Doctoral thesis submitted to
the Faculty of Behavioural and Cultural Studies
Heidelberg University
in partial fulfillment of the requirements of the degree of
Doctor of Philosophy (Dr. phil.)
in Psychology

Title of the thesis

Flexibility in Toddler's Object Substitution Pretense: The Role of Object Knowledge and Executive Functions.

presented by
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Born on 31. of August, 1986 in Göttingen

year of submission
2017

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ACKNOWLEDGMENTS (DANKSAGUNG)

An dieser Stelle möchte ich (aufgrund der persönlichen Relevanz hier in meiner Muttersprache) meinen herzlichsten Dank an all jene aussprechen, die mir in meiner Zeit als Doktorandin an der Universität Heidelberg beigestanden haben und dieses Projekt überhaupt erst möglich gemacht haben. Frau Prof. Dr. Sabina Pauen ließ sich damals von der Vorstellung meiner Diplomarbeit begeistern und holte mich in das Abteilungsboot und die aufregende gemeinsame Reise begann. Sie stellte mich vor spannende neue Herausforderungen, stand mir stets mit Ideen und Ratschlägen zur Seite, unterstützte mich in meinen neuen Vorhaben und wir diskutierten immer wieder mit Begeisterung, um die ganze Fülle an neuen Erkenntnissen in ein sinnvolles Ganzes zu integrieren. Ich danke Dir ganz herzlich für all die motivierenden Gespräche, die wertvollen Hinweise und dafür, dass Du mir immer wieder das Gefühl gegeben hast, auf dem richtigen Weg zu sein!

Ich danke auch Frau PD Dr. Stefanie Höhl, dass sie meine erste Kontaktaufnahme mit der Uni Heidelberg angenommen hat und mir so den Weg in die Abteilung eröffnet hat – und auch für die inhaltliche Betreuung in der Anfangszeit. Außerdem möchte ich auch Herrn Prof. Dr. Wolfgang Rauch dafür danken, dass er als Zweitgutachter mit auf diese Reise geht und im Gespräch schon ein offenes Ohr für meine Begeisterung über mein Thema hatte.

Ich danke auch Christiane Fauth-Scheurich für ihre steten Bemühungen darum, dass alle Projekte und Erhebungen letztendlich auch laufen, für ihre tolle Elternarbeit und alle Beratung rund um Poststempel, Mittelanforderungen und Hiwiverwaltung – Danke dass Du immer hinter allem stehst!

Außerdem gilt mein großer Dank all meinen Kolleginnen und Kollegen meiner Doktorandenzeit. Ihr wart einfach großartig! Christine, Du hast Dir am Nachbarschreibtisch alle meine Fragen angehört und hattest stets ein offenes Ohr sowie die passende Antwort – oder auch mal einen Spruch oder zwei. Die Gespräche mit Dir haben mir immer gut getan und waren oft ein guter Grund, sich auf den Schreibtisch zu freuen! Steffi, ich danke Dir für die gute Zusammenarbeit im Projekt – der Austausch mit Dir hat mich jedes Mal ein Stückchen weitergebracht und ich möchte auch die Gespräche und gemeinsamen Reisen nicht missen. Für diese gute Zeit möchte ich auch Sabrina Bechtel-Kühne danken – für Dich ist nicht die kleinste

Frage unbedeutend und Du gibst mir immer das Gefühl, dass ich mit meinen Anliegen bei Dir genau an der richtigen Adresse bin – ob nun wissenschaftlicher oder privater Natur. Auch Miriam Langeloh, Miriam Schneider, Christoph Konieczny, Megan Bock, Hanna Schleihauf, Sabine Grätz, Anna Strodthoff, Lena Lang, Johannes Bätz danke ich dafür, dass sie mir die Zeit hier so bereichert haben.

Schließlich gilt mein Dank auch den Studentinnen, die am Projekt mitgearbeitet haben – ihr habt mich durch Euren Einsatz stets unterstützt und es hat mir Spaß gemacht, mit Euch gemeinsam zu lernen – Danke an Anne Fernow, Leyla Kirrstetter, Laura Hassert, Jana Urban, Maren Stern und Jo-Ella Dirks. Auch all den Eltern und Kindern, die schließlich durch ihre Teilnahme an den Studien dieses Projekt überhaupt erst möglich gemacht haben, möchte ich an dieser Stelle danken.

Und meiner Familie. Danke ich von ganzem und mit ganzem Herzen! Meinem Mann Kai, der jeden dieser Schritte mit mir gegangen ist, meine Launen mit durchlebt hat und sich dennoch nicht davon abbringen ließ, mich immer und in allem zu unterstützen. Ich danke Dir für alles, was Du mir gegeben hast, damit ich an diesem Ziel – diesem Werk – ankommen konnte. Danke, dass Du immer an mich glaubst und es mir auch immer wieder sagst! Ich danke auch meinen drei wundervollen Kindern, deren fröhliches Lachen mir immer wieder vergegenwärtigt, wie reich an Glück ich schon bin und das mich auch immer wieder ein bisschen geerdet hat, wenn ich allzu weit in theoretische Überlegungen abschweifen wollte. Auch bei meinen Eltern und Geschwistern möchte ich mich bedanken fürs Nachfragen und Zuhören und das Mitfiebern bei jeder Konferenz und natürlich jetzt beim Finale. Und dahin komme ich auch jetzt – ‚à la fin du remerciements', und somit über ein bisschen Französisch ins Englische – ich wünsche allen, die dies gern lesen viel Freude daran.

ABSTRACT

Substituting objects in pretend play first emerges at around 18 months. Symbolic thinking is involved in this process, as one thing is used to stand for another. Accordingly, it is important to know how object-substitution pretense develops and how it connects to other cognitive and social processes. The current investigation focuses on the relation between flexibility in pretense involving object substitution and object knowledge. Furthermore, the role of basic cognitive skills such as executive functions for object-substitution is investigated. In Study 1, *N* = 72 toddlers participated in an imitation game involving simple actions performed on everyday objects. It was revealed that flexibility in object substitution pretense increases from 22 to 26 months of age: Older children were more proficient in joining the pretend game with familiar objects that were used in an unconventional fashion. In Study 2, *N* = 33 26-month-old children were tested with the same imitation game as in Study 1, using unfamiliar objects to present familiar actions. In Study 3, *N* = 37 children aged 26 months were tested in the imitation game with neither the objects nor the actions familiar to the participants. In Studies 2 and 3, flexibility in object substitution seemed increased as compared to Study 1: Children switched between two different uses of an object more easily. Highest flexibility was shown in Study 3 where reference to reality was lowest.

Study 4 referred to data obtained in Studies 1, 2 and 3, but related it to self-regulation capacities. In Study 1, 26-month-olds who performed better in the object-substitution task also performed better in a rule shifting task. In Study 2, the suppression of a dominant impulse showed some relation to flexibly using one unfamiliar object for two different conventional actions. In Study 3, shifting skills were related to overall performance in executing the newly acquired actions with unfamiliar artifacts.

The theoretical approach of the current investigation is derived from empirical findings on pretend play development, as well as development of the basic cognitive skills used to organize target oriented behavior. Results are discussed against the background of existing evidence and theoretical reflections. Further perspectives are developed on the basis of the obtained insights.

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1. INTRODUCTION

Und jedem Anfang wohnt ein Zauber inne, Der uns beschützt und der uns hilft, zu leben.

--Hermann Hesse (1877-1962)

As Hermann Hesse said in this famous quote, enchantment is in every new beginning, but most of all we find it when a baby is born. This little being fully depends on a person taking care of all her needs. Yet, in the blink of an eye, babies become autonomous persons with their own ideas about the world. Before they have acquired all the necessary knowledge about how to integrate into our complex social society, they start turning things upside down. In the realm of pretend play, they ride on sticks, they drink from empty cups and they talk to their teddies and dolls. Pretend play bursts with unconventional ideas and behaviors. At the same time such activities seem to be highly typical for children of all cultures. As adults we still remember how naturally we delved into those fantastic worlds once upon a time.

In this thesis, I would like to invite the reader to delve into the world of pretend play one more time. We will be concerned with the question of how children develop the capacity to participate in pretend play. Conceivably, some flexibility in thinking about artifacts seems inevitable to use a broomstick as a horse or to comment on the taste of imaginary tea. A young infant, let us call her Mary for the moment, has little object knowledge. She might display high flexibility in artifact use: Mary executes mouthing on every object she gets a hold on, irrespective of its conventional function.

When growing older, Mary will encounter the conventional use of artifacts, and thus develop some normative understanding of how she is supposed to handle different kinds of objects in a normative way. This normative understanding, and/or the strong association with a conventional use might decrease her initial flexibility. Upon observing the unconventional use of an object, Mary might protest and show the conventional handling instead. Yet, when objects are not familiar but strongly resemble more familiar objects she may confound different actions typically performed with the object at hand. Making a phone call with a remote control could be an example for a corresponding mistake.

When Mary enters school, she may witness how we use paper slips to pay for things, words to label animals that do not resemble the sounds produced by these animals, and how context defines appropriate and inappropriate behaviors. Plainly speaking, she comes to realize how social rules determine our behavior and sometimes even the meaning of things. Such experience may make her realize that we use arbitrary symbols to collectively refer to designated referents. This awareness of arbitrary relations between a symbol and its referent represents a huge advancement in socio-cognitive development. Substituting one object for another has long been treated as an early form of symbolism (Vygotski, 1967), and it is conceivable that symbolic understanding goes along with thinking flexibly about artifacts. Mary has not only encountered how to hammer a nail with a hammer, but may also have seen it being used to silence a lively discussion at a meeting or in a courtroom. She has learned to ignore the cues of an object that might afford her to use it in a special manner and thus is able to use it in an innovative way – an activity she happily exerts in pretend play when she might use the hammer for many other activities above and beyond hammering (in case her parents allow for it).

This dissertation strives to follow Mary's developmental path outlined here, covering the phase of early learning about artifacts, including the development of normative object knowledge, over the development of pretend play skills to a combination of both in object substitution play. The empirical part of this work focuses on the development of the latter skill, taking into account not only the age of the child but also her executive function skills, since many theorists argue that these capacities are implicated in pretend play. Possibly, shifting her attention flexibly helps Mary to act according to the pretense identity of the hammer instead of hammering all the time – or the attentional shift practiced during pretense helps her to improve her executive (shifting) skills. So, the fun of delving into this intriguing topic may begin... The reader will meet Mary again after encountering some scientific facts about the development of pretend play and object substitution. I start with the definition of important key terms.

2. DEFINITIONS OF PLAY, PRETEND PLAY, AND OBJECT SUBSTITUTION PRETENSE

Most definitions are confessions.

--Ludwig Marcuse (1894-1971)

When exploring a topic more closely, simple definitions always appear too superficial, omitting important aspects or certain theoretical considerations, as aptly expressed in the quote above. Nonetheless, I will try to give a first, basic definition to provide a common ground for further considerations. Subsequently, I will outline the debate about issues not easily integrated in one general definition. All pretend issues presented in therein will alter the view on standard definitions, as they add certain perspectives or question others. '*Play'* is the first term to be defined, followed by a more specific definition of *'pretend play'* as prominent subtype of play. Subsequently, *'object-substitution pretense'* will be defined in more detail, as this sub-form of pretend play is central for the investigation presented in this thesis.

2.1. PLAY

'The kids are playing' – appears to be a comprehensible phrase. But actually, it does not reveal what the kids are really doing. Play is hard to define because in comprises such a wide range of activities and varies across age groups and cultures (Burghardt, 2011; Lillard, 2015; Weisberg, 2015). Still, one main defining feature is easily agreed upon: Play is a non-instrumental activity that serves no other immediate goal than enjoyment (Weisberg, 2015) – or, plainly speaking, it serves fun rather than survival (Lillard, 1993a). According to P. K. Smith and Vollstedt (1985) most people recognize play when they see it. Five defining criteria could be reasonably agreed upon: (1) Intrinsic motivation, (2) positive affect, (3) nonliterality, (4) more concern for means than for ends, and (5) flexibility. The more of these criteria are met, the higher is the observer's certainty that 'the kids are playing'. However, according to Lillard (2015), it is important not to define play on a purely behavioral level. Much of what is really distinct about play occurs on the mental level. Sometimes, only the psychological state of the child distinguishes some functional behavior (e.g. sticking a spoon into a doll's mouth) from play (pretending to feed the doll her dinner with the spoon). Hence, Lillard (2015, p. 427) favors a recent 'list approach' by Burghardt (2011), which outlines two structural and three functional criteria:

- The behavior is incomplete, exaggerated, awkward, and precocious, occurs in a modified sequence, or is aimed at a target that is atypical for the activity.
- The behavior is repeated in a similar but not rigidly stereotyped way.
- The behavior is not fully functional, i.e. not relevant for the survival of the organism.
- The behavior is spontaneous, voluntary, pleasurable, rewarding, intentional, or autotelic (for the self).
- The behavior occurs under ample conditions, as opposed to under stress. The organism is in a "relaxed field".

These criteria allow quite reliably to categorize a given behavior as play or non-play. Having decided that a certain behavior can be called play, the next question arises: What are they playing? How play behavior is categorized, typically depends on the theoretical perspective (Lillard, 2015).

Piaget (1951) used behavioral categories to define different forms of play: Sensorimotor play, symbolic play and games with rules. *Sensorimotor play* involves repetitive interactions with own body parts or with objects for sensory- and motor stimulation. Having one object or situation to stand for another defines *symbolic play* in the sense of Piaget (Lillard 2015). In sports as well as in board games we find examples of Piaget's third category of g*ames with rules*. Burghardt (2011) further describes different categorization systems, e.g. construction, make-believe and rough-and-tumble play.

With focus on social development, Parten (1932) proposed categories expressing the interactive nature of different forms of play: solitary independent, onlooker (observing others), parallel (playing close to other children with similar objects, but no direct interaction), associative (involving some interaction and similar activity), or cooperative (organized group play). Hence, a wealth of different categorization systems is available. They all focus on different aspects of behavior. *Symbolic / pretend play* is the most commonly studied form of human play (Lillard, 2015), and can be found in most categorization systems. For many theorists, it is the signature form of play (Lillard, Hopkins, et al., 2013).

