controls were female. The average age and average years of education of both groups were comparable to the total sample (participants of both groups were on average 42 years old (SD = 13), about 44.4% of patients and 45.2% of controls had a school education of at least 12 years).

Both experiments were implemented in the Presentation soft- ware, Version 17 (Neurobehavioral Systems, Albany, CA, USA). It should be noted that participants also performed a short task on somatosensory discrimination (grating orienting task), which is beyond the scope of this paper and will be reported elsewhere.

2.3.5 Statistical analyses

Main effects and condition by group interactions were analysed with repeated measures analysis of variances and multivariate analysis of variances. In case of violations of sphericity, Greenhouse–Geisser correction was applied. Bonferroni adjusted post-hoc analyses, as well as differences between groups in the trust game (in terms of sympathy- and fairness-ratings as well as average investment rate) were analysed by two-sample *t* tests and Mann–Whitney *U* tests, as the data were not normally distributed. Effect sizes are reported as partial η^2 values ($\eta^2 \geq .01$, $\eta^2 \geq .06$, and $\eta^2 \geq .14$ are defined as small, medium, and large effects), Cohen's *d* ($d \geq 0.2$, $d \geq 0.5$, and $d \geq 0.8$ are defined as small, medium, and large effects) and *r* ($r \geq .1$ defined as small, $r \geq .3$ as medium, and $r \geq .5$ as large effects). The association between different dimensions of emotion processing, as well as the relationship to SSD pathology were expressed by Spearman's rank correlation coefficients. Fisher's *z* tests were applied to test the difference of correlation strength between groups. Analyses were performed with IBM SPSS Version 22. To address the question whether alexithymia influences the association between emotion regulation and SSD pathology, a mediation analysis was planned. Furthermore, a mediation analysis was planned to investigate the effect of alexithymia and emotion regulation deficits on emotion recognition performance. However, for both mediation analyses, the variables did not match the requirements (i.e., did not correlate significantly).

2.4 Results

2.4.1 Group differences in emotion processing and emotion regulation

For the TAS-20, a significant main effect of group ($F[3, 66] = 14.56$, $p < .001$, $\eta_p^2 = .398$) was revealed (Figure 2). SSD patients had significantly higher alexithymia, as reflected in the TAS-20 total score ($F[1, 68] = 28.95$, $p < .001$, $\eta_p^2 = .299$), as well as in the subscales DIF ($F[1, 68] = 41.93$, $p < .001$, $\eta_p^2 = .381$) and DDF ($F[1, 68] = 31.28$, $p < .001$, $\eta_p^2 = .315$) but not in the subscale EOT ($F[1, 68] = 1.50$, $p = .225$, $\eta_p^2 = .022$).

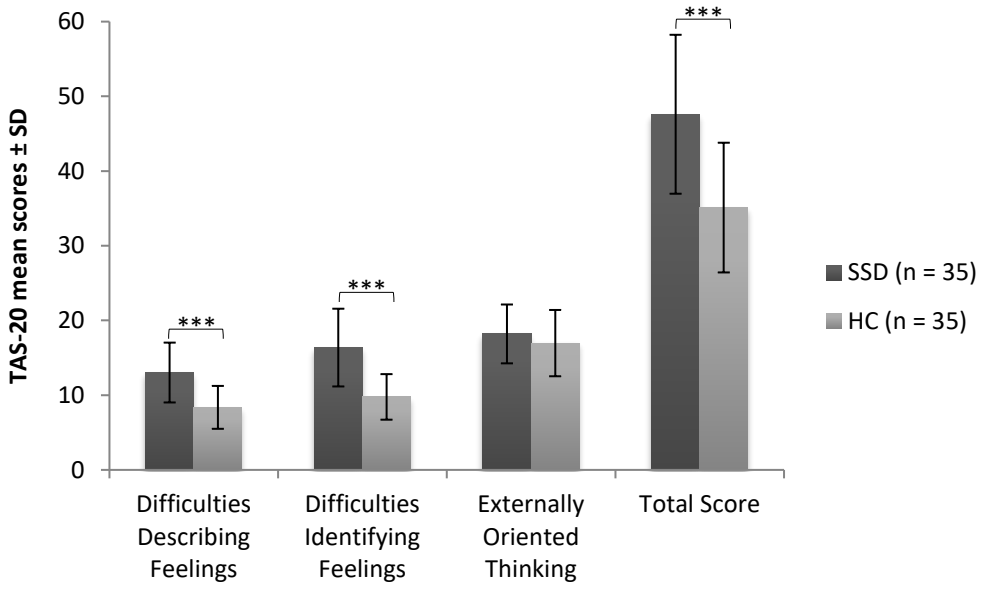

FIGURE 2 Toronto Alexithymia Scale (TAS)-20 mean scores and standard deviations (*SD*) of patients (somatic symptom disorder [SSD]) and healthy controls (HC) for the three subscales of the TAS-20 and the total score. *** $p < .001$

For the Emotion Regulation Questionnaire, again a significant main effect of group was revealed ($F[2, 67] = 9.17$, $p < .001$, $\eta_p^2 = .215$). SSD patients reported significantly less cognitive reappraisal ($F[1, 68] = 15.47$, $p < .001$, $\eta_p^2 = .185$) but a trend towards more expressive suppression ($F[1, 68] = 3.36$, $p = .071$, $\eta_p^2 = .047$).

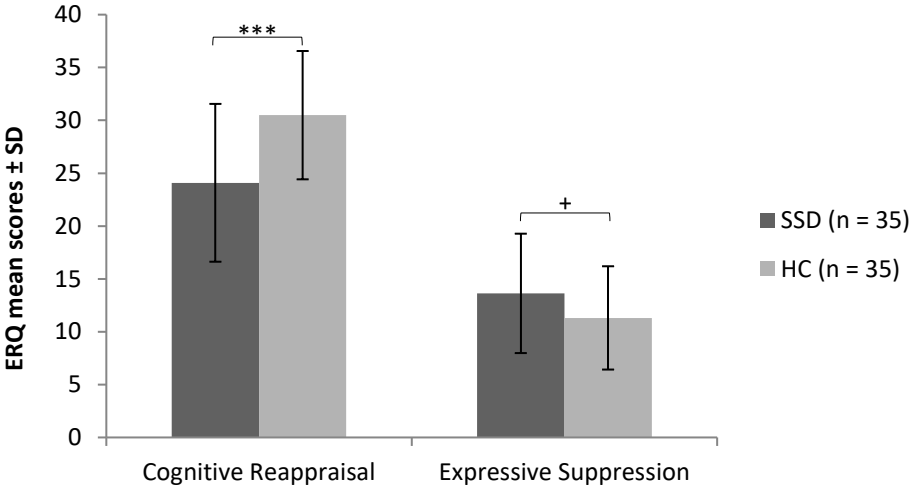

FIGURE 3 Emotion Regulation Questionnaire (ERQ) mean scores and standard deviations (*SD*) of patients (somatic symptom disorder [SSD]) and healthy controls (HC) for the two emotion regulation strategies cognitive reappraisal and expressive suppression. *** $p < .001$. $^{+}p < .1$

For emotion recognition abilities, we found a main effect of face valence (F[2, 67] = 35.95, p < .001, η_p^2 = .518), as well as a face x IAPS (F[4, 65] = 3.62, p = .01, η_p^2 = .182) and a face x group interaction (F[2, 67] = 3.86, p = .026, η_p^2 = .103). Post-hoc t tests revealed a statistical trend towards significance for patients with SSD recognizing more angry faces correctly (t[68] = −1.686, p = .096, d = 0.40; Figure 4). Moreover, a trend for the IAPS category was revealed (F[2, 67] = 2.53, p = .087, η_p^2 = .070). The three-way interaction, however, was not significant. In addition, no main effect of group occurred.

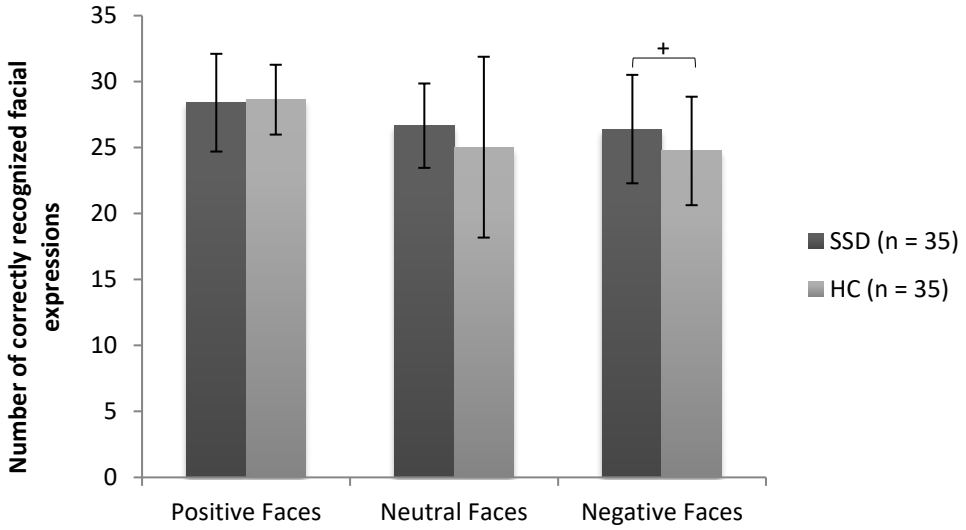

FIGURE 4 Number of correctly recognized positive, neutral and negative facial expressions with standard deviations for patients (somatic symptom disorder [SSD]) and healthy controls (HC). $^{+}$ p < .1

Regarding the Trust Game, a Mann–Whitney U test revealed significantly lower average investment rates in patients than in controls (d = 0.73). In addition, a significant main effect of group was revealed for the sympathy ratings (F[1, 47] = 6.16, p = .017, η_p^2 = .116) with patients giving lower ratings of sympathy than controls before (d = 0.85) and after (d = 0.53) the interaction. Furthermore, patients rated the trustees' behaviour as less fair than controls (d = 1.09; see Table 2).

TABLE 2 Trust Game scores (M ± SD) of patients (SSD; n = 18) and HC (n = 31) for average investment during the Trust Game, the sympathy ratings before and after the Trust Game and the ratings of the trustees fairness after the Trust Game

	1 SSD	2 HC	U test z value
Average investment rate (M ± SD)	4.6 ± 1.2	5.6 ± 1.6	z = −2.425, p < .05
Sympathy rating before interaction (M ± SD)	4.7 ± 1.1	5.5 ± 1.0	z = −2.831, p < .01
Sympathy rating after interaction (M ± SD)	4.8 ± 1.1	5.4 ± 1.2	z = −2.031, p < .05
Fairness rating after interaction (M ± SD)	4.9 ± 1.1	6.0 ± 1.1	z = −3.315, p < .001

Note. SSD = somatic symptom disorder group; HC = healthy control group; M = mean; SD = standard deviation.