2.2. Pretend Play

Across the literature, the term '*symbolic play*' is used interchangeably with '*pretend play*'. Originally, this term dates back to Piaget's definition of symbolic play (see above), but in the meantime, some important characteristics have been added. The debate about the representational nature of pretense has added a lot of meaning to the term 'symbolic' (see section 2.4.1). Therefore, a richer definition of pretend play will be used in the current work which also accounts for the mental level of pretend. Hence I will refer to this category as *pretend play* in the following, while *symbolic play* denotes Piaget's form of play when an object or a situation is made to stand for another.

There is high consensus that pretense is characterized by some form of representations or acting-as-if and that pretense behaviors and actions are not *meant* to literally reflect reality (Weisberg, 2015). In pretense, "an object . . . becomes a pivot for severing the meaning of horse from a real horse" (Vygotski, 1967, p. 15).

To account for the underlying mental processes, Lillard (1993a, p. 349) states that for true pretense, five features are necessary and sufficient:

(1) A pretender

(2) A reality (obviously omnipresent)

(3) A mental representation that is different from reality

(4) A layering of the representation over the reality, such that they exist within the same space and time

(5) Awareness on the part of the pretender of components 2, 3, and 4.

Rakoczy (2003) delivers a similar definition of pretend play in which he accredits a more central role to the action: *"Pretend play is an intentional action form in which an actor – for the sake of playing – knowingly projects a (mostly) false proposition onto a real state of affairs and intentionally, non-seriously acts in some sense as if the proposition was true, but intentionally* *and openly stops short of really acting as if the proposition was true or trying to properly perform the pretended action"* (Rakoczy, 2003, p. 3).

Most importantly, pretend play is neither a proper action nor a mistake. At the same time, pretend play is based on knowledge (concepts) and asserts a dual orientation towards reality: On the one hand it is based on the awareness that pretend play is not really true and on the other hand one is intending to behave 'as if it were true'.

These definitions underscore pretend play to rest on knowledge concepts of reality and to involve an intentional act of behaving according to a mental representation differing from this reality –rendering pretend play a representational activity. These criteria apply to the mature adult form of pretense. In how far all of the aspects hold for emerging forms of pretense is still a matter of debate. There has been much discussion concerning the awareness of mental representations (see Lillard's components 3, 4 and 5) as defining features of pretense in young children. This so called '*pretense debate*', which will be addressed in the following section, concerns the distinction between producing and understanding pretense.

2.3. THE 'PRETENSE DEBATE'

Initially, pretending was assumed to be based on *having* mental representations differing from reality. Thus it should also involve an *understanding* of representations differing from reality. Leslie (1988) argues that mental representation is an essential feature of pretense and therefore, understanding pretense is synonymous with understanding mental representations. Following from this, own pretense production and understanding pretense in others should emerge simultaneously.

Children start to produce their first pretend acts at around 18 months (see section 4.2 on early emergence of pretend play production). Leslie's notion that children also understand pretense in others this early has been questioned. When children are explicitly asked about the cognitive or intentional underpinnings of pretense (i.e. "Can someone who doesn't know anything about dogs / does not intend to pretend to be a dog still pretend to be a dog?"), children struggle to answer correctly up to the age of eight years (Lillard, 2015). Such findings imply a developmental gap between production and conscious comprehension of pretense (Rakoczy, Tomasello, & Striano, 2006), thus contradicting the idea that both emerge simultaneously.

An increased interest in the emerging mental state understanding brought forth the "theory of mind research". This also gave new impulses in research on pretense development: How is it possible that children produce pretense so early while not being able to explain other's pretense behavior explicitly? The many parallels between pretense understanding and mental state understanding in other domains (e.g. false beliefs) sparked a debate about the role of mental understanding in pretense.

Different theoretical approaches have been established to explain the large temporal distance between early pretend play production and later sophisticated understanding. The answer was searched for in conceptual underpinnings of pretense. Researchers took positions to either defend an early understanding of pretense as a mental activity, versus an early conceptualization of pretense as 'behaving-as-if', using actions instead of underlying mental states as sole indicators of pretense in others (see Ganea, Lillard, & Turkheimer, 2004). The following section will present both positions and the empirical evidence employed to support either of them. Subsequently, a third possible alternative is elucidated, the cultural learning account. This latter account integrates aspects of both positions and at the same time considers recent findings on the socio-cultural background of early pretense initiation. This account is especially useful for the conceptualization of pretense taken in the current work.

2.3.1. Conceptual Underpinnings of Pretense

'Meta-Representational Theory'. This account was first brought forth by Alan M. Leslie (see e.g. Leslie, 1987, 1994). According to this theory, even young children understand pretense in a meta-representational way. Meta-representations are complex cognitive representations with embedded simpler representations. When the child uses a banana as a telephone, she represents "this is a telephone", but this representation is embedded in the representation "I pretend that this is a telephone". This enables the child to process the simple representation in a non-literal way. Analogously, when the child sees her mother pretending, this action is interpreted as "She is pretending that this is a telephone". Such meta-representations have a common cognitive structure and are processed by the so called 'Theory of Mind Module' (ToMM) – a module also responsible for processing other instances of "as-if", such as when someone acts according to a false belief.

The main argument for this assumption is the following: One does not need to have a concept of dogs to be a dog, but one needs such a concept to understand that someone else is a dog. Analogously, a child does not need a concept of belief to have a belief herself – but she needs a concept of belief to understand that someone else has a belief. This argument is based on evidence implicating that young children not just engage in pretense, but also recognize pretense in others and join in it. O. Friedman and Leslie (2007) refer to children's early proficiency in several tasks to argue that children around two years of age already understand a lot about pretense: They manage to imitate pretense scenarios (Rakoczy, Tomasello, & Striano, 2004; Watson & Fischer, 1977), they select correct thought pictures displaying pretense content (Harris & Kavanaugh, 1994; Harris, Kavanaugh, Wellman, & Hickling, 1993), they correctively choose the object to perform a certain pretense act on (Bosco, Friedman, & Leslie, 2006; Walker-Andrews & Harris, 1993) and they indicate with looking times that they are surprised by actions violating a pretense script (Onishi, Baillargeon, & Leslie, 2007). All this evidence will be reviewed in further detail in Chapter 5 on the development of understanding pretense in others.

Taken this empirical evidence, O. Friedman and Leslie (2007) conclude that children start to pretend and simultaneously begin to understand pretense in others. Accordingly, the meta-representational theory assumes that children have a concept of pretense from the outset. However, it is conceded that the young child is not necessarily aware of the fact that she or others have a pretend concept. Thus, the theory does not claim a full awareness of mental states from the outset (O. Friedman & Leslie, 2007).

Leslie supposes that mental concepts such as pretense, desire and belief are inborn but mature at different ages. The process of maturation involves enriching concepts with new facts. But the concept as such remains unchanged: Leslie supposes that from two years on, children have the same concept of pretense as adults. Learning does not alter these concepts. The concept is 'a logical primitive, and is 'triggered' every time the child encounters instances of pretense.

'Behaving-as-if'-theory'. The so-called 'behaving-as-if' theories (Harris, 1994; Jarrold, Carruthers, Smith & Boucher, 1994; Lillard, 1994; Nichols & Stich, 2000; Perner, Baker & Hutton, 1994) oppose Leslie's rich account. They claim that children up to the age of 4 or 5 years not yet refer to the cognitive or intentional attitudes underlying pretense actions. Instead, young children conceptualize pretense as "behaving in a way that would be appropriate if p (the counterfactual situation) were the case" (Nichols & Stich, 2000, p. 139). Young children thus think of pretending as an action and not a mental activity. Following from this, young children are able to distinguish between 'as-is-behavior (actions that correspond to reality) and 'as-if-behavior' (actions that correspond to prepositions deviating from reality, see Figure 1).

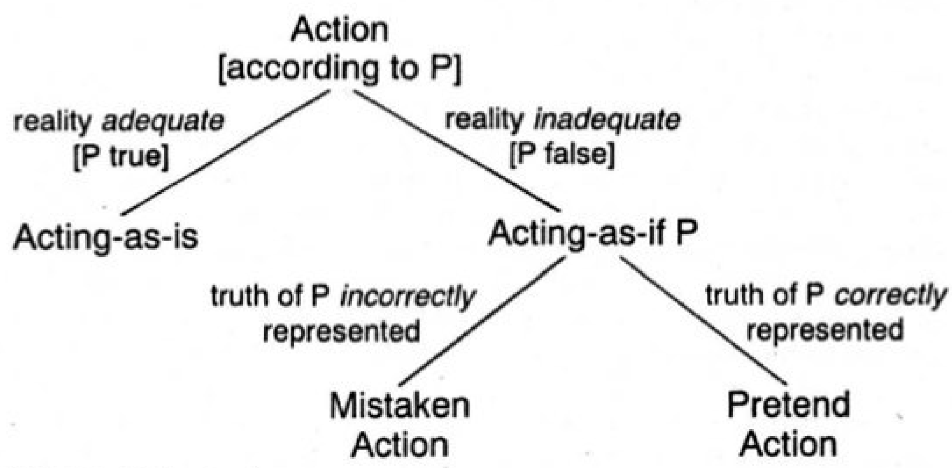

FIG. 12.1 Kinds of action.

Figure 1. Differentiation of as-is and various forms of as-if-behavior. Graphic retrieved from Perner, Baker, and Hutton (1994, p. 263).

The account assumes that children would not be able to distinguish between different forms of 'behaving-as-if', such as mistakes and pretense, because their pretense concept still lacks mental state understanding (Rakoczy & Tomasello, 2006). Certain overextension errors are predicted, as young children are not able to consider the cognitive and the intentional underpinnings of behavior. The so-called 'Moe-Studies' are seen as proof for such overextension errors (Lillard, 1993b; for overview and interpretation see Lillard, 2015; Richert & Lillard, 2002). Lillard (1993b) presented the troll 'Moe' to four-year-old children. Moe hopped like a kangaroo, even though it was explicated that he did not know anything about kangaroos. The four-year-olds nevertheless stated that he was 'pretending' to be a kangaroo. This confusion was also apparent in further studies, showing that children ascribed pretending to sleeping agents (i.e. looking like worms when asleep) or to inanimate objects (Lillard, Zeljo, Curenton, & Kaugars, 2000; Sobel, 2004). Moreover, in a study by Perner et al. (1994), 3-year-olds were shown to confuse pretense and false-belief: A person who *falsely believed* that a rabbit was in a cage still was denoted to *pretend* that there was a rabbit in a cage.

Even though this more coarse-grained understanding does not allow young children to ascribe mental states to others (mother is pretending that the banana is a telephone), it still is sufficient for understanding others' pretense and for joining in someone else's pretending. Furthermore, the account claims to explain the proficiency of even young children in pretense reasoning and simpler pretense-reality distinction tasks. They need to ascribe a pretense proposition, quarantine the real and the pretense scenario and act accordingly, namely seriously in real and non-seriously in pretense situations. This does not ask for a representation of the cognitive or intentional state of the pretender that drives the pretend action (i.e. the child does not need to understand that the mother pretends that the banana is a telephone and therefore has to be knowledgeable about the normal use of telephones).

Only at the age of around four when children have acquired a mature understanding of mental states (as measured by false belief and related tasks), they are also supposed to grasp this mental underpinnings of pretense (Rakoczy, 2003). It is to be noted that a whole range of different theoretical accounts can be referred to as 'behaving-as-if-theories'. In part they provide different explanations for why pretense understanding evolves earlier than other forms of mental state understanding (e.g. false belief understanding), but share the general assumption that young children have a more coarse-grained pretense understanding than adults (e.g. compare simulation theory (Harris & Kavanaugh, 1994) and theory theory (Perner, 1991, 1995), see e.g. Ganea et al. (2004) and O. Friedman and Leslie (2007) for a more detailed discussion of this topic).

Criticism of meta-representational and behaving-as-if-accounts. One main criticism of advocates of the meta-representational theory concerns the nature of the 'behaving-as-if-construal'. They argue that without the concept of pretense, children inevitably miss out on a key feature of pretense: In most cases pretense differs considerably from 'behaving-as-if p were true'. Suppose a child is pretending that a miniature car is a real car. Behaving as if it was a real car would imply the child trying to climb into the car and drive in it. But what we will most certainly observe is how the child pushes the car across the table, possibly making some 'vroom vroom' sounds. This is certainly not what we would expect if the child wanted to behave as if the car was a real car (O. Friedman & Leslie, 2007).

Some recent empirical evidence also supports the notion of the meta-representational account. Custer (1996) found children at the age of three to perform well on questions about pretense contents when asked to point to 'thought pictures' displaying beliefs, pretense contents or memories of protagonists. D. L. Davis, Woolley, and Bruell (2002) investigated 4 and 5-year-old's understanding of knowledge and thinking in pretense and accredited their subjects with an understanding that pretense involves mental representation.

A recent study by Melzer and Claxton (2014) contrasted the two theoretical positions of the action and the mental state hypothesis by simultaneously presenting 3 to 4-year-old children with actors who behaved according to two different concepts (e.g. imitating a dog versus making swimming movements). Additionally, children were provided with information about the knowledge and intentional status of the actor (e.g. 'he does not know anything about dogs'/ 'he pretends to be a dog'). Results did not clearly speak for one of the two accounts: Children did successfully integrate information about the actor's knowledge status when interpreting pretense behavior, thus supporting an early understanding of mental representation. But they failed to do so when this information was in conflict with the visible actions (an actor barking and not knowing anything about dogs was still rather affirmed pretending to be a dog than an actor who was knowledgeable about dogs but made swimming movements). The authors conclude that in this latter case, children were not able to consider the knowledge status because they could not ignore the impression from the action. On these grounds, they reason that processes of behavior control may play a role when it comes to the understanding of pretense in others.