2.4.2 Correlations between emotion regulation and the recognition of one's own versus other's emotions

Exploratory correlation analyses revealed significant correlations between alexithymia subscales and emotion regulation strategies. Table 3 reports the correlations across all participants and additionally for both groups separately. Direct comparisons of the strength of correlations revealed that the correlation of cognitive reappraisal and DIF was significantly stronger in SSD than in healthy controls ($z = -2.33$, $p < .05$).

TABLE 3 Correlations (Spearman's rho) between self-reported measures of alexithymia (TAS-20) and ERQ for the total sample (all; $n = 70$) as well as for the HC ($n = 35$) and for the SSD ($n = 35$)

			TAS-20			
			DDF	DIF	EOT	Total
ERQ	CR	HC	.071	.178	**−.366***	−.163
		SSD	−.181	**−.383***	−.241	**−.372***
		All	**−.301***	**−.403****	**−.310****	**−.443****
	ES	HC	**.546****	.158	.328^{+}	**.399***
		SSD	**.581****	.326^{+}	**.488****	**.531****
		All	**.556****	**.318****	**.424****	**.499****

Note. TAS-20 = Toronto Alexithymia Scale-20; DDF = difficulties describing feelings; DIF = difficulties identifying feelings; EOT = externally oriented thinking; Total = TAS-20 total score; ERQ = Emotion Regulation Questionnaire; CR = cognitive reappraisal; ES = expressive suppression; HC = healthy control group; SSD = somatic symptom disorder group. Significant correlations in bold print and significance levels are as follows.

$^{**}p \leq .01$.

$^{*}p \leq .05$.

$^{+}p < .1$.

There were no significant correlations between emotion regulation or alexithymia and the recognition of emotions in others but some statistical trends towards significance. A trend towards a positive correlation of the alexithymia subscale DDF and overall face recognition performance was observed ($r_s = .204$, $p = .09$). Moreover, a trend towards a positive correlation of cognitive reappraisal and the recognition of negative faces was found in the control group ($r_s = .322$, $p = .059$). In the SSD group, we observed a trend towards a negative correlation of the recognition of negative faces and the TAS-20 total score ($r_s = -.301$, $p = .079$). This correlation between the TAS-20 total score and the recognition of negative faces was significantly stronger in the SSD than in the healthy control group ($z = 2.05$, $p < .05$). It should be noted that in SSD, no significant correlation between emotion recognition and behaviour in the trust game was observed.

2.4.3 Correlations between the processing and regulation of emotions and somatic symptoms

Exploratory correlation analyses revealed significant positive correlations between both the number and the intensity of somatic symptoms and alexithymia subscales. Table 4 reports the correlations across all participants, as well as separately for the SSD and the healthy control group. None of the correlations between emotion processing and the measures of somatic symptoms differed significantly between groups (all *p* values ≥ .4).

TABLE 4 Correlations (Spearman's rho) between self-reported measures of alexithymia (TAS-20) and ERQ and measures of somatic symptoms (SOMS-7T and PHQ-15) for the total sample (all; *n* = 70) as well as the HC (*n* = 35) and the SSD (*n* = 35)

			TAS-20				ERQ	
			DDF	DIF	EOT	Total	CR	ES
SOMS	Number of symptoms	HC	.213	.298^{+}	.023	.174	.221	−.039
		SSD	.110	.249	−.021	.197	−.173	.081
		All	**.432*****	**.577*****	.095	**.446*****	**−.237***	.144
	Intensity of symptoms	HC	.179	.269	−.038	.119	.257	−.068
		SSD	.180	**.334***	.002	.274	−.192	.125
		All	**.539*****	**.667*****	.121	**.538*****	**−.335****	.187
PHQ-15		HC	.264	**.620*****	.303^{+}	**.416****	.014	−.120
		SSD	**.420***	**.510****	.287^{+}	**.546****	−.198	.239
		All	**.642*****	**.776*****	**.280***	**.686*****	**−.421*****	.217^{+}

Note. Tas-20 = Toronto Alexithymia Scale-20; DDF = difficulties describing feelings; DIF = difficulties identifying feelings; EOT = externally oriented thinking; Total = TAS-20 total score; ERQ = Emotion Regulation Questionnaire; CR = cognitive reappraisal; ES = expressive suppression; SOMS-7T = Screening for Somatoform Disorders; PHQ-15 = Patient Health Questionnaire; HC = healthy control group; SSD = somatic symptom disorder group. Significant correlations in bold print and significance levels are as follows.

$^{***}p < .001$.

$^{**}p \leq .01$.

$^{*}p \leq .05$.

$^{+}p < .1$.

2.5 Discussion

SSD has been linked to impairments in emotion processing, which may contribute to the development and maintenance of medically unexplained physical complaints. Thus, emotion processing might be an important target for the psychotherapy of SSD. The aim of this study was to explore different aspects of emotion processing in SSD and to investigate how they might interact. To this end, we examined the understanding and the regulation of one's own feelings, the recognition of others' emotions and trust in patients with SSD, and a healthy control group.

We were able to replicate previous findings of deficits in the processing of one's own emotions in patients with SSD in comparison to healthy controls, indicated by higher levels of self-reported alexithymia (Bankier et al., 2001; De Gucht & Heiser, 2003; Pedrosa Gil et al.,

2009). Our results are in line with earlier reports indicating that especially the identification and description of one's own feelings are affected in SSD (Deary et al., 1997). Consistently, recent studies high- light the particular importance of improving patients' abilities to understand their own feelings, and especially to identify them, when it comes to coping with bodily complaints (Bailer et al., 2017; Shibata et al., 2014).

In our sample, patients with SSD report using less cognitive reappraisal than healthy controls, indicating the insufficient application of cognitive strategies in order to regulate affective arousal in SSD, which is in agreement with previous studies (Bucci, 1997; Taylor et al., 1997). According to our findings, patients with SSD tend to use expressive suppression more often than healthy controls to cope with negative feelings. Whereas cognitive reappraisal is believed to be more adaptive to handle negative feelings, suppression of emotion-expressive behaviour was found to increase the response of the sympathetic nervous system (Gross, 1998b, 2002). Hence, it is a strategy that is believed to further enhance physiological aspects of emotional experience and therefore promotes continued attention to bodily sensations (Alexander, 1950; Pennebaker & Seagal, 1999; Traue, 1998).

Contrary to previous studies (Beck et al., 2013) and our hypotheses, our findings indicate that patients with SSD are as good as healthy controls in the recognition of others' emotions and even perform slightly better in the recognition of negative facial expressions. In contrast to the study of Buhlmann et al. (2006), we found no evidence for a negative bias in our emotion recognition task in patients with SSD. However, the better recognition rate of negative facial expressions might point to a higher sensitivity for negative emotions. It can be speculated that the higher sensitivity might be due to a sensitization caused by a higher incidence of negative reactions these patients experience in their social environment. These negative reactions might arise from persistent complaints about distressing symptoms and chronic help-seeking behaviour, which makes physicians and relatives feel increasingly strained and helpless (Kirmayer et al., 1994).

Moreover, in our study, patients with SSD acted less trustful in the trust game, as they had lower average investment rates and lower sympathy and fairness ratings. In case this reduced trust would also occur in the medical context, it might contribute to a higher number of medical consultations and frequent changes of physicians, a well-known pattern in SSD, so-called doctor hopping or doctor shopping (de Zwaan & Müller, 2006). Although this is

speculative, doctor hopping might arise not only from the frequent need of negative reinforcement but also from reduced trust in the physician's assurance of the patient's health. Moreover, related to the assumption of a higher sensitivity for negative emotions in others, SSD patients might be more sensitive to subtle signs of irritation in the doctor's face, making them doubt the doctor's trustworthiness.

Furthermore, our results show an association between the difficulties to understand own feelings and the application of maladaptive emotion regulation strategies: higher levels of alexithymia were related to a more frequent use of expressive suppression and less cognitive reappraisal. We found a trend-level association towards a better recognition of others' negative facial expressions through patients with lower TAS total scores and healthy controls who reported using cognitive reappraisal more often. These results are in line with previous studies that showed that the recognition of others' emotions is associated with the awareness of own feelings (Machado et al., 1999). Although speculative, this shows that individuals capable of using their own emotions beneficially (i.e., are in touch with them as indicated by low TAS scores and constructively work on them as indicated by frequent cognitive reappraisal) also perform better in recognizing emotions in others.

There is evidence that high levels of alexithymia are linked to somatic amplification (Nakao & Barsky, 2007; Wise & Mann, 1994). Somatic amplification is supposed to aggravate patients' somatic complaints, as patients reinforce bodily sensations by keeping their attention shifted on the physiological aspects accompanying affective arousal (Barsky et al., 1988). Indeed, we found significant correlations between alexithymia and the amount and intensity of somatic symptoms, both across all participants and specifically in the SSD group. We also found a negative association between cognitive reappraisal and the number and intensity of somatic symptoms in the total sample. As mentioned above, in contrast to expressive suppression, this emotion regulation strategy is believed to be more adaptive and to have no detrimental effects on emotion-related bodily sensations (Gross, 1998a). Although we cannot draw causal conclusions from these correlations, they might suggest that alexithymia and the preferred emotion regulation strategy serve as predictors of the intensity of somatic symptoms, warranting a closer examination in future studies.

One of the main limitations of the study is the primarily assessment of different emotion regulation strategies by means of a questionnaire that, first, only measures two ways

of coping with negative feelings, and second, like self-report questionnaires in general, might underlie inaccuracy of recall (Coughlin, 1990). In addition, we did not assess current negative affect that might be the link between sensitization and negative emotions of others, reduced trust, and bodily symptoms. Future studies should apply additional experimental paradigms combined with psychophysiological measurement of mood induction, to take a closer look at the dissociation of understanding one's own emotions and the physical perception of accompanying physiological aspects. These studies could also experimentally investigate emotion regulation in SSD, possibly including additional emotion regulation strategies, such as acceptance. In our experimental design to assess emotion recognition, we combined the presentation of emotional scenes with facial expressions. The assumption was that negative scenes would require emotion regulation for correct emotion recognition. However, we found neither a systematic effect of the valence of the scenes on emotion recognition nor an interaction with group. Thus, we suggest that there is no direct link between emotion dysregulation and emotion recognition in SSD (which is also supported by a lack of significant correlations between emotion recognition performance and emotion regulation as reported in the questionnaires in the SSD group). Another limitation relates to the very brief assessment of trust, which should be investigated more systematically by applying more sophisticated experimental paradigms in future studies. Further, not all of our participants attended the trust game, which is why the sample for analysing this paradigm was small and the generalizability of these results can be questioned. Future studies should use larger sample sizes to investigate emotion processing in SSD, in particular replicating our findings of reduced trust in SSD. Furthermore, regarding the assumption that less trust might be linked to “doctor hopping,” it would be of highest interest to assess the frequency of medical consultations in this context as well.

Our results replicate earlier findings of higher alexithymia and deficits in emotion regulation in patients diagnosed with previous versions of the DSM in a sample of patients with SSD and point to the important link between understanding one's own feelings and adaptive emotion regulation. We could not replicate the finding that patients with SSD have difficulties identifying others' emotions but on the contrary found slightly improved emotion recognition skills. Thus, our results indicate a dissociation in the emotion processing abilities of SSD patients, with impairments in understanding and regulating one's own emotions but an intact perception of others' feelings. These impairments might promote intolerance

towards one's own negative feelings and their accompanying physiological sensations, whereas a sensitization towards others' negative emotions and being less trustful in social interactions might make negative feelings even more likely to occur. We assume that these factors may constitute a vicious circle contributing to the maintenance of medically unexplained somatic symptoms (Figure 5): If patients with SSD lack trust in others, this might lead to a higher incidence of negative feelings in social interactions, which they have difficulties to understand. In addition, accompanying bodily sensations might arise, which the patients fail to link to preceding emotional experiences. Due to their limited abilities to use cognitive strategies, they might intuitively rely more on expressive suppression in order to regulate affective arousal, which then will further enhance physiological sensations. Interpreting those sensations as signs of dis- ease will most probably lead to further negative feelings and so forth.

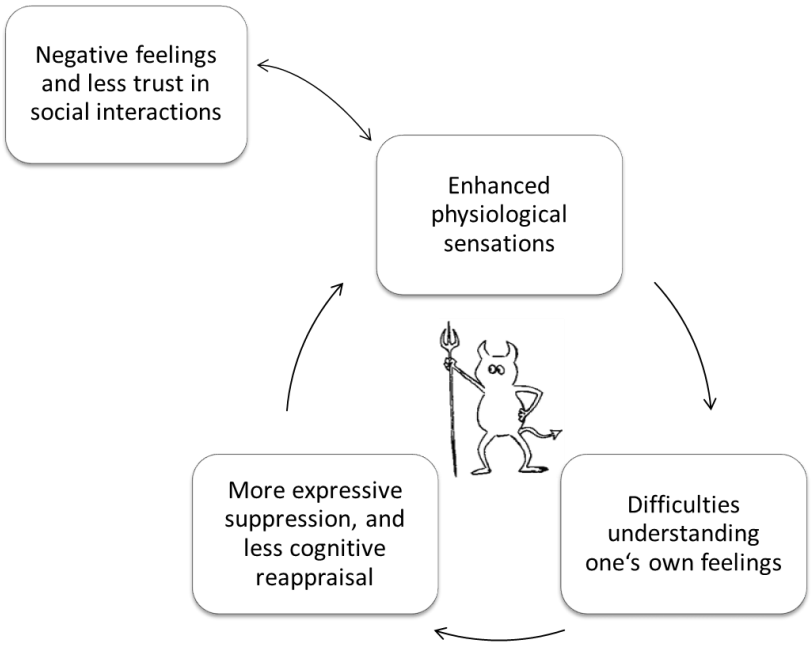

FIGURE 5 Vicious circle illustrating the possible influence of emotion processing impairments on the maintenance of medically unexplained somatic symptoms. Since feelings are accompanied by bodily sensations, the difficulties in understanding and regulating feelings may contribute to the misinterpretation and enhancement of physiological sensations and result in persisting somatic complaints.

The pattern of reduced trust behaviour and higher sensitivity to negative facial expressions in SSD is a new finding that might inform cognitive-behavioural models of SSD and will hopefully stimulate new research on social perception in SSD. A direct implication of our study for psychotherapy is that beyond emotion regulation training itself, improving the understanding of one's own emotions might present a crucial first step in the treatment of emotion processing deficits in SSD.

2.6 Synopsis of study 1

The first study of this thesis was conducted to investigate the interplay of different aspects of emotion processing, such as emotional awareness, emotion recognition and emotion regulation in SSD. We were further interested in the impact of these processes on social interactions, which is why a trust game was applied in addition to an experimental emotion recognition task as well as self-reported alexithymia and emotion regulation preferences.

We assumed that patients with SSD would perform worse than healthy controls in the emotion recognition task and to show less trust in others in the trust game. We further expected to find higher levels of alexithymia and indications for poorer emotion regulation, reflected by the habitual use of expressive suppression.

Contrary to our assumptions, the analyzed data suggested an intact perception of others emotions and a tendency for a higher sensitivity towards negative feelings in others. We found patients with SSD having less trust in others and to perceive them as less likeable and less fair than healthy controls did. Regarding emotional awareness and emotion regulation, our assumptions were supported by the data. Patients with SSD showed higher levels of alexithymia, applied less cognitive reappraisal and more habitual expressive suppression as emotion regulation strategy.

To further examine the perception of others' feelings despite deficits in understanding own emotions and a potential impact on mentalizing abilities, the second study aims at investigating a subgroup of patients with MUS, which is hypochondriasis. Hypochondriasis is particularly interesting, since it is not mainly characterized by experiencing aversive bodily symptoms, but by high levels of anxiety in response to those symptoms or even to thoughts about health threatening diseases without even experiencing symptoms at all. In the context of research on the relationship between different dimensions of anxiety and empathy, associations of affective empathy and anxiety have been demonstrated (Gambin & Sharp, 2016; Joireman et al., 2002) and it has been suggested, that perceiving aversive feelings like anxiety in others might intensify emotional arousal within oneself and increase own anxiety symptoms (Gambin & Sharp, 2018). Therefore, studies should examine those mechanisms explicitly in hypochondriasis. For this purpose, an experimental paradigm is applied in the second study that investigates the role of emotion recognition in affective ToM (Mier, Lis, et

al., 2010; Mier, Sauer, et al., 2010). Besides the reported heterogeneous results on emotion recognition, there is evidence for deficits in mentalizing in patients with MUS (Schönenberg et al., 2014) while studies on hypochondriasis are missing. Thus, we were further interested in how patients with hypochondriasis perceive their own reactions to others' emotions and if more distress is elicited in the course of empathy.

3 STUDY 2 | I can't handle your feelings: Empathy and emotion recognition in patients with hypochondriasis and depression[2]

3.1 Abstract

Objective: While it is well-known that patients with hypochondriasis (HYP) and patients with depression (DEP) suffer from difficulties in understanding own feelings and coping with them, little is known about the impact of these impairments on social-cognitive abilities. In particular in hypochondriasis, research is needed on different aspects of social cognition including empathy. The aim of the present study was investigating possible aberrations in social cognition in patients with HYP in comparison to a healthy and a clinical control group.

Methods: 58 patients with HYP, 52 patients with DEP, and 52 healthy controls (HC) completed a social-cognitive task and the Interpersonal Reactivity Index, as well as self-report measures of health anxiety and depressive symptoms.

Results: Significant differences in self-reported empathy between the three groups were found, but no differences in the social-cognitive task. HYP and DEP reported significantly higher distress in reaction to negative emotions of others than HC, and HYP even higher than DEP. In addition, HYP scored significantly higher on empathic concern than HC.

Conclusions: Our results suggest high emotional empathy in HYP and DEP, and unimpaired perception of others feelings. In particular, in HYP coping with own feelings elicited by a response to someone else's suffering seems to be affected.

3.2 Introduction

Alexithymia, the disability to understand, identify and describe own feelings (Nemiah & Sifneos, 1970) is central to several mental disorders (Leweke et al., 2012). Especially patients with hypochondriasis are known to suffer from a reduced ability to identify their own feelings (Bailer et al., 2017). However, until now, little is known how patients with hypochondriasis identify and react to the feelings of others, and whether a pattern of impairments arises that is specific for hypochondriasis.

[2] Manuscript submitted: Erkic, M., Witthöft, M., Bailer, J., Mier, D. (submitted). I can't handle your feelings: Empathy and emotion recognition in patients with hypochondriasis and depression

Illness Anxiety Disorder (IAD), formerly diagnosed as hypochondriasis, is characterized by persistent and excessive concerns about suffering from or developing a serious or even life-threatening disease, while no or only mild bodily symptoms, that are incommensurate with the extend of worrying, are experienced (American Psychiatric Association, 2013). The DSM-5 categorization of patients earlier diagnosed with hypochondriasis into patients with somatic symptom disorder (SSD) and patients with IAD, takes into account the central role of experiencing anxiety related to thoughts about health. Accordingly, like for depression (Nolen-Hoeksema, 1991), rumination is a key feature of hypochondriasis and especially IAD (Bailer et al., 2017). It should be mentioned, that the diagnostic and therapeutic benefits of dividing patients earlier diagnosed with hypochondriasis into SSD and IAD have been discussed controversially. One reason is the rather small percentage of patients, who were formerly diagnosed with hypochondriasis and now meet the criteria for IAD and the missing empirical support for this distinction (Bailer et al., 2016). Another reason is the fact that patients with health anxiety actually show better responses to already existing psychotherapeutic interventions, regardless of the presence of aversive somatic sensations (Kleinstäuber et al., 2011; Olatunji et al., 2014).

In hypochondriasis, difficulties in identifying own feelings (Bailer et al., 2017) might also cause physiological aspects of emotional reactions to be misinterpreted as signs of disease (Bailer et al., 2013; Barsky et al., 1993). Due to difficulties in disengaging from health related negative feelings (Witthöft et al., 2016) and a tendency for rumination, these reactions might in turn intensify physical complaints (Pennebaker & Skelton, 1981) and further enhance health anxiety (Karademas et al., 2008).

With regard to social situations, not only the processing of own, but also of others' emotions is of highest relevance. Own just as others' emotions have to be recognized, in order to enable a person to express feelings and behave socially appropriate and also to facilitate the understanding and prediction of others' actions (Gross, 1998b). Since patients with hypochondriasis show deficits in the identification of own emotions, it is highly plausible that the recognition of others' emotions and intentions is affected, too. Yet, there are only few studies examining the recognition of others' emotions in this population, which revealed heterogeneous results. While some studies found somatoform patients to perform worse than healthy controls in emotion recognition tasks (Beck et al., 2013; Pedrosa Gil et al., 2009),

others reported intact emotion recognition abilities (Erkic et al., 2018; Schönenberg et al., 2014). Independent of their actual facial affect perception, somatoform patients are suggested to have impaired mentalizing abilities (Schönenberg et al., 2014) and less trust in others (Erkic et al., 2018), which might contribute to the experience of negative feelings in social interactions. Mentalizing, or also called Theory of Mind (ToM), is the ability to attribute mental states, such as wishes, desires and intentions (Frith & Frith, 1999; Premack & Woodruff, 1978). ToM is a well-studied subject throughout different mental disorders, such as affective disorders (Bora & Berk, 2016; Kerr et al., 2003; Wolkenstein et al., 2011; Zobel et al., 2010), social anxiety disorder (Hezel & McNally, 2014; Washburn et al., 2016), schizophrenia (Brüne, 2005; Mier et al., 2017; Mier, Sauer, et al., 2010), or autism spectrum disorder (Baron-Cohen, 2001), which were shown to be accompanied by reduced mentalizing abilities. However, to our knowledge, there are only few studies on ToM in patients with a somatoform disorder, and in particular, there are no studies examining ToM in patients with hypochondriasis so far. Studies on somatic symptom disorder (Schönenberg et al., 2014; Stonnington et al., 2013; Subic-Wrana et al., 2010; Zunhammer et al., 2015) as well as studies with healthy participants, who report a higher extend of somatic symptoms (Preis et al., 2017), suggest ToM deficits in hypochondriasis, too.