This debate illustrates the difficulty of understanding the true nature of pretend play. It is concerned with the mental processes in children with limited verbal skills. Verbal inquiries thus pose an undue challenge to children this age. Nonetheless, most studies arguing for an early conceptual understanding of pretense as lacking mental representations are verbal studies (e.g. the Moe-studies, Lillard, 1993b). Rakoczy (2003) additionally criticizes that none of the behavioral theories makes specific claims about the ontogenetic origins of pretense. Behaving-as-if-theories, he supposes, are both compatible with an individual and a social origin of pretense (for more on this issue see section 4.3 on origin and initiation of pretense) and do not specify the role of social interaction for the development and initiation of pretense.

Rakoczy (2003) criticizes the meta-representational theory for their radical, 'non-descriptivist' apprehension of concepts as atomistic primitives. The contrasting descriptivist position supposes that the concept of pretense is gradually and holistically acquired to finally reach the full-fledged mature form that is also captured by the definitions presented in section 2.2. Children could, for example, first come to understand the conceptual relations between pretense and intentional action, and only later grasp the conceptual relations between pretense and cognitive mental states. According to Rakoczy (2003), Leslie denies this developmental individuation of the pretense concept and thus accredits even very young children with an adult-like conceptualization of pretense.

An alternative to the two big theoretical accounts is presented by Rakoczy (2003). It posits that children might understand pretense as an intentional action form without assuming that they have an innate, adult-like concept of pretense from the outset. Rather, a gradual conceptual development of pretense understanding, instead of an all-or-nothing fashion, is supposed, as elucidated in the following.

The Cultural Learning Account of Pretense. The cultural learning account is based on early understanding of intentions. Considerable empirical evidence indicates that children begin to see themselves and others as intentional agents from around 12 months onwards (Carpenter, Akhtar, & Tomasello, 1998; Meltzoff, 1995), as shown by the emerging phenomenon of gaze following, triadic interaction, and the use of communicative gestures (Rakoczy, 2003). This nascent understanding of others as intentional agents enables children to learn via imitation - with imitation being defined as intentionally performing an action one has understood as an intentional act by someone else (Tomasello, Kruger, & Ratner, 1993). Towards the end of their first year, infants show in their imitative behavior that there is more to it than just acting like someone else did. For example, they re-enact actions that accidentally failed to lead to a certain outcome (Carpenter et al., 1998; Meltzoff, 1995) or they show rational imitation by imitating a strange action: They would push a button with the forehead instead of with the hand, but only when they assume that the model has chosen this strange way to act on purpose, and not just because her hands were restrained (Gergely, Bekkering, & Király, 2002).

Possibly, 3-year-olds thus understand pretense as an intentional activity (not barely relying on actions) before they understand the cognitive mental states underlying pretense. They might be aware that one intentionally acts as-if when pretending, but only later understand that one can only pretend based on concepts (i.e. one cannot pretend to be a dog when one knows nothing about them). In a study with 3, 4 and 6-year-olds, Rakoczy et al. (2006) compared implicit (i.e. action) and explicit (i.e. verbal) understanding of other's pretend actions. The study was analogue to an earlier study from Rakoczy et al. (2004) where the experimenter either pretended or tried and failed to write with a capped pencil. However, in an additional condition, children were explicitly asked whether the experimenter was trying or pretending to perform the target act. Even six-year-olds struggled with this question, which is quite intriguing. It again contrasts the early implicit understanding of intentional structures underlying pretense, as shown in Rakoczy et al. (2004) with the explicit, full-fledged mental understanding developing much later. Thus it is implicated that there is more than just action as a cue to early pretense understanding, but it is not before 6 – 8 years of age that a full understanding reliably develops (Lillard, 1998).

The cultural learning account hence supposes that pretense, just like instrumental actions, is acquired by observing, understanding and imitating adults (Rakoczy, Tomasello, & Striano, 2005). Just as tools gain there instrumental function (a pencil can be used to write) through social transmission via imitative learning, objects gain a status function (a pencil can stand for a car in a certain context). Learning about status functions is inherently social, as a status function only exists because a group of people has agreed upon this function. A pencil is always useful to write a letter, while a slip of paper with a certain printing counts as money not because it has some special properties that render it useful, but rather because we have agreed upon its status. Studies on event-related-potentials in response to pretense scenarios with adults (Meinhardt, Kühn-Popp, Sommer, & Sodian, 2012) as well as with 6- to 8-year-old children (Kühn-Popp, Sodian, Sommer, Döhnel, & Meinhardt, 2013) also support the cultural learning account. Results indicate distinct underlying neural substrates for pretense in comparison to false belief-reasoning. Results thus imply that these two do not draw on a common underlying mental understanding, like it is proposed by the meta-representational account. So what is the benefit of this additional approach in relation to the mental-state and the behaving-as-if construal?

Some claim that the cultural learning account is just another variant of a behaving-as-if-theory (O. Friedman & Leslie, 2007); they criticize that it still fails to explain the key features of children's pretense, because it does not accredit that children recognize a certain attitude underlying pretense acts. For the current work, this account is very valuable nonetheless. It offers some comprehensible assumptions about how children first crack the code of pretense, without supposing some innate concept and yet also without denying all mental understanding on the side of the child. Cultural learning theory conceptualizes pretense as an inherently social activity because the meaning of pretense acts is socially constituted. The role of imitation in this account is also of special interest. Imitation serves as a learning mechanism that opens up the world of shared meaning and thus offers a bootstrap to develop a full-fledged mental understanding of pretense. This is an important aspect for the conceptualization of the current study, as imitation was used to investigate flexibility in a pretense situation.

After this excurse on the debate about the conceptual underpinnings of pretense and the opposing theories on this issue, the reader might better understand the initial warning about the provisional nature of definitions. It is important to agree upon defining characteristics. But only when knowing about the debate behind some of these characteristics, we can fully appreciate the scope of certain assumptions.

In sum, converging evidence suggests that for mature pretense, all the characteristics supposed by Lillard (1993b) and also Rakoczy (2003) do apply, though it is still a matter of debate by which means children achieve this mature form of pretense. As it seems, imitation plays a major role in this context because pretense is a social activity. It usually refers to culturally constituted meanings of objects and activities, it is typically introduced to the child via other people, and it often involves joint activities of different play-partners. A special form of pretend play is object-substitution pretense which is often interpreted as the most typical form of symbolic play in the Piagetian sense: An object is used in a way as though it were something else (Piaget, 1951).

2.4. Object-Substitution Pretense

One of the earliest forms of pretend play to be observed in children is the substitution of one object for another (McCune-Nicolich, 1981; Watson & Fischer, 1977). In object-substitution pretense, a child might pretend that a banana is a telephone or that a heap of pillows is a car. On a behavioral level, object-substitution pretense seems relatively easy to define. But, as noted when defining play in general, mental processes are more relevant. Using one object to stand for another is often perceived as a symbolic act, and the development of using symbols is highly relevant for social and cognitive development. But whether object substitution is really symbolic is still not clear. Therefore, the following section will be concerned with the symbolic nature of such substitution acts. The term ‘symbolic’ will be introduced and it will be discussed in how far it applies to object-substitution pretense. In the course of this discussion, the dual and the triune representation problem will be elucidated. The triune representation problem is concerned with substituting objects that have a distinct status function – e.g. using a banana as a telephone – which then takes us to early learning about artifacts in the subsequent section.

2.4.1. Symbolic Understanding in Object Substitution Pretense

‘Symbolic’ in a wider sense can be defined as something intended to represent something else (DeLoache, 1995). According to DeLoache (1995), the use of symbols requires “(a) some awareness of the relation between symbol and referent, (b) mapping the corresponding elements from one to the other, and (c) drawing an inference about one based on knowledge of the other.” (p. 109).

It is not entirely clear when a certain activity is to be classified as symbolic. According to some definitions, symbolization also incorporates some intentional capacities: An entity is *intended* to stand for something else (DeLoache, 1995). Thus, the level of abstraction differs tremendously between a child using a doll’s baby bottle to feed her doll (which they were made for) and a child using a building block as a baby bottle to feed her doll. Some therefore have argued that early play behaviors rather have to be called pre-symbolic or functional play.

Stage models of development mostly struggle with describing the transition from pre-symbolic or functional play to truly representational play. The term functional play has been criticized for its ambiguous use in the literature (Vig, 2007). Rakoczy (2003) refers to it in a rather wide sense as describing all kinds of playful actions where objects are used for the sake of playing, without any symbolic, non-literal, or as-if elements. Throwing a ball would qualify as functional play in this sense, as the ball or the action does not refer to something else. A child building with bricks would similarly be seen as exerting functional play, because this is what building blocks are made for. When as-if-elements are added to the play context (e.g. building a house for a doll), play gains a pretense aspect and can no longer be called purely functional play. The case of the doll's baby bottle used for feeding a doll, however, is difficult to file here, because the action definitely comprises an as-if element, even though the object as such is used in the way it was made for.

Vig (2007) uses the terms "representational" and "symbolic" to distinguish between early, simpler and more mature stages of pretend play. *Representational* refers to play expressing a child's recognition that toys represent objects in the real world (child recognizes that a doll represents a person); *symbolic* refers to higher-order decontextualized (decentered) play in which object substitution does not depend on a close physical resemblance to the real-world object represented (child pretends that a block is a baby bottle). This categorization system allows to file actions that do comprise as-if-element, but on a low level of abstraction concerning the object used.

It has even been questioned, however, whether object substitution pretense can be called symbolic at all (Perner, 1991) – according to some, this term implies some kind of *denoting character* or semantic content, simply speaking, an intention to refer to an entity in the real world. A speech act, for example "look, a mouse!" normally refers to a real-world object (denoting act). The drawing of a mouse, on the other hand, rather stands for itself, as I would not usually draw a mouse to inform someone that there is a mouse around (non-denoting act). A drawing can thus be regarded as symbolic only in a wide sense, as it refers to some mouse, but not one specific mouse actually existing. According to Rakoczy (2003), pretense acts are symbolic only in this wide sense because they are not usually used to inform about some real state of affairs (e.g. a child would not pretend to eat a building block to indicate that she is hungry).

The distinction between denoting and non-denoting acts is highly relevant for explaining the differential development of both: For denoting acts, one needs to make reference to some state of affairs in the real world. Non-denoting acts can be interpreted without a corresponding reference. This very difference possibly facilitates pretense understanding in comparison to, for example, false belief understanding and could explain why pretense understanding appears earlier in ontogeny. Thus, object substitution pretense could serve as a bootstrap for later, more complex understanding of symbolism in a strict sense. There is broad consensus that symbolism is implicated in object substitution pretense. Hence, the development of symbolic understanding is highly relevant for understanding early acts of object substitution. Judy DeLoache (1995) has intensely investigated the development of symbolic understanding in preschool aged children in her studies on the 'dual representation problem'. Tomasello and colleagues (Tomasello, Striano, & Rochat, 1999) formulated and investigated the 'triune representation problem' on the basis of this research. Both accounts will be discussed next.

The Dual Representation Problem. When using objects as symbols, children have to face what DeLoache (1995) called the *dual representation problem*. Symbols (i.e. external artefacts) are all entities that someone intends to stand for something else. Understanding and using symbols thus requires "dual representation" – the child has to simultaneously represent both: the concrete and the abstract nature of the symbol (DeLoache, 1991). The author acknowledges that different levels of awareness about the symbolic nature are possible. In most of her studies on this issue, she used a small scale model of a room that stands for a real room. The model closely resembles the real room. Model-room relations are first explained before a small snoopy is hidden at a certain location in the small-scale model. Upon the hint that the large snoopy could be found in the same place in the large room as the small snoopy in the small room (e.g. in the bed), the children were asked to find the snoopy.

In this task, the small-scale model *symbolizes* the real room. We thus have a denoting act, and the criteria for symbolism in the strict sense are met. The child has to use the symbol (e.g. the miniature bed) to solve a task (to find the big snoopy in the large bed) and therefore has to identify the relation between the symbol and the exact referent in the real world. While 36-month-old children typically succeeded in this task, 30-month-olds often have considerable difficulties (DeLoache, 1991; DeLoache, Kolstad, & Anderson, 1991; Marzolf & DeLoache, 1994). DeLoache (1995) explains this with dual representation status of the symbols: their physical appearance affords direct manipulation and exploration, but at the same time the objects stand for something else.

Similarity between a symbol and its referent is likely to facilitate the symbol-referent-mapping. The salience of the object's properties also influences the mapping process. When the symbol itself is interesting or complex to be processed, this mapping is more difficult. DeLoache thus assumes that processing the small model, which itself is very attractive, exacerbated the mapping to the large scale room.

Confirmatively, 30-month-old children performed better at the scaling task when photographs of the room were used instead of a small scale model. According to the author, the photos were less interesting and thus did not consume as much of the child's cognitive capacities. In a further study, DeLoache, Miller, and Rosengren (1997) found that children performed much better at the very same scaling task when it did not require dual representation. They made 30-month-olds believe that a troll and his room could be shrunk with a mysterious shrinking machine. Children were much better able to find the shrunk troll in his shrunk room – presumably because for them, it was the very same troll, not a symbol and its referent.

Hence, several aspects of the context, the symbol and the referent can influence the process of mapping a symbol to its referent. One aspect, namely the knowledge about an object, seems to be of special relevance. DeLoache (1995) has argued that the saliency of the symbol is also relevant. This is related to how much children already know about an object itself. When it has a well-known status function, it might be much more challenging to perceive it as standing for something else. This issue has been brought forth under the term "triune representation problem", which I will refer to in the following.