Empathy, an ability going beyond the mere recognition of others' emotional or mental states, has received only little attention in the field of somatic symptom disorders. To experience empathy, not only the feelings of another person have to be recognized, but also the feeling that is elicited within oneself in reaction to the feelings of the other person. To our knowledge, only de Greck and colleagues (2012) investigated empathy in somatic symptom disorder. In their study, empathy was assessed by questionnaire and by an experimental design accompanied by functional magnetic resonance imaging. The authors argue that empathy requires the correct recognition of another person's emotion, followed by the generation of a congruent emotional state within oneself. The data showed reduced emotion recognition abilities, enhanced distress and also aberrant activation in regions linked to emotional processing and mentalizing (e.g. amygdala, insula and superior temporal gyrus). This pattern was interpreted as a result of the inability to generate a congruent emotional state, which the authors consider to be in accordance with psychodynamic concepts of somatoform disorders, postulating that somatoform patients unconsciously suppress specific emotions for the benefit of protecting relationships. So, as a result of experiencing more

distress and the fear of getting overwhelmed by emotions, processes necessary for the generation of congruent emotions probably get inhibited (De Greck et al., 2012).

Since not only patients with hypochondriasis, but also patients with depression show rumination and alexithymia (Abela & Hankin, 2011; Görgen et al., 2014; Li et al., 2006; Mattila et al., 2008), patients with depression are a suitable clinical control group to investigate the specificity of potential social-cognitive deficits in hypochondriasis. Numerous studies indicate deficits in decoding others feelings, as well as difficulties in mentalizing in depression (Ladegaard, Larsen, et al., 2014; Ladegaard, Lysaker, et al., 2014; Mattern et al., 2015; Wolkenstein et al., 2011; Zwick & Wolkenstein, 2017). Especially patients with acute or chronic depression seem to have difficulties in empathizing with others, which may arise from cognitive deficits accompanying chronic depression and acute depressive episodes (Förster et al., 2018; Mattern et al., 2015; Zobel et al., 2010). In addition, Wilbertz and colleagues (2010) showed higher self-reported distress experienced in reaction to negative feelings of others and lower abilities in perspective taking in patients with early onset chronic depression compared to healthy controls.

The present study aimed at investigating different facets of social cognition in patients with hypochondriasis, a healthy and a clinical control group by applying an experimental task on social-cognitive abilities, as well as a self-report questionnaire on empathy. Current literature suggests clear social-cognitive and empathy impairments in depression, but results regarding hypochondriasis are less straightforward. Thus, we were a) interested in examining the specificity of possible social-cognitive and empathy deficits in hypochondriasis, and b) in exploring the relationship between the different aspects of social cognition; i.e. self-reported empathy and experimentally assessed emotion recognition and ToM in hypochondriasis.

3.3 Methods

3.3.1 Sample

Overall, 162 participants could be enrolled in the study. The sample includes 58 patients diagnosed with hypochondriasis (36 female), 52 patients with major depressive disorder (29 female) and 52 healthy controls (31 female). Participants were on average 42 years old (standard deviation [*SD*] = 12). Groups were matched by age, gender and years of education. Table 1 shows a detailed description of the group characteristics.

Table 1 Sample characteristics and symptom measures (mean ± standard deviation)

	1 HYP (n = 58)	2 DEP (n = 52)	3 HC (n = 52)	ANOVA / χ^2-test F / χ^2 -value	Post-hoc group comparisons
Age in years (M ± SD)	43.8 ± 11.6	42.7 ± 11.6	42.1 ± 12.9	F (2, 159) = .273, p = .761	
Gender: female (%)	62.1	55.8	59.6	χ^2 (2, N=162) = .455, p = .797	
School education (≥ 12 years; %)	29.3	32.7	46.2	F (2, 159) = .615, p = .542	
SHAI (M ± SD)	30.1 ± 4.6	9.0 ± 3.6	5.8 ± 2.8	F (2, 103.7) = 589.3, p < .001	1 > 2 > 3
PHQ-9 (M ± SD)	11.0 ± 5.3	17.3 ± 3.9	1.7 ± 2.0	F (2, 93.8) = 352.7, p < .001	2 > 1 > 3
Current DSM-IV diagnosis n (%)[a]:					
Hypochondriasis	100	0	0		
Any other somatoform disorder (SD / PD)	6.9	0	0		
Any depressive disorder (MD / Dysthymia)	32.8	100	0		
Major depression	25.9	90.4	0		
Dysthymia	13.8	38.5	0		
Any anxiety disorder	62.1	40.4	3.8		
Panic disorder	44.8	0	0		
Social phobia	15.5	25.0	0		
Specific phobia	15.5	13.5	3.8		
Obsessive compulsive disorder	10.3	0	0		
Posttraumatic stress disorder	3.4	0	0		
Bulimia nervosa	0	3.8	0		

Note. HYP = Group of Patients with Hypochondriasis; DEP = Group of Patients with Major Depressive Disorder, HC = Healthy Control Group; PHQ-9 = current depressive symptoms assessed with the Patient Health Questionnaire; SHAI = Short Health Anxiety Inventory; SD = Somatization disorder; PD = Pain disorder; MD = Major depression.
[a] According to the Diagnostic and Statistical Manual of Mental Disorders (4th ed.).

3.3.2 Study design and procedures

Participants were part of a larger study on health anxiety (Bailer et al., 2016; Kerstner et al., 2015; Witthöft et al., 2016). Patients were recruited from a Cognitive Behavior Therapy outpatient unit at the Central Institute of Mental Health (CIMH), Mannheim, Germany, and healthy participants via advertisements published in local newspapers and on the web page of the CIMH. All participants completed a set of self-report questionnaires and checklists related to health anxiety, depression, bodily diseases, and current medication prior to being enrolled in the study. Diagnoses of mental disorders were established by applying the Structured Clinical Interview for DSM-IV (SCID-I; Wittchen et al., 1997). Participants were excluded if they had a life time diagnosis of psychotic disorders, substance use disorders, organic brain disease or organic mental disorders. To ensure the distinction of the two patient groups, depressive patients were excluded if comorbid hypochondriasis, panic disorder, obsessive compulsive disorder, generalized anxiety disorder, or any somatoform disorder was diagnosed. This was not only due to the high comorbidity of these mental disorders with hypochondriasis (Barsky et al., 1992; Noyes Jr et al., 1994), but also because of the known overlapping risk and maintenance factors as well as phenomenological aspects, such as a high anxiety sensitivity (Abramowitz et al., 2007; Olatunji et al., 2009). For the healthy control group, an additional exclusion criterion was the presence of any affective disorder. For more detailed information on inclusion and exclusion criteria, see Bailer and colleagues (2016). Ethical approval was obtained from the Medical Ethics Committee of the Medical Faculty

Mannheim at the University of Heidelberg, Germany. Prior to being enrolled in the study, all participants were informed about study procedure and purposes and provided written informed consent.

3.3.3 Self-report questionnaires

Empathy was assessed using the German version of the Interpersonal Reactivity Index, the Saarbrücker Persönlichkeitsfragebogen (SPF; Paulus, 2009). It consists of four scales measuring different components of empathy: Empathic Concern (EC, 4 items, Cronbach's α = .65) reflects a tendency of feeling emotional concern, warmth, and compassion for others, Perspective Taking (PT, 4 items, α = .72) measures the ability to cognitively adopt someone else's point of view, Fantasy (F, 4 items, α = .76) quantifies the strength of the emotional identification with fictive characters from books or movies, and finally, Personal Distress (PD, 4 items, α = .76) indicates the experience of negative feelings when observing the distress of others. Reliability estimates across participant groups for the current study were in an acceptable range.

In addition, the German version of the Short Health Anxiety Inventory (SHAI; Bailer et al., 2013) was used to measure current symptoms of health anxiety. Depressive symptoms were assessed by the German version of the Patient Health Questionnaire (PHQ-9; Spitzer et al., 1999). Both questionnaires showed good reliabilities in the present sample (SHAI: 14 items, α = .97; PHQ-9, 9 items: α = .92).

3.3.4 Experimental task

The experimental task was developed by Mier and colleagues (Mier, Lis, et al., 2010; Mier, Sauer, et al., 2010) to investigate the role of emotion recognition in affective Theory of Mind (ToM), and has been applied successfully in several mental disorders (Mier et al., 2017; Mier et al., 2013; Mier et al., 2014). The stimulus material consisted of portrait photos depicting either a neutral facial expression, or an expression of happiness, anger, or fear. Each trial started with the display of a statement, introducing one of three conditions: One condition required the correct processing of the depicted person (neutral face processing) and was introduced by a statement about a physical feature; the other two conditions required either the recognition of emotions, introduced by a statement about a persons' emotional state, or affective ToM, introduced by a statement describing an emotional intention. The stimuli in the affective ToM and emotion recognition conditions were identical. The stimuli in

the neutral condition showed the same persons, but only with neutral facial expressions. Participants had to indicate whether the preceding statement matched a presented picture by pressing the according (yes/no) button, as depicted in figure 1. Both the statements and facial stimuli were presented for 2 seconds each and a fixation cross was presented between trials for 2 seconds on average. With a total of 30 trials for each social-cognitive function, the experimental time was 9.5 min. The experiment was implemented in the Presentation software (Neurobehavioral Systems, Albany, CA, USA).

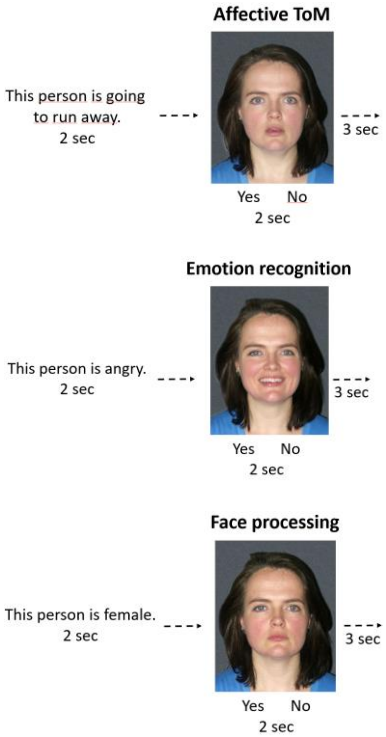

FIGURE 1 Experimental design and conditions of the task developed by Mier and colleagues (2010a, 2010b). Participants have to evaluate the fitting of statement and picture. Answers are indicated by button press.

3.3.5 Statistical analyses

All data were analyzed with IBM SPSS Version 24. Analyses of variance (ANOVA) and multivariate analyses of variance (MANOVA) were performed to analyze main effects and condition by group interactions. Afterwards, Bonferroni adjusted post-hoc comparisons were applied to compare specific groups. Categorical variables were analyzed using the Pearson´s chi-squared test.

The associations between experimentally investigated and self-reported facets of social cognition were investigated with exploratory Pearson product-moment correlation

analyses. The difference of correlation strength between groups was tested using Fisher's z tests.

Effect sizes are reported as partial η_p^2 values ($\eta_p^2 \geq .01$, $\eta_p^2 \geq .06$, $\eta_p^2 \geq .14$ defined as small, medium and large effects), Cohen's *d* ($d \geq 0.2$ defined as small, $d \geq 0.5$ as medium, and $d \geq 0.8$ as large effects) and *r* ($r \geq .1$, $r \geq .3$, $r \geq .5$ defined as small, medium and large effects).

3.4 Results

3.4.1 Group differences in emotion recognition and empathy

A MANOVA revealed a significant main effect of group regarding the IRI (Wilks $\lambda = .69$, $F(8, 312) = 7.98$, $p < .001$, $\eta_p^2 = .17$), with significant differences between the three groups on the scales *Personal Distress PD* ($F(2, 159) = 25.77$, $p < .001$, $\eta_p^2 = .25$) and *Empathic Concern EC* ($F(2, 159) = 11.95$, $p < .001$, $\eta_p^2 = .13$). Bonferroni adjusted pairwise post-hoc *t* tests revealed a significantly higher score on *PD* in the HYP compared to the DEP group ($t(102.67) = 3.07$, $p = .003$, $d = 0.586$). Both the HYP ($t(92.8) = 7.06$, $p < .001$, $d = 1.348$) and the DEP group ($t(102) = 4.59$, $p < .001$, $d = 0.9$) scored significantly higher on *PD* than healthy controls. Regarding *EC*, the HYP group again scored significantly higher than healthy controls ($t(108) = 4.97$, $p < .001$, $d = 0.949$). No further group differences were significant (all *p*s > 0.05).

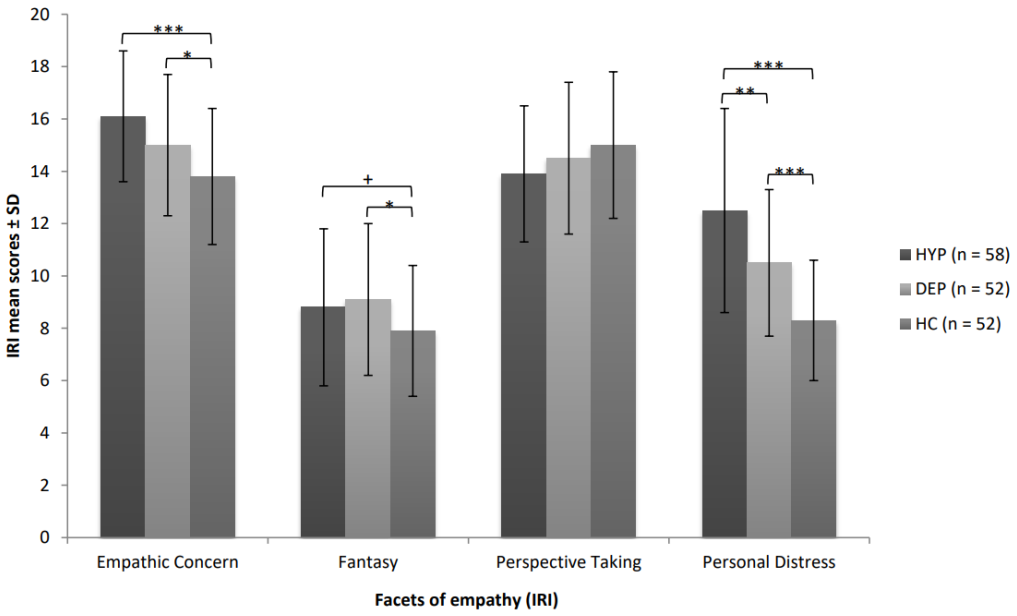

FIGURE 2 Mean scores and standard deviations (*SD*) for the four scales of the IRI of patients with hypochondriasis (HYP), depressive patients (DEP) and healthy controls (HC). *** $p < .001$, ** $p < .01$, * $p < .05$, $^{+}p < .1$

The groups did not differ significantly regarding their performance in the social cognitive task (Wilks λ = 0.98, $F(6, 308) = 0.41$, $p = .87$, $\eta_p^2 = .01$) and the interaction between group and social cognitive task condition was not significant (Wilks λ = 0.99, $F(4, 310) = 0.29$, $p = .89$, $\eta_p^2 = .004$).

3.4.2 Correlations between self-reported measures of empathy and experimentally assessed social-cognitive abilities

Exploratory correlation analyses revealed only few indications of significant associations between the different facets of self-reported empathy and performance in the social cognition task. The results are presented separately for the three groups (see table 2).

Regarding Emotion Recognition, a significant negative correlation with *Empathic Concern* was found in patients with hypochondriasis. No significant correlations were revealed for experimentally assessed ToM in this group. There were no significant correlations in the DEP and HC group.

Comparisons of the strength of correlations revealed that the correlations did not differ significantly between groups ($p > 0.05$ for all correlations).

Table 2 Correlations (Pearson product moment correlation r) between self-reported measures of empathy (IRI) and experimentally assessed social-cognitive abilities (ER and ToM) for the groups HYP (n = 58), DEP (n = 52) and HC (n = 52)

		IRI			
		Fantasy	Empathic Concern	Perspective Taking	Personal Distress
ER	HYP	-.184	-.301*	-.251+	-.072
	DEP	.019	.216	-.016	.040
	HC	-.096	-.029	-.204	.082
ToM	HYP	.030	-.003	-.124	-.058
	DEP	-.111	.010	-.089	.102
	HC	-.236+	.006	-.250+	.223

Note. IRI = Interpersonal Reactivity Index; ER = Emotion Recognition; ToM = Theory of Mind; HYP = Patients with Hypochondriasis; DEP = Patients with Major Depressive Disorder; HC = Healthy Control Group. Bonferroni adjusted significant correlations in bold print and significance levels are as follows. **p ≤ .01, 2-tailed; *p ≤ .05, 2-tailed; +p < .1, 2-tailed.

3.5 Discussion

While hypochondriasis has been linked to a deficit in the identification of own emotions, little evidence exists on possible alterations regarding the reaction to emotions of others. The current study investigated different aspects of social cognition in HYP, and

compared them to DEP and HC. By combining experimental with questionnaire data, our findings suggest an intact recognition of others' emotions and mental states in patients with HYP, but enhanced self-reported affective reactions to the emotions of others.

In order to react appropriately in social interactions, a person has to be able to read the social signals of another person and to interpret the received information. In contrast to studies that showed deficits concerning these abilities in patients with somatic symptoms (Beck et al., 2013; Pedrosa Gil et al., 2009; Schönenberg et al., 2014; Stonnington et al., 2013; Subic-Wrana et al., 2010; Zunhammer et al., 2015), our findings point to an intact recognition of emotions and intentions of others in hypochondriasis and in depression. In fact, our results revealed no significant differences regarding experimentally tested emotion recognition and ToM in all three groups. Thus, while - at least in our task - patients with hypochondriasis and patients with depression seem to be able to interpret another person's inner experience appropriately, both patient groups reported difficulties when it comes to coping with the elicited emotions within themselves.

In accordance with the findings of de Greck and colleagues (2012), our results regarding self-reported empathy point to higher *PD* in both groups of patients compared to healthy controls. Moreover, patients with hypochondriasis seem to experience even more personal distress than patients with depression. Unlike in the study of de Greck and colleagues, our results indicate that patients with hypochondriasis additionally perceive themselves as more compassionate than healthy controls, indicated by higher scores on *EC*. Lamm, Batson and Decety (2007) investigated the role of perspective taking and cognitive appraisal on empathic concern and personal distress. Using video clips of faces of patients undergoing a painful treatment, they could show that participants, who were instructed to imagine themselves being in the observed situation scored higher on *PD*, while participants, who were instructed to imagine the feelings of the observed patient experienced more empathic concern (Lamm et al., 2007). In addition, when the participants were told that the painful treatment had not been successful, they experienced even more personal distress, even if they did not imagine themselves being in the situation. The authors suggest that the consideration of the long-term consequences and overall benefits of the treatment foster a reappraisal of the situation as less aversive. Thus, higher levels of distress experienced by patients with hypochondriasis might point to lower abilities to regulate emotions adequately,

which would be in accordance with studies showing emotional dysregulation in patients with health anxiety and somatoform symptoms (Bailer et al., 2017; Erkic et al., 2018).

The ability to regulate own emotions and to distinguish between a personal experience and empathic understanding of another person is crucial with regard to social functioning (Decety & Jackson, 2006). There is evidence that individuals use the same neural circuits (e.g. amygdala and temporal poles) for themselves and for others in the course of processing and understanding emotions, and when it comes to taking over someone else's perspective (Decety & Jackson, 2006). We assume that patients with hypochondriasis fail to disentangle own feelings and emotions of others and therefore experience more intense emotions in the course of perspective taking, resulting in higher levels of distress. It can be assumed that the experience of personal distress is accompanied by physiological arousal, which might culminate in an amplified perception of bodily reactions. As a result of a deficient understanding of own emotions and a tendency to apply rather dysfunctional emotion regulation strategies, the persistent focusing on such physiological sensations might maintain and even further enhance health anxiety. Ruby and Decety (2004) argue that the distinction between own experiences and third-person perspective requires an adequate interaction of the somatosensory cortex, which is associated with self-perspective, the frontopolar cortex, which appears to be important for third-person perspective and is involved in executive inhibition, and also the right inferior parietal cortex. In order to investigate our assumption that patients with hypochondriasis fail to distinguish between own experiences and perspective taking, future research could apply the approach of Lamm, Baton and Decety (2007) to investigate self- and other perspective in hypochondriasis, and use functional magnetic resonance imaging to explore possible aberrations in these neural circuits.

Overall, while the correct recognition of emotions is believed to be required to enable a person to react correspondingly during social interactions and to elicit an empathic reaction, our results suggest a divergence of self-perceived empathy abilities and actual performance in a social-cognitive task. However, in patients with hypochondriasis, a negative correlation between emotion recognition and self-rated *Empathic Concern* was revealed. An explanation might be, that the better the emotion recognition abilities of patients with hypochondriasis are, the more likely are they to feel overwhelmed, when they perceive someone experiencing unpleasant emotions. Speculatively, patients with hypochondriasis with very good emotion

recognition capacities might tend to distance from the other person's experience and to apply suppression as emotion regulation strategy in order to cope with elicited emotions, which might result in less empathic concern. Furthermore, patients with somatic symptoms are believed to suppress emotions in order to protect social relationships, which might not only maintain health concerns, since it has been shown to enhance physiological aspects of feelings (Gross, 2002), but also inhibit the generation of congruent emotions and therefore hamper social interactions (de Greck et al., 2012).