The Triune Representation Problem. Findings from Fein (1975) show that children in their third year of life still have problems understanding when an adult uses an object with a well-known status function as a symbol (e.g. a cup for a hat, see also section 6.3 on the ontogeny of object substitution pretense). This takes the dual representation even a step further and has been called 'triune representation problem' (Tomasello et al., 1999). The object serves three representations at the same time: (1) a manipulable entity (a cylindrical object); (2) the actual identity and function of the object (a cup to drink from); and (3) the object that it is supposed to stand for (a hat). From this follows that object knowledge should influence processes of mapping a symbol to its referent because it can turn a dual representation problem into a triune representation problem. Consider the following situation: An infant takes a remote control, puts it to the ear and starts talking. When we assume that this child does not know the true function of the remote control, it does not face a triune representation problem but rather might misrepresent a remote control as a mobile phone or not associate any meaning with it at all. An older child who already knows how to distinguish remote controls from mobile phones would face a triune representation problem (Pauen, 2014).

This example illustrates that the use of objects as symbols depends heavily on the conventional knowledge about this object. But how do children acquire this knowledge? And how can such knowledge be characterized best – is it rather rigid and normative or flexible from the outset, and when do children consider contextual aspects when evaluating their object knowledge? These questions will be addressed in the following section on children's early learning about artifacts, before we return to pretend play development.

3. Early Learning About Artifacts

"Rather than thinking, on each occasion, about what object might physically achieve the goal ('which of these things can make lasting marks on this page?'), we effortlessly bring to mind the category of tool designed for the task (i.e. pens), find one, use it, and then – apparently unlike any other species – repeatedly store it for later use should a similar need reoccur."

-- Casler and Kelemen (2005, p. 472)

‚Knowing' an object (e.g. a pen), involves knowing how it looks like and how it feels when manually encountered, but also knowing what you typically do with it and what it is made for, as illustrated in the quote above. To grasp the function of an object, a child has to observe how the object moves or how it is being used – merely looking at the object alone is not sufficient (Elsner & Pauen, 2007; Madole & Oakes, 1999). Learning about object function often involves social interactions. Learning through trial and error is possible as well, however, children mostly gain their functional knowledge by imitating other people or becoming engaged in processes of emulation. By observing her mother using a knife to cut an apple the child learns that the knife is a sharp tool. They also come to distinguish the knife's handle from its blade – thus they learn how to properly grasp a knife (Elsner, 2009).

Function is not always as obvious as perceptual characteristics like form or color are; the ability to attend to functional aspects thus emerges later than the ability to attend to form, color or other aspects of appearance. Awareness for the functional identity of objects has been shown to emerge towards the end of the first year (Fenson & Schell, 1985). Träuble and Pauen (2007) found infants as young as 12 months to categorize unfamiliar objects according to a functional though perceptually non-salient part, after watching only one short demonstration of the part's function. Madole, Oakes, and Cohen (1993) demonstrated that 10-month-old infants attended to differences in form while 14-month-olds were able to attend to differences in function. Eighteen-month-olds finally managed to consider the relation between form and function – they reacted with heightened attention when a familiar object was used in an atypical fashion. Thus, learning about the functional identity of artifacts begins early and requires only limited incidences of observation. As a consequence, young preschoolers reliably and explicitly hold the view that artifacts are typically designed to serve a specific purpose (e.g. German & Johnson, 2002; Matan & Carey, 2001).

Conventions and norms may vary with the cultural background, however: While 9-month-olds from Sweden anticipated eating actions from spoons, Chinese infants anticipated those actions only from chopsticks (Green, Li, Lockman, & Gredebäck, 2016). So children seem to develop culture specific expectations regarding the conventional use of artifacts relatively early. Accounting for the normative dimension, children expect not only their mother to use tools according to their intended function, they also expect other people adhere to these conventions. Casler, Terziyan, and Greene (2009) proved 26- to 38-month-olds to think normatively about artifact functions. Children learned the function of several novel and familiar artifacts. When the artifacts were used in an atypical way, children reacted normatively e.g. by protesting.

So, knowledge about objects and normative assumptions about their use influence children's behavior from early on: Casler and Kelemen (2007) demonstrated that even after only one demonstration of the proper function of an artifact, 24-month-olds avoided to use this object for any other purpose. Children in this study displayed 'functional fixedness' – by insisting on the conventional use of the artifacts (Adamson, 1952; Duncker & Lees, 1945). In a study by Killen and Uzgiris (1981), 10- to 16-month-old infants imitated conventional actions like drinking from a cup more often than unconventional actions like drinking from a toy car.

Slightly older children (i.e. 22-month-olds) already showed instances of imitating the unconventional actions, thus demonstrating some flexibility in their thinking about the norms and conventions of artifact use. Of course, the benefit of learning cultural conventions is irrefutable, but flexibility is also an important hallmark in learning about artifacts. Context-sensitive reasoning is only possible when a child can also disengage from the conventional use – for example to understand the meaning of the hammer in the hand of a judge in contrast to the hammer in the hand of a doctor or a carpenter (Wyman, Rakoczy, & Tomasello, 2009). Problem solving also requires us to overcome functional fixedness and think flexibly instead – e.g. when the solution to a given problem requires an unconventional use of an artifact.

A study by Barrett, Davis, and Needham (2007) shows that this is quite a challenge for young children. The authors asked 12- to 18-month-old children to turn on a light, but the switch was not directly accessible. In order to reach it, children needed a stick to reach through a small hole of a box. When provided with an unknown artifact with a broader end and a long, slim handle, participants did not have any problem to grasp the tool at its broader end and insert the handle through the hole. However, when presented with a familiar artifact, namely, a spoon, they had great difficulties to grasp it by its bowl and insert the handle.

This illustrates that challenges in learning about artifacts are at least two-fold: Children have to acquire social norms and conventional uses of artifacts in order to employ them effectively (i.e. not trying to cut the apple with the handle of the knife). However, they also need to develop flexibility in thinking about artifacts in order to use them in new and creative ways. This flexibility will enable children to interpret different uses of artifacts according to the context. These variations in meaning of artifacts occur in real life (i.e. the hammer in different hands), but for young children, another form of context that heavily skews conventional meanings is pretend play. Toddlers around their second birthday have accumulated quite an amount of conventional knowledge about artifacts; however, they still struggle when it comes to use them flexibly. In pretend play, this flexibility emerges earlier than in other contexts – approving that in play, "a child always behaves beyond his average age" (Vygotski, 1979, p. 102). Hence, pretend play offers the opportunity to practice flexible thinking about artifacts.

In the following, the development of pretend play will be elucidated. Research has shown that a distinction between production (the child showing own pretense acts) and understanding of pretense in others (i.e. comprehending other's pretense acts) is applicable. The development in these two domains will be presented in two consecutive sections. Concerning pretend play production, different stage models and universally accepted developmental trends (decontextualization, decentration and integration/sequencing) will be introduced. Special emphasis will be put on early emergence of pretense play production and possible precursors, because this phase is of particular interest for the current work. Finally, the question of the origins and initiation of pretend play production is addressed, as theoretical debate exists on the role of social experiences regarding this matter.

4. Development of Pretend Play Production

"…in play, it is as though [the child] were a head taller than himself"

--Vygotski (1979, p. 102)

Young toddlers can appear to be quite proficient at tasks they would not normally accomplish – as long as they happen in a pretend play frame. A little 4-year-old can imitate the role of a mother and warn her dolls in a serious voice about not spilling their drink, even though she spills it herself sometimes when it comes to true dinner time. Albeit, this reveals that she *knows* how to behave (in principle). This revelation fascinates parents and researchers because we catch a glimpse on how mature our children already are – a fascination which is also expressed in the literature repeatedly, often quoting Vygotski (1979), as noted above. But how does this proficiency in pretend play production develop?

Lillard (2015) denotes pretend play production to peak at around 4 years of age, as indicated by Haight and Miller (1993) who found most children that age to engage in pretend play during home session observations. The age span between three and five is commonly referred to as 'high season of pretend play', as all forms of pretend play are most prominent in this period (Singer & Singer, 1992; Weisberg, 2015). Although pretend play appears somewhat later in other cultures where it is less encouraged, it is latest observed to emerge at the age of three and to peak some years later (Lillard, 2011).

Between 15 and 24 months of age, children show great improvements in pretending (Haight & Miller, 1993; McCune, 1995). Tamis-LeMonda and Bornstein (1994) found children's engagement in pretend play to increase by 250% from 13 to 20 months of age. Both Piaget and Vygotski supposed pretend play to cease at an age of six. A more recent study indicates that children can remain engaged in child-like pretend play until the age of 11 (E. D. Smith & Lillard, 2012). A more detailed developmental course is provided by stage models of pretend play.

4.1. Stage Models of Pretend Play Production

Many different stage models have been proposed to describe the development of pretend play (Corrigan, 1987; Nicolich, 1977; Ungerer, Zelazo, Kearsley, & O'Leary, 1981; Watson & Fischer, 1977). Though all these accounts differ in some aspects, they converge in highlighting three developmental trends that are reliably observed (Rakoczy, 2003), namely (1) decontextualization, (2) decentration and (3) integration/sequencing.

4.1.1. Decontextualization

Children become more flexible in their object use in pretense; they move from using realistic objects (replicas) in object substitution pretense to more abstract objects. This process through which the behaviors and objects used in pretense become increasingly detached from their real-life referents is called decontextualization (Flavell, 1985). Although decontextualization occurs in various forms of pretense, object substitution pretense provides the most intuitive example: a toy phone (replica object) that is used in place of a real phone is less decontextualized than a wooden block used as a telephone. Further development becomes apparent in the use of one's own body parts in objects substitution pretense. Whereas younger children tend to use their index finger as a substitute toothbrush, older children would rather pretend to hold an imaginary toothbrush in their hands (Suddendorf, Fletcher-Flinn, & Johnston, 1999). Decontextualization is also of particular importance when it comes to object substitution pretense, hence in section 6.3 on development of object substitution, this issue will be elaborated in more detail.

4.1.2. Decentration

Children grow more and more capable of including other pretend actors into their pretend scenarios. Watson and Fischer (1977) found a developmental sequence in 14- to 24-month-old children which begins with simple pretense actions the child exerts on herself (i.e. pretending to sleep on a pillow). Older children then include a passive other (e.g. a doll sleeping on the pillow) who then also becomes more alive and fulfills own action (e.g. the doll cries after waking up on the pillow). Decentered acts directed toward inanimate as well as animate or lifelike objects were observed to emerge around 19 months (Fenson & Ramsay, 1980).

4.1.3. Integration / Sequencing

Gradually, simple pretense actions are extended and structured into more and more complex sequences. When at first, an 18 month old just holds a cup to her lips and pretends to drink, more sophisticated pretenders would first pour some imagined tea from a teapot, stir in some non-existent sugar and then pretend to drink. Fenson and Ramsay (1980) studied children from 13 to 24 months of age and found simple sequences with repetitions of the same theme to emerge at around the same age as first decentered acts have been observed (i.e. 19 months). Coordination of two different acts did not emerge before 24 months of age.

4.2. Early Emergence of Pretend Play Production

As the focus of the current work is on very early pretense, it is highly interesting when pretend play first occurs in ontogeny. Many studies cite that somewhere between 18 and 24 months is the starting period (Leslie, 1987; Piaget, 1951) although some studies found first signs of pretense already at 13 to 15 months (Fenson & Ramsay, 1981; Morrissey, 2014; Tamis-LeMonda & Bornstein, 1994; Walker-Andrews & Kahana-Kalman, 1999). As apparent from section 2.3, some defining characteristics of pretend play are still debated upon. Thus, theoretical positions also determine whether early actions that look like pretense are classified as true pretend actions. McCune (1995) proposes a developmental sequence for representational play that starts with pre-symbolic actions on a first developmental level. Lifting a cup to the mouth and shortly touching it with the lips would be one such pre-symbolic action. But only when it is apparent that the child links the play act and its real counterpart (e.g. by sound effects, facial expression), the action is classified as pretending (i.e. level 2 – self-pretend). Others adopt more conservative criteria (e.g. Tomasello et al., 1999) and argue that when lifting a cup to the mouth, the child is simply doing what she saw others doing with this object; without any symbolic preposition. In any case, observational and experimental studies indicate that in the second half of the second year, at the latest, simple forms of pretend play are observable in most children (Bretherton, O'Connell, Shore, & Bates, 1984; Haight & Miller, 1993; McCune, 1995; Rakoczy, 2003).

Some behavioral signs have widely been used to mark the first true pretend actions: These are: (a) performing actions in a non-serious but coordinated way, (b) without fully completing these actions, (c) accompanying corresponding activities with verbal comments, appropriate sound effects and exaggerations. With truncated movements revealing that they do not really want to perform the "real" action, children indicate that true pretense is underway. For example, a child lifting an empty cup to the mouth, throwing her head back and making slurping sounds is clearly pretending to drink.

Some early precursors may smooth the way for such proficient, later forms of pretense, as illustrated by the following example: A twelve-month-old boy feeding his father with pieces of cereal and then, just before the food reaches the adult's mouth, retracts his hand and eats the food himself, thereby holding eye contact with the father and smiling mischievously (own observation). With this behavior, also called '*teasing*', the infant possibly displays first signs of pretense capabilities. From Lillard's (1993b) definition of pretense (see section 2.2), we can derive that an action first has to be learned properly before one can pretend to act it out, e.g. by intentionally interrupting that action. Children encounter feeding actions and handing objects frequently from early on. Holding an object out for another person and then pulling it back has been observed in children around their first birthday (Reddy, 1991). These teasing actions have been interpreted to show children being aware that they can violate the conventional course of a given action.

Thus, teasing, which also displays early signs of humor, is suggested to be a precursor of pretending. A few studies have teased children experimentally, e.g. by keeping them from taking a desired object (Charman et al., 2000) or by being unwilling to hand the object (Behne, Carpenter, Call, & Tomasello, 2005). The latter study has shown that 9-month-old infants were able to differentiate between the experimenter being unwilling versus unable to hand a toy, while 6-month-olds were not. Charman et al. (2000) aimed to investigate whether children's reaction to the teasing experimenter would relate to later pretend play, but this relation did not show in their results. However, in these studies, understanding of teasing was used as dependent variable. As production of pretense precedes understanding, possibly the production of teasing rather than the response to teasing would be a more valuable matter of investigation.