Regarding our findings, it has to be noted that patients were diagnosed via clinical interviews based on DSM-IV disorders, resulting in the diagnosis of hypochondriasis, which has been divided into two different disorders, SSD and IAD, with the introduction of the DSM-5 (American Psychiatric Association, 2013). In order to take this change into account, we included symptom specific measurements in our study, particularly assuring to assess health anxiety as a common core symptom of both diagnoses, hypochondriasis and IAD. Despite the above mentioned criticism of the practicality of the distinction between IAD and patients with SSD who experience health anxiety, examining differences between subgroups of somatic symptoms and related disorders, i.e. IAD and SSD, should be considered for future studies.

Our assumptions were premised on results that were mainly based on research with patients with somatic symptoms and not health anxiety in particular. Thus, the inconsistent literature regarding social-cognitive abilities might sustain the necessity to investigate those mechanisms in specific subgroups of patients with somatic symptoms and related disorders separately. Future research should explicitly distinguish between social-cognitive abilities in hypochondriasis and other somatic symptoms and related disorders. Furthermore, our sample size was not large enough to test for small to medium effect sizes what would be of particular interest in future studies investigating specificity across conditions with medically unexplained symptoms.

We did not assess the preferred emotion regulation strategies that our participants tend to apply in order to cope with distress in social interactions. However, it can be assumed that patients with hypochondriasis apply less efficient emotion regulation strategies, which would be in accordance with findings regarding emotion regulation and health anxiety among members of the general population (Görgen et al., 2014) and in somatoform patients. Future studies should investigate these mechanisms in hypochondriasis in particular to reinforce this

assumption. Especially the suppression of emotions is believed to be a frequently applied regulation strategy in this group of patients, whereas it is known to even enhance physiological aspects of emotional experiencing (Alexander, 1950; Pennebaker & Seagal, 1999; Traue 1998; Gross 2002).

Our results might contribute to a deeper understanding of mechanisms of social-cognitive difficulties in patients with health anxiety, who are quite capable of reading social signals of their counterpart, but seem to struggle with their own reaction to them. As a result of an intact perception of others' feelings and a possibly high level of empathic concern, an intense emotional response arises in patients with hypochondriasis, when being confronted with unpleasant feelings of others. Since they are not only prone to experience more distress in such situations, but also to suppress negative feelings in order to protect social relationships, they might tend to apply rather dysfunctional emotion regulation strategies, as e.g. expressive suppression. Comparable to a vicious circle, expressive suppression leads to even more pronounced physiological reactions in consequence of intense emotions. This process and the resulting interpretation of physiological reactions as alarming, gives rise to even more intense health anxiety. A potential consequence might be less compassionate and less prosocial behavior, since they might feel overwhelmed in distressing social situations and tend to distance themselves. Thus, regarding psychotherapy, our results indicate that beyond the improvement of understanding own emotions, it is necessary to take into account cognitive regulation styles and metacognitions in patients with hypochondriasis.

In sum, our findings suggest no impairments in the perception of emotions and mental states of others in hypochondriasis and in depression, but a high affective empathic reaction to the emotions of others. In hypochondriasis, this enhanced responsiveness might foster the experience of personal distress, which is associated with increased levels of health anxiety. Additional deficits regarding the regulation of own emotions might contribute to unrealistic and threatening health-related concerns.

4 GENERAL DISCUSSION

The present thesis is aimed at contributing to a better understanding of emotion processing in patients with MUS. Besides the well-known impairments in emotional awareness, reflected in high levels of alexithymia, only few studies investigated emotion regulation and mentalizing abilities in this group of patients so far. Considering the potential impact on future directions in psychotherapy, addressing this issues is of highest relevance: A deeper understanding of the interplay of emotion processing and social functioning in patients with MUS could contribute to an improvement of the treatment of these disorders and thereby help to reduce the burden on the patients and the health care system, as well as decrease rates of work disability and health-related absence. In order to gain further insight into these processes in patients with MUS, different experimental paradigms as well as self-report questionnaires on emotional awareness and empathy were applied. In study 1 emotion recognition, emotion regulation and trust were investigated in SSD, and in study 2 emotion recognition, ToM and empathy in hypochondriasis.

4.1 Summary and discussion of study results

Within the scope of a multicenter-study on improving the effects of CBT for patients with MUS by enriching it with emotion regulation strategies (Kleinstäuber et al., 2019), additional data of participants from two study sites (Mannheim and Landau) was acquired, applying two different paradigms and an emotion regulation questionnaire to investigate emotion processing in this group of patients (study 1). The experimental task, that was used to assess emotion processing, combines emotion recognition and regulation (Fenske et al., 2015). Following the presentation of a picture of a positive, neutral or negative scene, participants had to indicate the valence of an angry, neutral or happy face by pressing the according button. Accordingly, not only the correct emotion recognition of the facial expression is demanded, but also the simultaneous suppression of a reaction to irrelevant emotional stimuli. Moreover, an adapted trust game (Franzen et al., 2011; Lis et al., 2011) was conducted to assess alterations in the perception of others in patients with MUS. Before and after playing several rounds of the investment game, participants had to rate how likeable and afterwards also how fair they perceived their coplayers. Additionally, emotional awareness as well as the habitual use of either expressive suppression or cognitive reappraisal when coping with negative feelings was investigated using self-report questionnaires.

Regarding emotion recognition, our results do not only indicate an intact perception of others emotions, but also a tendency for a better recognition rate of negative feelings in others, which might point to an enhanced sensitivity towards negative feelings. Nevertheless, while Buhlmann and colleagues (2006) actually found a negative bias regarding self-referential emotion expressions of others, our results revealed only a trend and further investigation of this subject is needed. However, it can be speculated, that a higher sensitivity towards negative emotions might be the result of experiencing more negative reactions in social interactions, caused by overstrained relatives and friends who might feel increasingly helpless due to the constant complaining about symptoms. This might also be reflected in our findings based on the applied trust game. Not only did patients with MUS invest less, but they also rated their coplayers as less likeable and less fair than healthy controls, indicating a lack of trust. While this again is only speculative, the frequent medical consultations of changing physicians might not only serve the purpose of getting negative reinforcement regarding health concerns, but they might also be the result of increased distrust in the physicians evaluation of the patients health status. It has to be noted, that besides the rather simple structure of the applied trust game, also the generalizability of the results is questionable due to a reduced sample size for the trust game data. Thus, in order to test this presumption, further research on the potentially heightened sensitivity towards negative reactions of others and trust in patients with MUS is needed.

In accordance with previous findings (Bankier et al., 2001; De Gucht & Heiser, 2003; Deary et al., 1997; Pedrosa Gil et al., 2009), higher levels of difficulties in identifying and describing own feelings were found in patients with MUS. This result underlines the proposed necessity of improving the understanding of own emotions in the process of coping with somatic complaints (Bailer et al., 2017; Shibata et al., 2014). Additionally, in comparison with healthy controls, a higher level of habitual use of expressive suppression when coping with negative feelings has been demonstrated in patients with MUS. Expressive suppression is considered a rather maladaptive emotion regulation strategy, since it has been associated with an increased response of the sympathetic nervous system (Gross, 1998; 2002) and with enhancing bodily sensations by promoting a constant attention shift towards them (Alexander, 1950; Pennebaker & Seagal, 1999; Traue, 1998). Taken together, both findings are in line with previous studies, indicating that high levels of alexithymia are associated with emotion regulation deficits (Alexander, 1950; Laloyaux et al., 2015; Pennebaker & Seagal,

1999; Swart et al., 2009) and somatic amplification (Nakao & Barsky, 2007; Wise & Mann, 1994). However, rather than the application of maladaptive emotion regulation strategies, it was the absence of more beneficial strategies that was associated with the number and intensity of somatic as well as with depressive symptoms in study 1. This result is in contrast to previous findings, suggesting a higher relevance for the application of maladaptive strategies than for the lack of adaptive emotion regulation (Aldao et al., 2010). It has to be taken into account that the results regarding the preferred way of coping with negative feelings only distinguish between two different strategies, so they do not display sufficiently detailed emotion regulation with its various facets. Moreover, the habitual use of either expressive suppression or cognitive reappraisal is based on self-report, which might be inaccurate due to recall effects (Coughlin, 1990). Here again, the use of experimental paradigms in future studies, applying mood induction to assess the actual understanding of own feelings, accompanying physical sensations and emotion regulation as well as the effects on experiencing aversive symptoms is recommended.

Within the second study, a mentalizing paradigm was conducted, that required the participants to indicate by button press whether a preceding statement about a physical feature, the emotional state or the emotional intention matched the following picture of a neutral or emotional facial expression of the depicted person (Mier, Lis, et al., 2010; Mier, Sauer, et al., 2010). Using these different conditions, this paradigm did not only assess the recognition of the emotional state of a person, but also the correct interpretation of the persons' emotional intention. Furthermore, different facets of empathy as well as indicators of psychopathology were assessed using self-report questionnaires. In order to investigate alterations in these processes but also to shed light onto the specificity of the presumed difficulties in patients with hypochondriasis at the same time, patients with hypochondriasis were compared to a healthy and a clinical control group diagnosed with depression.

In contrast to earlier findings on social-cognitive abilities in MUS (Beck et al., 2013; De Greck et al., 2012; Pedrosa Gil et al., 2009; Schönenberg et al., 2014) and depression (Ladegaard, Lysaker, et al., 2014; Mattern et al., 2015; Wolkenstein et al., 2011; Zwick & Wolkenstein, 2017), the results suggest an intact perception of others' emotional and also mental states for both patient groups. In spite of intact mentalizing abilities, patients reported more difficulties than healthy controls in coping with own emotions elicited in reaction to

emotions of others. This was reflected by higher levels of personal distress in patients with hypochondriasis compared to healthy controls and depressive patients and by higher levels of empathic concern compared to healthy participants. Patients with depression showed higher levels of personal distress than healthy controls, as well. De Greck and colleagues also found enhanced distress in patients with MUS and suggested that, resulting from higher distress and the fear of getting overwhelmed in the course of empathy, patients with MUS suppress specific emotions and therefore fail to generate a congruent feeling within oneself – which would be a necessary prerequisite in the course of empathy. Based on the assumption that the same neural circuits are activated in the course of taking over someone else's perspective, while at the same time the distinction between own experiences and understanding the experience of another person is required (Decety & Jackson, 2006; Ruby & Decety, 2004), it could also be proposed that patients with hypochondriasis do not fail to generate a congruent emotion per se, but they might fail to disentangle own feelings from empathic understanding of another person, which makes them prone to experience increased distress and more intense feelings, reflected by higher levels of empathic concern.

Moreover, the results of study 2 revealed a negative association of empathic concern and emotion recognition. Thus, while only speculative, it can be assumed that in those patients with particularly good emotion recognition abilities, poor emotional awareness promotes feelings of being overwhelmed by unpleasant emotions of others, which as a result of the habitual use of rather maladaptive emotion regulation strategies, leads to the suppression of elicited emotions within oneself and to distancing from the other persons' emotional experience, reflected by less empathic concern.

Besides demonstrating decreased emotional awareness in patients with MUS, the results of the first study presented in this thesis revealed an association of alexithymia and the number and intensity of somatic symptoms. This finding is in line with the assumption that high levels of alexithymia are linked to somatic amplification (Nakao & Barsky, 2007; Wise & Mann, 1994). In addition, the data point to a higher level of habitual use of expressive suppression in MUS, which has not only been associated with alexithymia as well (Kessler et al., 2010), but also with an enhanced activity of the sympathetic nervous system (Gross, 2002) and an increased focus on and experience of bodily sensations (Pennebaker & Seagal, 1999). Taken together, these findings give rise to the assumption that deficits in emotional

awareness, reflected by increased levels of alexithymia, bear a key function in the reinforcement and maintenance of unpleasant bodily symptoms. In spite of existing evidence for the underlying associations, future research is needed to investigate the actual interplay and potential mediating role of alexithymia in the association of maladaptive emotion regulation and MUS.

Regarding emotion recognition in others, a negative bias has been suggested (Buhlmann et al., 2006), which is in line with the assumed higher sensitivity towards negative feelings and less trust in others (study 1). Besides a potentially higher sensitivity towards negative feelings, there is evidence that patients with hypochondriasis experience more distress in reaction to negative feelings of others (study 2). In connection with a presumably high occurrence of negative reactions from overstrained physicians and relatives (Kirmayer et al., 1994), these factors might foster the development of doubt in clinicians' judgements and increase the probability of multiple consultations with changing physicians, an often observed behaviour in MUS (de Zwaan & Müller, 2006). Thus, while only speculative, it has been suggested that patients with MUS experience overall more negative feelings in interactions with others, resulting in more bodily symptoms, which they fail to link to an emotion, promoting an attention shift towards those physical sensations and therefore enhancing them (study 1). In addition, since expressive suppression of feelings is supposed to increase the response of the sympathetic nervous system (Gross, 2002), and the frequent use of suppression is associated with the experience of more negative and less positive emotions as well as with less positive relations and less closeness in relationships (Gross, 2013), this interpersonal affect regulation style presumably comes along with more distress in social interactions.

Earlier theories on concepts of somatoform disorders postulate that somatoform patients unconsciously suppress specific emotions for the benefit of protecting relationships, which could be derived from attachment style theories. Waller and Scheidt have reviewed the findings on attachment styles as an influencing factor on affect regulation in somatoform disorders (2006). They conclude that patients with somatoform disorders have a high proportion of dismissive-avoidant attachment, which is linked to an impaired affect awareness and externally oriented thinking (Waller & Scheidt, 2006). According to findings on attachment styles, children develop insecure attachment strategies, like to deemphasize (insecure

dismissing) or exaggerate (insecure preoccupied) the expression of distress, if they have learned that their needs will not be met by caregivers, when they express emotional distress (Kobak et al., 1993). Thus, it could be assumed that an avoidant attachment style, which is linked to the inhibition of emotional expression and deficits in the processing and tolerance of emotions, serves to protect social relationships (Waller & Scheidt, 2006). Hence, it could be speculated, that individuals who develop an avoidant attachment style in response to the experience that significant others do not react as needed to their emotional expressions, do not only suppress emotion-expressive behaviours but also try to distance from own feelings, since they seem irrelevant, and consequently lose the ability to understand and express them adequately over time. The results of study 1 revealed a significantly lower use of cognitive reappraisal in patients with MUS, which is in line with the assumption that these patients exhibit impaired cognitive mechanisms regarding emotion identification and regulation and therefore focus on somatic sensations uncoupled from an emotional experience (Bucci, 1997; Taylor et al., 1997). Therefore, it could further be suggested that this acquired emotion regulation style fosters somatosensory amplification and thus enhanced somatic symptoms. This would implicate that in order to breach this vicious circle, it would be necessary to enhance emotional awareness, facilitating the generation of cognitive representations of emotional experiences and thus enabling individuals to link accompanying bodily sensations to emotional arousal. This might reduce the focusing on isolated bodily sensations and eventually result in less aversive bodily symptoms.

In sum, the data presented in the scope of this dissertation points to an intact perception of others' emotions in patients with MUS, while earlier findings on impairments in coping with feelings of others and difficulties in understanding own feelings have been replicated. While the results are in accordance with earlier findings, demonstrating associations of expressive suppression and MUS (Görgen, Hiller, & Witthöft, 2013), MUS and alexithymia (Bailer et al., 2017; Bankier et al., 2001; De Gucht & Heiser, 2003) as well as alexithymia and expressive suppression (Kessler et al., 2010), the interplay of these factors is not sufficiently explained, yet.

Presumably, these factors interact in a vicious circle while difficulties understanding own feelings have the role of a key variable that influences the enhancement and maintenance of the other relevant processes:

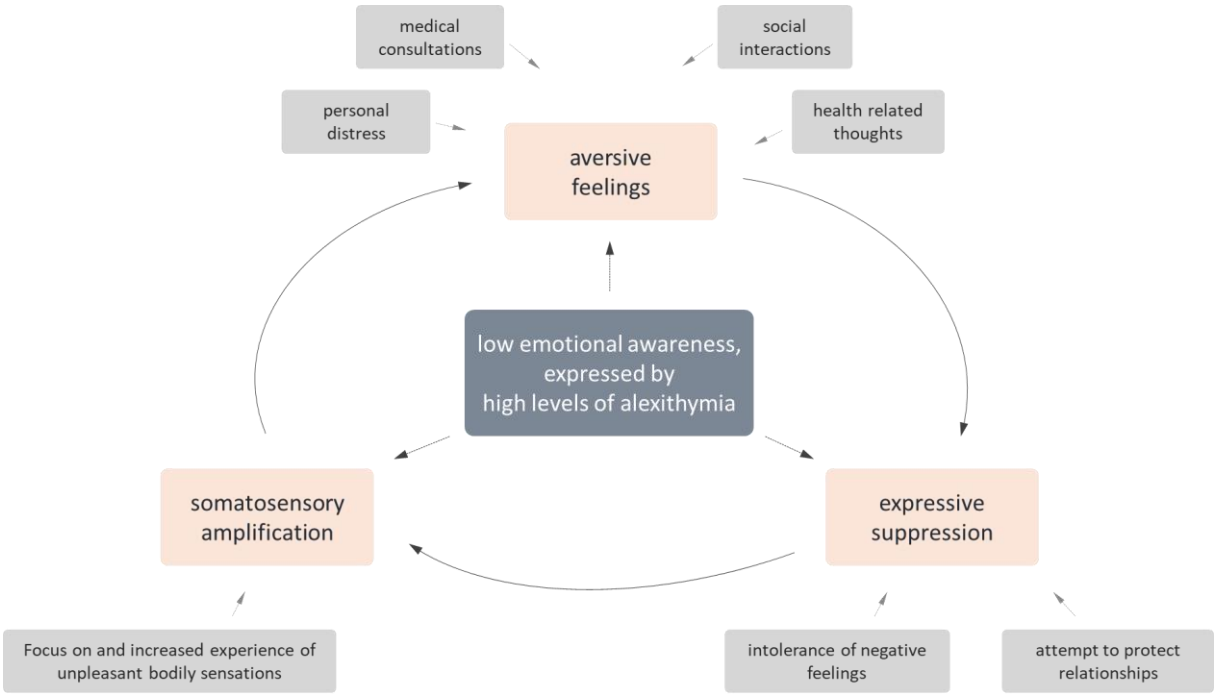

Figure 1 Vicious circle illustrating the possible interplay of different aspects of emotion processing in patients with MUS. Various external and internal stressors elicit negative emotions, including higher levels of distress in social interactions. Due to an intolerance of negative feelings and in an attempt to protect social relationships, patients with MUS apply expressive suppression in order to cope with the elicited feelings. This promotes focusing on and therefore enhancing unpleasant bodily sensations, which again elicits aversive feelings. This interplay is based on low emotional awareness, which is associated with these factors and maintains the vicious circle.

4.2 Future research

The trust game in study 1 was implemented only after the start of the ENCERT study, which is why the sample for analyzing this paradigm is small. Also, the applied paradigm offers only a brief assessment of trust. Further research on trust with a more elaborated experimental paradigm and a larger sample size should be performed to replicate our findings and give further insight in alterations regarding the perception of others in patients with MUS. To test the assumption that a heightened sensitivity towards negative emotions and a lack of trust in others is associated with “doctor hopping”, potential associations of the perception of others with the actual frequency of medical consultations and the number of changing physicians should be analyzed as well. Also, the assumption that patients with MUS experience more negative feelings in interactions with others was derived from higher levels of distress and the data collected from the trust game and emotion recognition task. This should additionally be investigated more detailed to test whether patients with MUS actually perceive their interactions with others differently. It could be assessed combining

questionnaires, like the Social Support Questionnaire (F-SozU; Fydrich et al., 2007), and experimental paradigms, like a Cyberball Game (Williams & Sommer, 1997).

The assumption that patients with MUS fail to link bodily sensations accompanying emotional arousal with specific emotions should be experimentally underpinned. It would be recommended to apply mood induction and psychophysiological measurements, for example electrodermal activity or heart rate variability, combined with self-reported emotional experiences on affective, cognitive and physiological levels. In addition, in the scope of study 1, emotion regulation was assessed by questionnaire and in consideration of only two strategies, expressive suppression and cognitive reappraisal. It would be insightful to use mood induction and to complement the experimental design with further emotion regulation strategies, like acceptance, that have to be applied by the participants in the course of the experiment. Thus, the ability to apply the different strategies as well as the outcomes of doing so could be assessed via self-report and associated with psychophysiological variables.

Moreover, self-efficacy has been suggested as another variable that impacts the ability to regulate emotions. Arnstein and colleagues argue that self-efficacy mediates the relationship between depression, disability and pain intensity in chronic pain patients and that lower self-efficacy contributes to the development of depression in this group of patients (Arnstein et al., 1999). Other results support the assumption that self-efficacy is an important factor in coping with stressful events (Endler et al., 2001; Schönfeld et al., 2016) and inversely predicts psychological distress, depression and anxiety (Soysa & Wilcomb, 2015). Hence, self-efficacy might also have an impact on the ability to regulate emotions and thus contribute to the intensity of health anxiety. Future studies should therefore investigate self-efficacy in the context of emotional awareness and emotion regulation in patients with MUS and specifically in health anxiety.

As stated above, with regard to the assumption, that the same neural circuits are activated in the course of perspective taking and personally experiencing emotions (Decety & Jackson, 2006; Ruby & Decety, 2004), high levels of distress might be caused by the failed distinction of own emotional experiences and other-perspective in patients with hypochondriasis (study 2). Self- and other-perspective and neural aberrations in these processes should be investigated in patients with MUS and health anxiety using functional magnetic resonance imaging. A suitable experimental paradigm could imply the confrontation

with an initially aversive situation under the premise of a positive long-term outcome, as described by Lamm and colleagues (2007). It should be combined with measurements of self-reported personal distress and empathic concern and should involve the prior instruction to either imagine oneself in the presented situation or to keep in mind, that the scenario is happening to someone else, in order to shed light on the ability to differentiate these two perspectives and to investigating the influence of perspective taking and cognitive appraisal on empathic concern and personal distress.