When asking for the very early beginnings of pretend play production, one naturally comes across the question of how pretend play is initiated in the first place. Does it emerge spontaneously as an invention of the child or is cultural learning from others crucial for pretend play to be initiated? The debate on this question has been shaped by Piagetian individualism and Vygotskian culturalism (Rakoczy, 2003) which will be covered in the following section. Recent research on pretense markers as used by mothers to delineate pretense from true actions will be considered as contributing evidence to this debate. Also, the apparently differential development of pretense production and pretense understanding has contributed to this debate, a matter that will be discussed subsequently in section 5 on the development of pretense understanding.

4.3. Origin and Initiation of Pretend Play - Piagetian Individualism and Vygotskian Culturalism

The following section is concerned with the origin of pretend play in young children and which role social interaction and modeling play in initiating pretend play production. Piaget held the view that pretense is an asocial activity and ludic symbols are not constructed in social interactions (Piaget, 1951). Piaget's developmental theory revolves around his concepts of accommodation and assimilation. In assimilation the world is assimilated to the ego, while accomodation means that the ego is adapted to the world. The aim of intelligent development is to reach equilibrium between these two. However, as development is still underway, one of them typically dominates a process in a specific domain (see Figure 2).

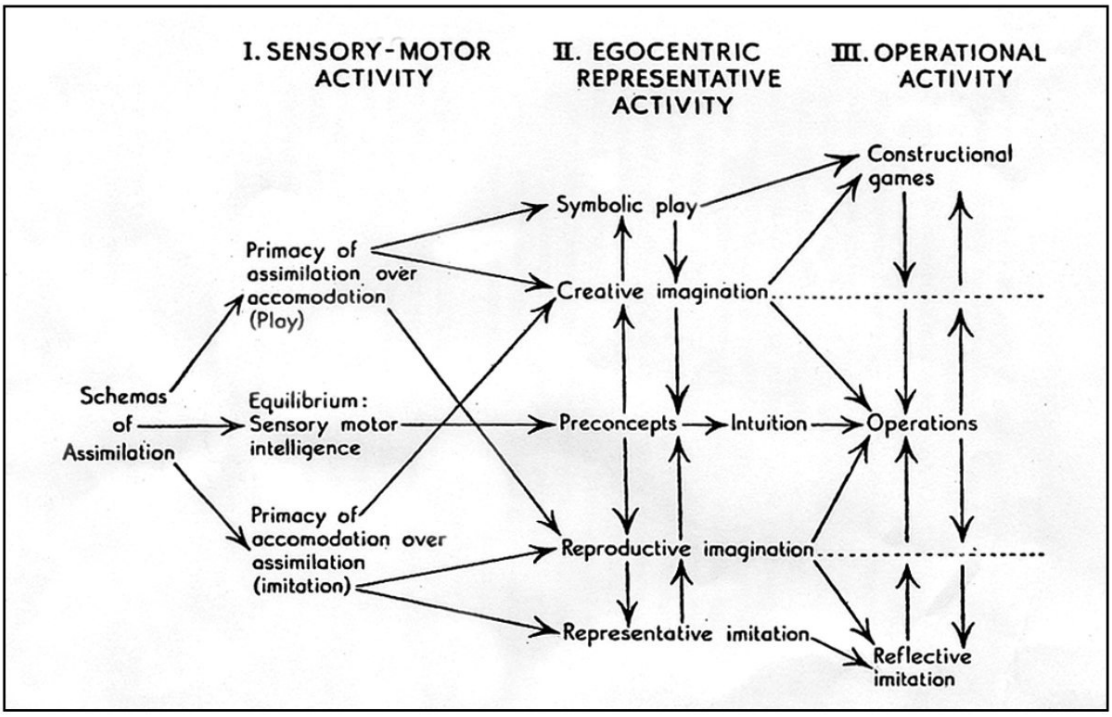

Figure 2. Development of imitation and play according to Piaget (1951, p. 1).

For Piaget, play reflects a domain which is characterized by primacy of assimilation over accomodation. Imitation, on the contrary, is characterized by primacy of accomodation over assimilation. Imitation is purely social: the child imitates others' actions but is not able to flexibly apply them to new circumstances. Accomodation (the child adapting to the world) is the dominant process. In contrast, play reflects childhood egocentrism: The child exhibits more and more flexibility in extending action schemata to new objects. This extension first comprises rolling not only balls but every object that is round (oranges, apples). Later in the second year, however, extending action schemata leads to the use of objects in a clearly inappropriate context (e.g. pretending to sleep in the bathtub).

Thus, Piaget considers pretending "as a defective form of reality orientation" (Rakoczy, 2003, p. 22) which reflects that the child has not yet developed a solid conception of reality. As soon as this conception is acquired, Piaget assumed children to cease engaging in pretend play. Piaget thought of play as the opposite pole to the social mode of imitation, hence he viewed it as an essentially unsocial activity. Therefore, the individual child's imagination and creativity are supposed to be the sources of early pretense acts, while social interaction and imitation do not matter. Solitary pretense is supposed to precede joint pretense. Actually, Piaget's theory does not explain how children come from solitary to joint pretense – which requires some form of understanding other's pretense.

This Piagetian individualistic view dominated the field for a considerable time, which might also explain why in many early studies, social interaction was not considered relevant (Lillard, 2015). In a widely cited review by Fein (1981), the author states that "It is very unlikely that parents play pretend games with their young children or model such games" (Fein, 1981, p. 1106). Studies that used observation of solitary pretense (e.g. McCune, 1995) were taken as indicative that pretense develops from within the child. Fein (1981) concluded that there was little evidence for adult modeling playing a major part in the initiation of pretense, thereby speaking against earlier claims which stressed the importance of social factors (El'Konin, 1966, cited in Haight & Miller, 1992). These claims were made by representatives of Vygotskian culturalism, which will be covered in the following.

In contrast to Piagetian individualism, Vygotskian culturalism stresses the role of social interaction as the primary context for the emergence of pretense, mainly expressed by one of

Vygotski's students, Daniil El'Konin. According to this theoretical approach, early pretending develops mainly through adult modeling and imitation. Therefore, it is postulated that children's early pretense is object specific: They imitate pretense actions with the very same objects they have seen adults do it. Children gradually develop the capacity to disengage from the socially initiated, fixed function of objects and to engage in object-substitution pretense. The Vygotskian perspective does not view this distortion of reality as an expression of a still immature conception of reality. Instead, pretend play draws on themes from reality. Thus it is not to be seen as a process of assimilation (the child altering reality for her own needs) but rather serves as a means of practicing issues of everyday life (Rakoczy, 2003).

As the Vygotskian account on pretend play became more prominent, the social context in which pretend play emerges came into focus (Lillard, 2015)[1]. Today, many studies have stressed the important role that adult modeling plays in initiating pretense in young children. Kavanaugh, Whittington, and Cerbone (1983) found that American mothers pretend in front of their 7-month-old children. Haight and Miller (1993) followed and filmed nine children with their mothers over a period of 36 months. All of these mothers already showed pretend actions when playing with their 12-month-old children, even though half of the children did not pretend themselves at that time.

Numerous studies suggest that adult modeling enhances children's pretense behavior (Bretherton et al., 1984; Jackowitz & Watson, 1980; Ungerer et al., 1981; Watson & Fischer, 1977). Empirical evidence for pretense varying over different cultural backgrounds (Carlson, Taylor, & Levin, 1998; Gaskins, 1999; Göncü, Tuermer, Jain, & Johnson, 1999) also strengthens the position that social influences play a dominant role in pretense initiation and development.

Striano, Tomasello, and Rochat (2001) have shown that in children below two years of age, most pretense with objects is either a direct or deferred imitation of adults or is instigated by adult verbal instructions. The authors suppose that 2-year-old children would not invent pretense by themselves, at least not at such a young age. Based on these findings, the theoretical position of pretense as instance of collective intentionality evolved, which mainly draws on a Vygotskian Cultural Learning theory (Tomasello, Kruger & Ratner, 1993; Tomasello, 1999a, 1999b). In

[1] This is probably mainly due to Vygotski's main focus on social interaction for learning, as indicated i.e. in scaffolding. However, Göncü and Gaskins (2011) denote that Vygotski, just like Piaget, saw symbolic play as primarily individual and not as fundamentally social and cultural activity.

section 2.2, when defining pretense, this account and its assumptions on intention understanding in pretense have already been presented. For ontogeny issues, it just remains to be said that this theoretical position again stresses the impact of social factors for acquiring pretend play. The ‘social orientation’ of recent research on pretend play has also brought forth a new line of studies investigating mother’s pretense modeling and its role in initiating pretense. Insights from this research will be presented in the following, to illustrate when and how parents start to introduce children into pretense.

4.4. Pretense Markers

Parents use so called ‘pretense-markers’ when pretending with their children. Earlier studies on context specific interaction behavior of mothers found them to use a higher pitched voice and special interaction frames in pretend play (Reissland, 1998; Reissland & Snow, 1996). Lillard and Witherington (2004) had mothers engage in a real and a pretend snack situation with their 18-month-old children and compared behavioral cues displayed by the mothers. These scenarios differed in several important ways. Mothers looked more at the children when pretending. When really snacking, the focus was more on the food. Smiling was observed more frequently and was of longer duration during pretend snack, some of these smiles could even be considered as ‘false smiles’ (Ekman & Friesen, 1982). The timing of the actions differed between scenarios, with most actions happening more quickly in pretense, others were prolonged (e.g. filling the cereal into the bowl). Movements were also exaggerated in space. Mothers talked and produced more sound effects when pretending.

Lillard and Witherington (2004) also investigated the relation between mother’s behavior and child engagement in pretend play. Children of mothers who smiled and looked more at them participated more in pretense. In a later study, Lillard et al. (2007) asked whether mother’s behavior in pretense changed with the age of the child in order to adapt to growing pretense competencies. Surprisingly, this suggestion was not confirmed. Nevertheless, the study extended previous findings: Using the Computer Speech Laboratory, higher pitch variability was found in pretense than in true snack situations. Results on children’s engagement in relation to mothers’ smiling and gazing replicated those of Lillard and Witherington (2004). Summing up, mothers have many different tools available to mark pretend actions for their children, and children show early sensitivity for these pretend markers. This may on the one hand help them to distinguish real from pretend actions, but also to learn about the pretend actions themselves. Both assumptions again underscore the importance of early social interaction in acquiring and refining pretense capacities.

Recently, the distinction between producing own pretense acts and understanding pretense in others has become more and more prominent. Fostered by the interest in early theory of mind capacities, mental processes behind the conception of other's pretense acts come into focus. In the current study, we are concerned with early pretense acts that are elicited via modeling. We refer to findings suggesting that "children do not blindly imitate in play what they do not understand but rather demonstrate the behaviors that they can comprehend and control" (Jackowitz & Watson, 1980, p. 545; McCall, Parke, et al., 1977; see e.g. Watson & Fischer, 1977). To pin down what children actually conceive when they see other's pretense, the following section will illustrate the development of this understanding.

5. DEVELOPMENT OF UNDERSTANDING PRETENSE IN OTHERS

"…understanding of a pretense episode requires that children go beyond a literal encoding of the person's actions and remarks to construct a coherent representation of their nonliteral content"

-- Harris et al. (1993, p. 2)

In many developmental fields, comprehension precedes production, like it is the case for language development (see e.g. Bergelson & Swingley, 2012). In pretend play, however, the situation seems to be reversed: When asked about pretense in others, children seem to know much less than one would conclude from observing their pretense behavior. Of course, understanding of pretense can take different levels of sophistication and there is high consensus that an adult-like understanding, as depicted in the citation above, evolves relatively late. This section will outline the development from an early sensitivity for pretense acts in others through to an elaborated mentalistic understanding.

5.1. EARLY SIGNS OF SENSITIVITY FOR PRETENSE IN OTHERS

Onishi et al. (2007) used a violation- of-expectation task with infants as young as 15.5 months – which is the earliest age at which pretense understanding has been investigated so far. An experimenter filled one of two empty cups with imaginary liquid and then either drank from this or the other cup that was still 'empty'. Infants were surprised in this latter case, which possibly indicates that even at this young age, infants can recognize pretense in other people. Bosco et al. (2006) investigated a sample of children between 15 and 26 months and had them act according to pretend propositions. For example, they offered them a glass of imaginary water and asked them to (pretend to) drink from it. On the simplest tasks, even the youngest children did succeed. The authors concluded that children begin to understand pretense at 16 months of age. Such findings elicited heated debates. With respect to the study by Onishi et al. (2007), for example, it was speculated that children may just keep track of events and the objects involved -

which does not necessarily imply that children are interpreting pretense intentions (Lillard, 2015). Onishi's findings may demonstrate that sensitivity for pretense in others can be observed in toddlers as young as 16 months of age, but there seems to be broad consensus that a more sophisticated level of understanding, including pretense reasoning, can first be ascertained at about two years of age, as indicated by the studies discussed in the following.

5.2. Early Pretense Reasoning

Converging evidence exists that at around two years of age, children display a minimal understanding of pretend play actions (Harris et al., 1993; Walker-Andrews & Harris, 1993; Walker-Andrews & Kahana-Kalman, 1999). The tasks in these studies are similar to the one used by Bosco et al. (2006) mentioned above, but have a higher complexity for the older subjects. Children are presented with a pretense scenario involving a certain pretense proposition, and they are asked to act according to the proposition or describe what happens in the pretense scenario. The experimenter would, for example, suppose that a wooden block was soap which they could use to wash a teddy. Children around 24 months of age proficiently followed this pretense scenario and acted upon it (Harris et al., 1993, study 1). They thus displayed minimal pretense understanding, made a practical inference from the pretense proposition (I can wash the teddy with the soap) and distinguished their pretend play representation from reality, as they were not looking for real water (Rakoczy, 2003).