As previously mentioned, there has been a controversial discussion about the DSM-5 diagnostic criteria for IAD and SSD. Further research is needed to investigate the actual differences of SSD and IAD regarding emotion processing and social cognition and to examine if certain difficulties in these processes are specific for either one of these diagnoses. Also, to investigating the differences between patients with IAD and those who were previously diagnosed with hypochondriasis would be of interest. In particular, the problematic reactions to others' emotional experiences, that have been revealed in patients with hypochondriasis in the scope of study 2, should be replicated in patients with IAD.

Taken together, the interplay of experiencing more negative emotions, especially in the context of social interactions, poor emotion regulation and somatic amplification needs further investigation. The presented associations of alexithymia with these aspects of emotion processing point to the crucial role of emotional awareness. It should be further investigated, whether an improved emotional awareness actually enables patients with MUS and health anxiety to link physical sensations to emotional arousal, if this reduces the focusing on bodily sensations and also if this already results in less aversive bodily symptoms or if it enables these patients to apply more functional but also more cognitively demanding emotion regulation strategies, like cognitive reappraisal or acceptance.

4.3 Implications for psychotherapeutic interventions

A central characteristic of patients with MUS is the experience of aversive somatic symptoms, which is accompanied by psychological factors, like constant rumination about these symptoms, high levels of health anxiety, and time- and energy-consuming coping strategies (American Psychiatric Association, 2013), like reassurance by numerous medical consultations (de Zwaan & Müller, 2006). Regarding the treatment of patients with MUS, cognitive behavioral therapy (CBT) is the method of choice (Gottschalk & Rief, 2012; van

Dessel et al., 2014) . However, there seem to be specific characteristics in this patient group that are currently not sufficiently addressed: Since CBT has been found to be less effective in MUS than in other mental disorders (Gottschalk et al., 2015), recent approaches in psychotherapy are targeting the improvement of emotion processing abilities in these patients (Gottschalk et al., 2015; Kleinstäuber et al., 2016). Existing approaches, such as proposed by Kleinstäuber and colleagues (2019), concentrate on the influences of distress on psychological and physiological processes and on psychoeducation on the interplay of these aspects. It further focuses on short-term- and long-term-consequences of typical coping behaviours, like reassurance, avoidance of physical strain or, the opposite, engaging in activities that promote physical overload. Furthermore, the effects of shifting attention and evaluation processes are addressed. Applying cognitive strategies, like the widely used ABC-model after Ellis (1991), that describes the interaction of events, beliefs and consequences on behavioral, emotional and physiological levels, or the SORKC-model (Kanfer & Saslow, 1974), that enlightens the influence of personal traits on the perception of events, cognitive behavioral psychotherapy aims at improving the understanding of the interplay of distress, the impact of own thoughts and the individual appraisal of situations, as well as personal behaviours that serve as coping strategies. Recent approaches have implemented emotion regulation training into the existing psychotherapeutic interventions (ENCERT; Kleinstäuber et al., 2019). In the ENCERT-study, negative emotions were targeted as the primary causes and consequences of MUS. Like in traditional CBT for MUS, interventions like the ABC-model were applied to discover and change dysfunctional believes about bodily symptoms and health, but the main focus was on educating patients on emotions, their purpose and observable aspects within oneself, like physiological reactions. Further, coping strategies, like acceptance and mindfulness, were practiced. The outcome measures of CBT and ENCERT in patients with MUS were comparable, whereas especially patients with higher levels of emotional distress have benefited more of the training of specific emotion regulation skills (Kleinstäuber et al., 2019).

Being able to identify and verbalize feelings is required in order to consciously apply helpful strategies to cope with these feelings. Lumley and colleagues (2004) demonstrated that alexithymia interferes with the beneficial effects of emotional disclosure by expressive writing or talking in individuals with high levels of alexithymia and a variety of aversive bodily symptoms. They further suggest that patients with high levels of alexithymia need more practice, time and additional guidance pertaining the accessibility of emotions and related

thoughts, for example regarding the identification of stressors, negative emotions, and the influences of stressors on their thoughts and beliefs. Lumley and colleagues further report a decrease in alexithymia after an intervention with guided disclosure, although further research is needed to support this finding (Lumley, 2004). Nevertheless, the presented findings support the assumption that an enhancement of emotional awareness is possible and might promote beneficial effects on further psychotherapeutic interventions. Moreover, in order to enhance the tolerance of negative feelings, patients might also benefit from strategies derived from Acceptance and Commitment Therapy (ACT; Hayes et al., 2009), that amongst other important aspects of psychological flexibility also focuses on reducing experiential avoidance, a process associated with suppression. According to the findings demonstrated in the scope of this dissertation, it would be recommended to complement traditional CBT, like provided by Kleinstäuber and colleagues (Kleinstäuber et al., 2017) with a training specifically aiming at enhancing emotional awareness and the tolerance of negative emotions. The associations of emotional arousal and bodily sensations could probably be demonstrated using mood induction combined with biofeedback. This might further facilitate the accessibility of own feelings for patients with high levels of alexithymia.

4.4 Conclusion

Since aversive somatic symptoms are central to MUS, it is crucial to extend the knowledge about possible increasing and maintaining factors, such as emotion processing. Despite the growing interest in emotion processing in patients with MUS and the rising number of studies on related subjects over the past decades, existing findings are partially heterogeneous and many questions remain unanswered.

There is agreement on the presence of high levels of alexithymia in MUS (Bankier et al., 2001; De Gucht & Heiser, 2003; Deary et al., 1997; Pedrosa Gil et al., 2009), while findings on the recognition and empathic understanding of others' emotions are inconclusive (Beck et al., 2013; Pedrosa Gil et al., 2009; Schönenberg et al., 2014). There is also evidence, that high levels of alexithymia are associated with the experience of aversive somatic symptoms (Bankier et al., 2001; Burton et al., 2009; De Gucht & Heiser, 2003; Subic-Wrana et al., 2010). Also, alexithymia has been associated with expressive suppression of emotions (Kessler et al., 2010; Lumley, 2004; Nemiah & Sifneos, 1970), which in turn has been linked to less closeness and positive relations with others (Gross, 2013). As emotion regulation has been suggested as

a transdiagnostic construct central to the maintenance of psychopathology and the treatment across different mental disorders (Sloan et al., 2017), it has come into focus in MUS as well.

The data presented and discussed in the scope of this dissertation has demonstrated a dissociation of the understanding of own emotions and mentalizing abilities in patients with MUS. Earlier findings on higher levels of alexithymia (Bankier et al., 2001; Burton et al., 2009; De Gucht & Heiser, 2003; Subic-Wrana et al., 2010) as well as the association of alexithymia and expressive suppression (Kessler et al., 2010; Lumley, 2004; Nemiah & Sifneos, 1970) have been replicated, while no impairments in the recognition of others' emotions have been found. In fact, our data point to a higher sensitivity towards negative feelings in others and to more personal distress in reaction to others' emotions. While further research is needed to confirm our assumption, there are indications for a lack of trust and a negative perception of others in patients with MUS. It can be suggested that this promotes negative emotions in social interactions and might even contribute to the frequent consultation of changing physicians.

While recent psychotherapeutic approaches tried to implement the training of emotion regulation into existing CBT interventions (Kleinstäuber et al., 2019), we state that an improvement of emotional awareness should be the first step and would be necessary in order to enable highly alexithymic patients to actually change their coping mechanisms. This assumption is supported by findings of Lumley and colleagues (2004), who have shown that it is possible to initiate an improvement in emotional awareness via intensive training and that this is beneficial for following approaches in changing emotion processing.

This dissertation provides valuable insights into the processing of own as well as others' emotions and potential maintaining factors, like poor emotion regulation and an increased prevalence of negative feelings in social interactions. The findings of the studies in the scope of this dissertation can contribute to the improvement of the existing cognitive behavioral psychotherapeutic treatment of patients with MUS.

5 SUMMARY

Patients with MUS are not only characterized by experiencing distressing somatic symptoms and health related abnormal thoughts, feelings and behaviours, but also by difficulties understanding and expressing own feelings, reflected by high levels of alexithymia. Moreover, alexithymia has been linked to poor emotion regulation and more specifically to expressive suppression of emotions, which in turn has been associated with social distress and less positive social interactions. While this is crucial for social functioning, findings on social-cognitive abilities in patients with MUS, such as to recognize others' emotions and mental states, and to empathize with others, are heterogeneous. The aim of this dissertation was to improve the understanding of emotion processing in patients with MUS, to shed light on potential maintaining factors and to provide suggestions on the improvement of existing psychotherapeutic interventions.

Applying an experimental emotion recognition task and a trust game, as well as assessing self-reported emotional awareness, an intact perception of others' emotions despite deficits in understanding own feelings were revealed in patients with somatic symptom disorder compared to healthy controls. Furthermore, the findings indicated a lack of trust and a negative perception of others. Regarding emotion regulation, a self-reported higher level of habitual use of expressive suppression was revealed.

Further, emotion recognition and the attribution of mental states to others were investigated experimentally in patients with hypochondriasis compared to a depressive and a healthy control group. Here again, the findings indicate intact mentalizing abilities. Moreover, own reactions to others' emotions were assessed using a self-report questionnaire and point to higher levels of personal distress in health anxiety in comparison to both other groups. In addition, patients with hypochondriasis reported more empathic concern than healthy controls.

The findings of this thesis confirm the assumptions that patients with MUS suffer from emotion dysregulation, since they exhibit high levels of alexithymia and show more habitual use of expressive suppression in order to cope with feelings, which is considered to be rather maladaptive and to further enhance physiological aspects of emotional arousal. Nevertheless, an intact perception of others' emotions and mental states was demonstrated. However, the

presented results point to problematic reactions to others' aversive emotions, reflected by high levels of personal distress. In conclusion, the results indicate the importance of raising emotional awareness and improving emotion regulation in patients with MUS.

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Bailer, J., Witthöft, M., Erkic, M., & Mier, D. (2017). Emotion dysregulation in hypochondriasis and depression. *Clin Psychol Psychother*, *24*(6), 1254-1262. https://doi.org/10.1002/cpp.2089

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7 CURRICULUM VITAE

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SCHULISCHER WERDEGANG

1994 – 1998	Gerhart-Hauptmann-Schule, Marburg
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2007 – 2014	Studium der Psychologie (Diplom) an der Philipps-Universität Marburg Titel der Diplomarbeit: „Wahrgenommene soziale Unterstützung bei Kindern und Jugendlichen mit ADHS – Psychometrische Beurteilung der Child and Adolescent Social Support Scale“
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WEITERE QUALIFIKATIONEN

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