At 25 to 30 months they even managed to follow whole pretense sequences in which one object had different identities in every new scenario (Harris et al., 1993, study 3 and 4). They were also able to infer pretense propositions from pretense actions and use these for their own pretense reasoning. Upon imaginary tea to be spilled on the table, they correctly reacted by wiping the table, for example (Harris et al., 1993, study 5). Between 22 and 32 months, children have also been shown to proficiently keep track of several transformations in a pretense scenario. They handed the ‘full’ cup, when the experimenter had filled two cups and drank from one already (Walker-Andrews & Harris, 1993). Strikingly, older two-year-olds do not only act according to pretense propositions, but also describe their content (i.e. which of the cups is full/empty) quite competently (Harris et al., 1993, study 6 and 7). What these studies indicate is that two year-olds can keep track of pretense scenarios and can productively and systematically reason about their content. This can be considered as first instances of counterfactual reasoning, which is quite remarkable as even four- to six-year-olds find these tasks very hard in a non-playful context (Dias & Harris, 1990 as cited in Rakoczy, 2003).

Even though it seems impressive how well children can follow pretense acts and make correct inferences, these studies fall short in one aspect: They did not require the children to contrast the pretense proposition with reality. It seems comprehensible that the children kept track of this distinction implicitly, as they did not use real water to wash the teddy, for example. Nevertheless, one could critically argue that possibly, they just assumed that the pretense scenario was real for the time being. They may simply switch back and forth between pretense and reality perspectives, but not yet be able to take both perspectives in parallel (see e.g. Perner, Stummer, Sprung, & Doherty, 2002). Studies on pretend-reality distinction address this problem. They strive to give insight into when and how children are capable of taking two perspectives in parallel. In the studies presented first, children were asked explicitly on their pretense understanding. Subsequently, some findings will be presented that indicate an implicit understanding emerging somewhat earlier in development.

5.3. Pretense-Reality Distinction

Flavell, Flavell, and Green (1987) undertook the most straightforward test on children's distinction between reality and pretense: They asked three-year-olds about the real and pretend identities of a sponge that an adult pretended to be a truck. Results indicate that older three-year-olds distinguish well between these two identities. Verbal responses were correct most of the time, stating that the object really and truly was a sponge and that the adult only pretended that it was a truck. Interestingly, this task was easier to solve for young children than a structurally similar appearance-reality task (see also Harris & Kavanaugh, 1994; Lillard & Flavell, 1992).

By three years of age, children also understand that pretend and real entities differ. Wellman and Estes (1986) found 3-year- olds to answer correctly when asked whether people can act physically on real versus pretend entities. They stated for example that only a real and not a pretend cookie could be touched or seen. With a more language-independent and thus also more implicit test, Custer (1996) showed that three-year-olds can also reason about the content of other's pretend abilities. Children were presented with a story about a protagonist who held a pretend representation that contradicted reality. More specifically, he pretended that there was a fish on the rod whereas - in reality -, there was a boot hooked on the rod. When children were then asked to choose one of two pictures – one depicting a shoe, the other a fish on the rod - they mastered this task, whereas an analogous belief task was much more difficult for them. Custer (1996) explains this disparity with the higher complexity of false belief understanding: These are mental representations that *are taken to correspond to reality* – while in fact, they contradict reality. Pretend representations, on the other hand, are not supposed to correspond to reality (see also Woolley & Wellman, 1993). This also relates to the issue of denoting and non-denoting symbolic acts (see section 2.4.1). Apparently, it exacerbates the task when a reference to the real state of affairs has to be undertaken (Rakoczy, 2003).

At around three years of age, children are also able to understand that different people can pretend different things, and that other's pretense can differ from what they pretend themselves (Hickling, Wellman & Gottfried, 1997; Bruell & Woolley, 1998). In a study by Hickling, Wellman, and Gottfried (1997), the experimenter pretended that there was chocolate milk in a glass, in the presence of a subject and a puppet. They then "drank" the milk in the absence of the puppet. Children correctly answered that the puppet would still pretend that the glass was full when returning. Sometimes, however, children up to the age of six might still experience temporary pretend-reality confusions. Bourchier and Davis (2000) had their 2 and 5 – 6 year-old participants engaged in pretending that in one box, there was a monster and in another, there was a friendly animal. Even the six-year-olds tended to avoid the 'monster box', even though they state to know that nothing is in the boxes.

So at the age of three, converging evidence accredits children the ability to correctly distinguish between pretense and reality in many aspects, though in some exceptional cases they still show signs of confusion. Rakoczy et al. (2006), argued against the background of the cultural learning account (see section 0) that with more implicit tests, even younger children might demonstrate an understanding for pretense-reality distinctions. They sought to parallel research that attested infants as young as 18 months with an implicit intentional understanding by probing their responses in the re-enactment task of failed attempts (Meltzoff, 1995). Even if explicit (i.e. verbally expressed) comprehension of intentions emerges much later, children seem to account for intentions of others at the behavioral level much earlier. Thus more tasks were requested that ask children to choose between *acting* according to the pretense or the real proposition of a certain scenario.

In one such study (Rakoczy & Tomasello, 2006), children saw an experimenter either *pretending* or *trying* and failing to perform a certain action (e.g. writing with a pencil which was still capped). 27-month-olds and to a certain degree even 22-month-olds reacted differently in the two situations: After the pretend model, they also pretended more, after the trying model, they tended to perform the action properly (e.g. by uncapping the pencil of the experimenter). This differential sensitivity ought to show an emerging understanding for the intentional structure of pretense acts, which is a first level of mentalistic awareness.

In sum, studies on pretense understanding thus indicate that children are sensitive to pretense actions at 15- to 16-month-olds (Onishi et al., 2007). Around two years of age children show early pretense reasoning capacities (Harris et al., 1993), and at three years of age, they reveal a corresponding understanding even when pretense is pitted against reality scenarios to probe whether children are able to distinguish between the two (Wellman & Estes, 1986). Children become even more proficient with age to succeed in tasks of increasing complexity on that matter, even though some cases (e.g. a monster in transparent box), can still cause confusion (Bourchier & Davis, 2000). More implicit tests have the potential to reveal such capacities somewhat earlier (Rakoczy & Tomasello, 2006).

Having explored the early developmental steps children master on their way to producing pretense acts themselves (Chapter 4) and understanding such acts in others (Chapter 6), we will now turn to object use in development, as the focus of the current work is on pretend play with objects, and specifically, object-substitution pretense. To eventually arrive at this mature form of object play, infants first start to explore objects (developmentally as well as situationally). The forthcoming section hence elucidates this journey from early exploration to later proficient pretend play with objects. What has been illustrated here in the context of pretend play in general will be applied to pretend play with objects.

6. Object Use in Development – Exploration, Representational Play and Object Substitution

"Adults can learn a great deal about young children's development by watching them play with toys or other objects."

--Vig (2007, p. 201)

Playing with toys or other objects appears to be an important activity for young children. In Piaget's theory (see also section 4.3), cognitive development is rooted in sensorimotor interactions with objects (Pellegrini, 2013). In western cultures, when adults engage in object play with infants, they aim to link the infant to the world of non-personal objects and the physical environment. The focus typically lies on shared extradyadic attentional processes (Keller, 2007). As parents, we are thrilled when our baby understands that we are both relating to an object and refer to it together. These instances of joint attention are perceived of as important step in socio-cognitive development (Bakeman & Adamson, 1984) and of course, object play is at the heart of this phenomenon. Also, object play is seen as initiating and supporting the development of metacognitions and thus is expected to foster cognitive growth and disengage the infant from the dependency on social relationships.

Against this background, it is reasonable that the levels of sophistication a child displays in object play is assumed to offer an important 'window on development' – as is also expressed in the citation above (Vig, 2007). Especially when it comes to symbolic understanding and symbolic use of objects, such play behavior can be extremely informative. It should be noted, however, that these considerations are very culture specific. In cultures apart from typically western cultures that stress independent development, object play occurs less frequently and is less central to caregiver-child interactions. This will naturally influence the developmental course of play with objects (see Keller, 2007 for an overview). To specify different forms of object play in western cultures, a developmental outline of play with objects will be given.

6.1. Development of Object Play

Playing with objects is central for Piaget’s sensorimotor stage of development. Thus, early object play is often subsumed under sensorimotor action or sensorimotor play. Several scales have been developed to describe manipulation of objects in early sensorimotor development (e.g. Uzgiris, 1975, McCall, 1974, Weisler and McCall, 1976; Fenson et al, 1976; Zelazo, 1980; Nicolich, 1977). These scales denote early behavior to be exploratory and undifferentiated - the action is not specific to the object manipulated. In this period, "the object is what I do" (McCall, Eichorn, Hogarty, Uzgiris, & Schaefer, 1977, p. 64). On a behavioral level, mouthing is predominant at 2 months, followed by visual examination at 3 months. With 4 months, infants start to hit objects on surfaces and one month later also shake objects. At 6 months, infants examine objects visually and manually, and at 7 months of age, infants begin sliding, tearing and pulling objects. Dropping and throwing objects follows at 8 to 9 months. These different sensorimotor actions can, after their emergence, also be shown at later stages of development – thus, 7-month-olds still explore objects via mouthing (Ruff, 1984).

Later, when finger dexterity and fine motor coordination improve, behavior is more and more tailored to fit the features of the object, following the question: “What is this and what can it do?” (Weisler & McCall, 1976, p. 493). For example children would try open flaps, press buttons or slide cars and not balls any longer. The focus lies on discovering the functional properties and physical characteristics (Vig, 2007). Finally, during the middle part of their second year, children move beyond the mere discovery of sensorimotor and functional characteristics of objects and instead use them representationally. At this point, behavior focuses rather on play and not so much on exploration any longer, guided by the question: “What can I do with this object?” (Weisler & McCall, 1976, p. 494).

To distinguish between play and exploration, criteria of play need to be met, namely these are actions with means-over-ends orientation, occurring voluntarily in a relaxed field and are exaggerated, segmented and non-sequential as compared to functional behavior (Burghardt, 2011). Pellegrini (2013) therefore delineates object play from *exploration*, *construction* and *tool use*. Play differs behaviorally from exploration: While in play, children display positive affect, higher heart rate variability (HRV) and positive affect, exploration is characterized by suppression of heart rate variability which typically indicates higher task demands, low distractibility, and negative or flat affect (M. Hughes & Hutt, 1979). Exploration of objects precedes other forms of object use developmentally (Belsky & Most, 1981; McCall, 1974), as well as situationally: An object is explored first, followed by play with the object.

So even if early play is not yet representational, it still can be called play as long as it does not serve the mere exploration of the object's properties. A nine-month-old might first explore a building block via mouthing and touching, but then turns to play when banging the block onto the table for 10 minutes, thereby expressing joy over the sound she produces. However, the core of object play definitely is pretending with objects, and most research in this field is devoted to this form of play, which we will now turn to.

6.2. DEVELOPMENT OF PRETEND PLAY WITH OBJECTS

Development of pretense with objects follows the three main developmental trends already outlined in Chapter 4.1: decentration, sequencing, and decontextualization. First instances of pretend play with objects are self-related (autosymbolic) actions, approximately occurring between 12 and 18 months. Children for example pretend to drink from a miniature cup from a doll's china set. In contrast to earlier forms of play, the actions are now based on understanding their function (Vig, 2007). Object pretense becomes decentered as it develops: Objects are related to other agents, e.g. the doll will be fed with the bottle. As for sequencing, first, pretense revolves around one single object. Later, multiple objects are related in play, for example stirring food in a pot, then serving it to the doll and feeding the doll with a toy spoon. The most important developmental trend concerning the improvement of object play is decontextualization - children become less and less dependent on a certain context for pretending and thus also less dependent on objects to provide them with certain cues.

First, highly contextualized replica objects are used. As these toys were initially designed to be used in play, functional use and play are more or less tantamount for these objects. Pretending to drink from a doll's cup might thus not require much symbolic awareness yet (Striano et al., 2001; Tomasello et al., 1999). Some theorists have therefore delineated this form of play as 'functional play', which is characterized by the fact that objects are used according to their intended function (Belsky & Most, 1981). However, some theorists (e.g. Vig, 2007) have criticized this term upon its ambiguity. She rather labels object play of lower complexity as "representational" in contrast to "symbolical" (see also section 2.4 on the definition of object-substitution pretense).

More of true symbolic awareness is apparent in the first instances of object substitution – when one object is used as if it were something else (Bosco et al., 2006; Fein, 1981; Nicolich, 1977; Onishi et al., 2007). Object substitution is often considered to be a very early form of pretending (e.g. Weisberg, 2015) - probably because representational thinking cannot be questioned any longer. Piaget (1951) as well as Vygotski (1967) saw a special link between object substitution and the development of representational capacities. Vygotski states that through play, the ability to recognize that a present object can stand for an absent one is developed.

It has been a matter of debate whether early object substitution is truly symbolic in nature (Perner, 1991; Rakoczy, 2003; Tomasello et al., 1999) and also whether the term 'symbolic' really applies to pretend acts in general (see section 2.4.1). Symbolic awareness is one possible explanation for the course of events observable in the developmental sequence of object substitution. Early studies on object substitution did not refer to symbolic understanding in further detail. Here, the developmental course of object substitution will be outlined, adding to the picture sketched earlier by providing information about which forms of object substitution are first to emerge.

6.3. Development of Object Substitution Pretense

Children start to show object-substitution pretense towards their second birthday (Jackowitz & Watson, 1980; McCune-Nicolich, 1981; Pederson, Rook-Green, & Elder, 1981; Ungerer et al., 1981; Watson & Fischer, 1977). It rarely occurs before 19 months, although children this age already pretend with actual objects. At 24 months, however, about 75 % of children use substitute objects in their pretend play (Lillard, 2015). Hence, the time between 19 and 24 months seems to be a highly dynamic phase regarding object substitution development.

Children first use objects that are highly similar to their referents. Later, they also succeed in using substitutes that are more dissimilar and they manage to relate several substituted objects (Striano et al., 2001; Tomasello et al., 1999). Fein (1975) supposed that similarity facilitates object-substitution pretense because the mapping of a pretend identity onto a given referent is easier. Dissimilarity, on the other hand, interferes with mapping, rendering it more difficult (Fein, 1975; Hopkins, Smith, Weisberg, & Lillard, 2016). Relating several (dissimilar) substitutes seems to be highly challenging. In one of the earliest experimental studies on object substitution, Fein (1975) investigated this transition from simple substitution with replica objects to single and double substitution with dissimilar objects. She demonstrated how a plush horse drank from a cuplike cup (similar substitutes). In the subsequent trials, either the cup or the horse or both were substituted by dissimilar objects (e.g. a metal form for the horse). While nearly all children tested (93 % of 22- to 27-month-olds) succeeded to imitate with similar substitutes, imitation with dissimilar objects was harder: Only 79 % imitated when the cup was substituted, and 61 % imitated when the horse was substituted. Double substitution was even more challenging, only 33 % succeeded when both objects were substituted by dissimilar objects.

Note that in this study, object substitution was elicited via modeling. Producing substitute pretense without modeling develops later, between three and four years, as shown by Elder and Pederson (1978). They asked children from 30 to 42 months to pretend with several objects at different levels of decontextualization. Actions were not modeled for the children. The youngest age group (30-month-olds) only succeeded with objects closely resembling their referents (block of wood for telephone) and not with objects that had a different function (sauce pan for telephone). The older age group (42-month-olds) did not have problems with any of the substitution conditions and even managed to substitute with imaginary objects.

Objects can differ from their referents in various dimensions, however – e.g. in form (appearance of an object) and in function (conventional use of an object). The block of wood is similar in form, but it does not have a distinct function of its own. The saucepan, on the other hand, definitely has a special function typically associated with it. Earlier studies, like that from Fein (1975) and also from Elder and Pederson (1978), have been criticized for not differentiating the dimensions of form and function. Therefore, Jackowitz and Watson (1980) conducted a study exploring the different impact of form and function information. They used the more implicit test of modeling the actions to their subjects. Whereas sixteen-month-olds were only able to imitate an adult's pretend action when similar substitutes were used (i.e. a toy phone for phone call), 23-month-olds managed to do so even for most dissimilar objects (i.e. toy car for phone call). Form and function seemed to be equally facilitative, thus contradicting other findings. Elder and

Pederson (1978) found function to be more important than form, and still other studies suppose form to be more important than function (e.g. Boyatzis & Watson, 1993). In a recent study along these lines, Bigham and Bourchier-Sutton (2007) found form and function to be equally important, thus supporting findings from Jackowitz and Watson (1980). Bigham and Bourchier-Sutton (2007) presented different levels of decontextualization in object-substitution pretense to children ranging from three to eight years. The experimenter asked: "What am I pretending?". Children saw e.g. sawing actions either with a toy saw (similar in form and function) or a wooden spoon (similar in form, dissimilar in function) or a straw (dissimilar in both aspects). For both age groups, substitution with objects *similar* in *form* and *function* were easily accomplished. For three- to four- year-olds, all other substitute types were equally difficult. There was more variance among the older children, however. The task appeared to be most difficult when both *form* and *function* of the substitutes conflicted with the referents. A straw that is intended to be used for drinking is harder to substitute than a stick with no intended function. Conflict in form and function posed an even greater challenge than imaginary object pretense or body-part-as-object pretense (BPO), even though these forms were thought to occur later in ontogeny than object substitution pretense (see e.g. Jackowitz & Watson, 1980).

Findings form Tomasello et al. (1999) also indicate that BPO-substitution might be easier to understand than such complex forms of object-substitution pretense. Bigham and Bourchier-Sutton (2007) related children's special difficulties with the problem of triune representations (Tomasello, Striano, & Rochat, 1999, see section 0 for this issue). With ambiguous objects, a child does not have to consider the actual identity, either because it has none (as ambiguous objects have no set function) or because children do not experience any conflict when the referent and target object look similar. For this reason, ambiguous objects might be easier to use in object-substitution than objects with a distinct function known to the child.

To summarize the presented findings on the role of form and function for object substitution is difficult: Studies varied in whether they used modeling of actions or explicitly asked the children to produce object substitution on their own. No one study has directly compared production and comprehension using a within-group design. On these grounds, Hopkins et al. (2016) conducted an experiment that contrasted different levels of decontextualization in object substitution pretense, while also pitting pretense production and pretense understanding against each other. All 3- to 5-year-olds in this study performed at ceiling on a test of object substitute *production*, while pretense *comprehension* improved considerably from younger to older subjects. In contrast to Bigham and Bourchier-Sutton (2007), Hopkins et al. (2016) found that the function of a substitute object is more important for pretense comprehension than is the form. Objects similar in form but dissimilar in function were of intermediate difficulty for the children. This finding was interpreted to supports Fein's (1975) theory that some similarities deliver *clues* and thus facilitate the mapping of mental representations onto their substitutes, while dissimilarities render the task more difficult because they *interfere* with the mapping of mental representations. The interaction of the two finally determines the difficulty of the process (Jackowitz & Watson, 1980).

In conclusion, pretense with objects similar in form and function seems to be easiest for children and develops first. To substitute ambiguous objects seems more difficult and thus occurs some time later. Using objects / tools in a non-conventional way seems to be most difficult and is thus developed latest. Fein (1975) suggests that similarities deliver clues to facilitate mapping of mental representations on substitutes while dissimilarities interfere with a corresponding mapping. Later studies explored the relative impact of dissimilarities in form and/or function, suggesting function may be more influential than form.

The interference caused by dissimilarities in function is also addressed by Tomasello et al. (1999) who identified the 'triune representation problem'. This problem has been formulated in reference to the symbolic content of object-substitution pretense. By asking whether young children use objects as symbols, Tomasello and colleagues questioned the symbolic nature of early pretense acts. This takes us back to the question of when and in how far object substitution is symbolic in nature, which has been addressed in detail in chapter 2.4. Possibly, object substitution with functional objects is especially intricate when symbolic mapping is exacerbated by interfering true functional identities. Children might need a grasp of the arbitrary nature of symbols to master this problem – a theoretical assumption which is difficult to test, especially in very young children.

To master the triune representation problem, a multitude of cognitive skills might also be relevant. Children need to suppress the object's real identity (Hopkins et al., 2016). They are required to keep both the real and the pretended identity in mind (Amsel, Bobadilla, Coch, &

Remy, 1996). And they have to shift flexibly between behavioral rules that apply to the true and the pretense identities, respectively (Carlson, White, & Davis-Unger, 2014). *Executive Functions*, a set of higher order cognitive functions, are thought to enable the mastery of these tasks. Thus they have long been assumed to play a role in pretend play and especially in object substitution pretense. In the following chapter, these functions will be defined and their ontogeny during early years will be outlined. Subsequently, empirical evidence suggesting Executive Functions to be implicated in pretend play will be presented.

7. Executive Functions in Development

"Without the discipline to complete what one started and delay gratification, no one would ever complete a long, time-consuming task such as writing a dissertation, running a marathon, or starting a new business."

--Diamond (2013, p. 138)

7.1. Definitions and Theoretical Approaches

Controlling one's urges and impulses to organize flexible, purposeful, goal-directed behavior is highly relevant to meet every day's challenges. It is one of the earliest tasks society places also on their youngest members (Mischel et al., 2011; Moffitt et al., 2011, Jurado & Rosselli, 2007). Research suggests a set of behavior regulation processes which help us to meet these everyday challenges and have been subsumed under the term 'Executive Functions' (EFs). One aspect of EFs, termed 'self-control' by Diamond (2013), allows us to delay gratification and thus to keep working on a time-consuming task, as indicated in the citation above. Thus, self-control helps me right now to keep writing this thesis instead of doing something immediately rewarding (like going out for shopping or having some ice cream). I delay this gratification for the more distal and abstract reward of receiving my PhD – which I know now, is a challenging task for me, as we are typically 'creatures of habit' (p. 138).

Research interest in these behavior regulation processes has surged in recent years (Martin & Failows, 2010). In the current literature, we find high consensus concerning the definition of EFs – namely on the fact that all existing definitions are unsatisfactory (Zelazo & Müller, 2011). There exists no universally accepted, consistent definition of EFs nor of its components. Just like for pretend play, several conceptual debates exacerbate defining EFs. A comprehensive picture of EFs will not disclose itself from the definition alone; but a definition will nonetheless be helpful as a common ground to start from when illustrating the conceptual debates. So how can EFs be defined?

EFs is an umbrella term comprising many different processes (C. Hughes & Graham, 2002). Historically, the construct of EF has its roots in the observation of behavioral deficits in patients with lesions of the prefrontal cortex (PFC; Zelazo & Müller, 2011). From these observations, theorists compiled lists of partially overlapping deficits resembling each other in structure. Yet, definitions based on lists of observations instead of conceptual ideas face special problems, as well become apparent below. Some existing definitions will be reviewed here, leading to the working definition for the current investigation.

Some definitions suppose that EFs constitute a management system, helping us to override more automatic, prepotent impulses of body or mind (Albertson & Shore, 2008; Espinet, Anderson, & Zelazo, 2012; Garon, Bryson, & Smith, 2008). They allow consciously controlling thoughts and behavior directed toward a certain goal (Carlson, 2005; S. E. Miller & Marcovitch, 2015). Among different definitions, some agreement exists on the idea that EFs involve controlling one's actions (Martin & Failows, 2010). Target-oriented behavior, flexibility, adaptability, planning and impulse control are repeatedly mentioned across definitions (Bechtel, 2014). In the current work, we define executive functions in reference to Bechtel (2014) as processes of target-oriented flexible control and adaptation of thoughts, feelings and behaviors. They are mainly relevant in new, unfamiliar situations where automatic, habituated responses would not lead to adequate solutions. Instead, EFs help to modify these automatic impulses and thus serve the goal of behavior planning and adaptation.

EFs have been closely associated with maturation of the prefrontal cortex (Garon et al., 2008), a brain region which matures until adolescence. The numerous investigations concerning EFs (see Carlson, Zelazo, and Faja (2013) for an overview of the massive increase in publications in recent years), have shown that EFs are implicated in a whole variety of social and cognitive domains, namely children's social understanding and peer relations (Carlson, Mandell, & Williams, 2004; Carlson & Moses, 2001), cognitive adaptation (Bernier, Carlson, & Whipple, 2010), academic success in mathematics (Blair & Razza, 2007; Bull, Espy, & Wiebe, 2008) and reading abilities (Swanson & Ashbaker, 2000; Swanson, Xinhua, & Jerman, 2009; Wasserman, 2012), academic achievement in general (Latzman, Elkovitch, Young, & Clark, 2010; van der Sluis, de Jong, & van der Leij, 2007), and even financial success later in life (Moffitt et al., 2011). Especially relevant for the current work are the findings on the relations between EFs and pretend play, which will be discussed in further detail in section 7.3 below.

Given these wide implications, a thorough understanding of the structure and the development of EFs is indispensable. Several models exist about the theoretical conceptualization of EFs. And as different studies refer to different models, empirical findings are often hard to integrate. But especially for research on the development of EFs, such integration is of utmost importance. Therefore, a short overview of existing theories will be given, and subsequently, it will be stated which elements of these theories are most valuable to investigate developmental aspects of EFs and the relation between EFs and pretend play in early childhood, which is the focus of the current work.

Some theories are called '*narrowing accounts*', because they aim at simplifying EFs (Martin & Failows, 2010). They emphasize *one aspect of EF as defining feature*. Which skill is central varies between different accounts, from inhibition (Barkley, 1997) to working memory (Baddeley & Hitch, 1974) to the interaction between working memory and inhibition (Roberts & Pennington, 1996). This theoretical approach has been criticized as not accounting for the complexity of the construct with all the strategic and metacognitive processes involved (Zelazo & Müller, 2011). Furthermore, empirical findings (e.g. Lehto, Juujarvi, Kooistra, & Pulkkinen, 2003) report low correlations among different EF tasks. Additionally, clinical findings indicate that there is some dissociation in performance regarding different EF tasks. Some patients may fail one task (e.g. the Wisconsin Card Sorting Task commonly used to assess shifting performance) but be well able to succeed in a different task (e.g. the Tower of Hanoi, a typical planning task), which indicates that performance does not fully rely on a single underlying common basis (see Miyake et al., 2000).

A group of contrasting accounts is made up by so called *'widening accounts'* (e.g. C. Hughes & Graham, 2002; Ozonoff & Strayer, 1997) – they widen the concept of EF as they do not emphasize one central aspect. Rather, they focus on *multiple components*, which might be related or not (Martin & Failows, 2010). These accounts are consistent with empirical findings showing that inhibition and working memory may actually be independent processes (see e.g. Beveridge, Jarrold, & Pettit, 2002). Some of the widening accounts also leave room for the contribution of social interaction to EF (Martin & Failows, 2010).

The *cognitive complexity and control theory* (CCC; Zelazo & Frye, 1998; Zelazo, Müller, Frye, & Marcovitch, 2003) gives special credit to the complexity of the situation. Switching flexibly between different rules and response options is central, and growing reflective capacities are thought to allow for an increase in performance with age. Development of this theory was mainly based on investigations with the dimensional change card sort task (DCCS, see e.g. Zelazo et al., 2003). In this sorting task, subjects are required to attend to different dimensions of the stimuli to choose the correct response (see section 7.2.3 for further details). Dimensions are in conflict with each other. For example, red rabbits and blue boats have to be sorted either by shape or by color. When changing the rule, the previously attended dimension has to be ignored. Three-year-olds had tremendous difficulties in changing between sorting rules with conflicting sorting dimensions, even though they were able to sort according both rules when there was no conflict. Four-year-olds managed well to sort even with conflicting dimensions. Zelazo and colleagues supposed that older children were able to form a superordinate rule and integrate this in a hierarchical rule system. They are capable of representing rule systems like ‘when A is the case, x has to be sorted according to rule y’. With age, increasingly complex rule systems can be represented which allows for more fine-grained behavioral control.

An influential theoretical approach is the *‘unity-in-diversity-account’*, which combines narrowing and widening accounts. It can mainly be credited to Miyake et al. (2000). On the basis of their latent variable analysis, they suppose *an integrated framework of three skills*: Working Memory (WM), set shifting (SHF) and response inhibition (RIB). These three skills are dissociable but moderately correlated in older children and adults (Bernier et al., 2010; Carlson et al., 2014; Garon et al., 2008; Miyake et al., 2000).

WM stores currently relevant information and updates these continuously. SHF refers to flexibly changing from one well-established mental representation (mind set) to a new representation. RIB comprises suppressing dominant impulses in favor of alternative goals (Bechtel, 2014).

This componential structure has also been confirmed for school-aged children (Huizinga, Dolan, & van der Molen, 2006; Lehto et al., 2003). In most studies with younger children, only two factors were found: SHF and RIB formed one single component which was separable from WM (Lee, Bull, & Ho, 2013; Lee et al., 2012; M. R. Miller, Giesbrecht, Müller, McInerney, &

Kerns, 2012; Van der Ven, Kroesbergen, Boom, & Leseman, 2012). Some studies indicate that in preschool aged children, model fit was best when only one factor was supposed (see e.g. C. Hughes, Ensor, Wilson, & Graham, 2010; Wiebe, Espy, & Charak, 2008; Wiebe et al., 2011). This implies that the structure of EF becomes more differentiated with age (Brydges, Fox, Reid, & Anderson, 2014; Lee et al., 2013). There also exists evidence questioning this differentiation hypothesis (Howard, Okely, & Ellis, 2015). Studies with children between two and three years of age revealed moderate to nonexistent correlations between tasks targeting different aspects of EF (Carlson, Mandell, et al., 2004; Carlson, Moses, & Claxton, 2004; C. Hughes & Ensor, 2007).

Another theoretical approach to conceptualize EFs is to distinguish between different EF components, namely ‘hot’ and ‘cool’ EFs (Metcalfe & Mischel, 1999; Zelazo & Müller, 2011). Hot EFs are more implicated in regulating affect and motivation. They come into play when it comes to the four F’s, referred to by Stuss and Alexander (2000) as fear, flight, fight and procreative behavior. Cool EF is likely to be elicited by abstract, decontextualized problems. On the contrary, hot EF is requested for issues with high affective involvement, which demand flexible evaluations of the affective significance of stimuli (Zelazo & Müller, 2011). This distinction was derived from evidence on distinct patterns of activation on a neural level. Tasks involving a hot aspect, like cookies or gummi bears that children typically crave for (e.g. delay of gratification task, Mischel, Shoda, & Rodriguez, 1989) are associated with activation of orbitofrontal and limbic regions. These same regions are also implicated in emotion regulation and belong to the neural reward system. Tasks aiming at cool EFs rather elicit activation in the dorsolateral prefrontal cortex (Poletti, 2010; Zelazo & Carlson, 2012). Empirical evidence indicates that this distinction is useful (Metcalfe & Mischel, 1999). However, in very young children, it is difficult to tease apart hot and cool aspects, as rewards and motivational incentives (e.g. an attractive task context) are necessary to execute the tasks in the first place (Bechtel, 2014). In the following, I will focus rather on the three-component structure, though the distinction has to be kept in mind.

Overall, studies addressing the structure of EF in early development point to a lack of cohesion and stability of EF measures during early toddlerhood (see S. E. Miller & Marcovitch, 2015 for a comprehensible overview). Miyake and Friedman (2012) incorporated several of their own empirical findings (N. P. Friedman, Miyake, Robinson, & Hewitt, 2011; N. P. Friedman et al., 2008) to revise their initial model. For SHF and WM a common latent factor as well as an individual factor could be found. RIB, on the contrary, loaded on the common factor, but an individual latent RIB factor did not ameliorate the model. Whether this model also holds for younger age groups is not yet clear (Bechtel, 2014). It is thus advisable to keep in mind that the three component model of Miyake et al. (2000) is still disputed. The model can be very helpful to formulate precise research questions and provide a conceptual basis for empirical investigations (Bechtel, 2014).

Measurement of EF in the current work refers to the model of EF being composed of WM, SHF and RIB. We tested these components with different tasks and investigated possible correlations among task performance. As will be further elucidated in section 13.1, we used a variant of the 'hide the pots' task (Bernier et al., 2010) to assess WM in our own studies; a modified version of the dimensional change card sort (Zelazo, 2006) to test for SHF and an adaptation of the snack delay task (e.g. Kochanska, Murray, & Harlan, 2000; Voigt, Pietz, Pauen, Kliegel, & Reuner, 2012) as a measure of RIB.

7.2. EF – Development and Measurement

As apparent from the previous section, the definition of EF and its components is still a matter of debate. Particularly in early development, many questions remain unanswered. So far, EFs were measured with a variety of tasks, supposed to assess either different components or the common underlying factor. Tasks were quoted as typical for one component in one study, but were used to assess quite a different component in another study. The Tower of Hanoi, for example, is a pure measure of planning for Zelazo and Müller (2011), while for Miyake et al. (2000), it represents a measure of inhibition. EF tasks have to face the 'task-impurity problem' (Martin & Failows, 2010): Because each task is embedded in its special context, any EF process will implicate other cognitive processes in addition to executive ones (Miyake & Friedman, 2012; Miyake et al., 2000).

Measuring EF throughout development requires age-adapted testing. EFs in toddlers below the age of three have only recently become the focus of investigation. Hence, not many age-adapted tasks exist. The starting point for EF investigation in infants can be traced back to the 1980's: Adele Diamond tested 12 month old infants with the A-not-B task. This task has originally been introduced by Piaget (1954) to investigate the development of object permanence. However, Diamond (1985) interpreted the findings as indicating problems with carrying out an intention despite a conflicting habitual tendency– which actually means inhibition in terms of executive functions. Findings with recently implemented methods (e.g. EEG and preferential looking) corroborate this assumption: Activation during A not B task is increased in prefrontal regions (Bell & Fox, 1992) and eight-month-old infants tend to look at the correct location even if they are not able to grasp for the correct (e.g. Baillargeon & Graber, 1988).

Today, a range of tasks is available to test WM and RIB in infants and toddlers (see Carlson, 2005; Kochanska et al., 2000). It is still difficult to find shifting-tasks for young children (Garon et al., 2008), but the task developed by Bechtel (2014) and Pauen and Bechtel-Kuehne (2016) provides a promising first step in this direction. The following section will give an overview of tasks that are currently used to assess the different components of EF in children below school age. The main focus is on the tasks that were used as basis for the tasks implemented in the current investigation.

7.2.1. Working Memory

When an infant needs to keep in mind the location of a toy to retrieve it after a short delay, she uses her WM capacity, albeit in a very simple form. Some tasks measure this 'retention capacity' (e.g. the delayed-response-task, Diamond & Doar, 1989). However, empirical evidence suggests that this earlier skill can be delineated from a more complex variant: When information is not only kept, but also manipulated and updated (Alloway, Gathercole, Willis, & Adams, 2004; Gathercole, Pickering, Ambridge, & Wearing, 2004; E. E. Smith & Jonides, 1999). Simple retention is a necessary prerequisite for more complex processes. Some of the retention capacity develops before six months of age, while in the latter half of the first year, the number of items and the length of the retention delay increases (see Pelphrey & Reznick, 2004 for a review). In the literature on EFs, most testing refers to complex WM, also termed updating (e.g. Miyake et al., 2000). This also applies to the current investigation. Therefore, updating will be in focus here.

Updating is assessed, for instance, with adaptations of self-ordered pointing tasks. For the 'three-boxes' or 'scrambled-boxes task' (Diamond, Prevor, Callender, & Druin, 1997), a number of boxes (three or more) that differ with respect to their color and form are filled with a reward.

The child retrieves the first reward. The arrangement of the boxes is changed between search trials. To retrieve all rewards, the child has to keep in mind which box still contains a reward. Children from 15 months onwards have been tested with this task.

Another multi-location search task is the 'spin-the-pots task' (C. Hughes & Ensor, 2005). Eight visually distinct boxes are circularly arranged on a rotatable tray. In six of these boxes, a sticker is hidden as a reward. Before the child is allowed to search for the rewards, the boxes are covered with a scarf and the tray is rotated. To succeed, the child has to remember all locations that have already been searched. C. Hughes and Ensor (2005) used this task with two-year-olds. An adaptation of this task for younger children has been developed by Bernier et al. (2010) to assess WM in toddlers between 18 and 26 months of age. In their version, one sticker at a time is hidden in one of three visually distinct boxes. The boxes are stationary like in the 'three-boxes task', but before searching, children have to wait for a certain delay whilst the boxes are covered with a piece of cloth, like in the 'spin-the-pots task'. Three trials are accomplished and the sticker is hidden once in each box. This latter task thus differs from the previous in that only one box is baited with a reward (target box) per trial. Yet, the identity of the target box has to be updated from trial to trial.

Bechtel (2014) and Pauen and Bechtel-Kuehne (2016) have developed a task based on this latter 'hide-the-pots task'. In their version, one entity (a small wind-up toy) is hidden in one of three or one of six boxes. A delay is implemented by covering the boxes. However, the boxes look identical. Thus, the child has to remember the location to identify the target box. For the current work, we used this task variant (see section 13.1).

The capacity to manipulate and update current information develops tremendously during preschool years, as e.g. indicated by advancements in self-ordered pointing tasks during this period (see e.g. Hongwanishkul, Happaney, Lee, & Zelazo, 2005). Furthermore, Diamond et al. (1997) as well as Bernier et al. (2010) report improvements in their variants of the multi-location search tasks before the age of two. However, findings on early complex updating performance in infancy are still scarce and tasks that can be implemented longitudinally are still rare (Garon et al., 2008).

7.2.2. Inhibition

RIB is probably the most thoroughly investigated component of EFs. Considering the wealth of literature on this issue, we can only provide the reader with a short description of tasks that are relevant for the current investigation. As with WM, different levels of RIB are distinguished in the literature, namely simple and complex RIB (see e.g. Garon et al., 2008). Simple RIB describes the suppression of a dominant impulse, while complex RIB requires the application of some rule to exert control over behavior. In applying a rule, WM gets involved in the task, as this rule has to be remembered. Empirical evidence supports the distinction between simple and complex RIB (Carlson & Moses, 2001; Marsh et al., 2006; Murray & Kochanska, 2002). The ability for simple RIB starts to develop in the first year, as indicated by early performance in the ‘don’t paradigm’. When infants are asked to suppress a rewarding behavior, 8-month-olds succeed 40% of the time (Kochanska, Tjebkes, & Forman, 1998) while 33 month-olds manage to succeed the majority of the time (Kochanska, 2002).

Delay of gratification (Mischel et al., 1989) is the paradigm most commonly used to assess simple RIB in preschool years (Garon et al., 2008). The child has to suppress the impulse to immediately reach for a treat – either to get an additional reward (waiting tasks) or a larger reward (choice tasks) later. On both types of tasks, considerable improvement of performance was observed over the preschool period (Carlson, 2005; Lemmon & Moore, 2007). A variant, namely the ‘snack-delay’ task can already be implemented in the second year (22 months and up; Kochanska et al., 2000). A treat is placed in a transparent container in reach of the child. The child must delay the urge to eat the treat until the experimenter rings a bell to signal that the treat can be taken. Waiting times vary between 10 and 30 seconds. The snack-delay task differs from the aforementioned tasks in that there is no ‘benefit’ of suppressing the impulse, as there is no larger or additional treat when the child manages to wait. This simplifies the task and reduces the need for verbal instruction. The child possibly needs fewer resources to understand the instructions and to mentally represent some absent reward.

Measuring complex inhibition in children requires more verbal understanding. Children must understand and apply an arbitrary rule to control their behavior successfully. In the ‘bear-dragon’ task, for example, children have to perform a certain action when the bear advises them to do so, but not when the dragon advises them (Reed, Pien, & Rothbart, 1984). Between 3 and 5 years of age, children make huge progress in solving this task (Carlson, 2005; Carlson & Moses, 2001). Similar progress can be observed in a more advanced variant of this task, the 'Simon-says' task. Here, verbal instructions are only to be followed when preceded by the phrase 'Simon says…'; and in the 'tower' task, which is a turn taking game (Carlson, 2005). A modification of the 'stroop' task for adults (Stroop, 1935) is the 'day-night stroop' task for preschool aged children (Gerstadt, Hong, & Diamond, 1994). Children are asked to say 'day' upon seeing a picture of a moon, and to say 'night' when shown a picture of a moon. The 'head-toes-knees-shoulders' task represents a further very popular means of measuring complex inhibition (Ponitz, McClelland, Matthews, & Morrison, 2009). Children are first asked to point to the corresponding body part when it is named by the experimenter. After some trials however, the rule is altered and a different, incongruent body part has to be touched (e.g. shoulders upon the verbal cue 'toes').

It is conceivable that the representation and application of a verbal rule involves WM capacities. Thus, tasks on complex inhibition suffer more from the above mentioned 'task-impurity problem', while tasks on simple inhibition may represent a 'purer' measure of the inhibition component (Bechtel, 2014). Additionally, they work more reliably with younger toddlers than tasks that require much verbal instruction. On these grounds, a measure of simple inhibition, developed by Bechtel (2014) and Pauen and Bechtel-Kuehne (2016) was also chosen for the current investigation. It is based on the 'snack-delay' task mentioned above. The child is required to suppress the urge to eat cookies from a transparent bowl placed within reach on a table while the experimenter leaves the room for up to two minutes (for a detailed description see section 13.1).

7.2.3. Shifting

SHF comprises to disengage from a current mindset (e.g. a way of thinking about a stimulus) to engage in a new mindset (Diamond, 2013; Garon et al., 2008). Such a shift is necessary when the context changes and a previous rule is no longer valid. When the bed has been used as a steamboat in context of play (with rough and tumble elements), a child has to switch to a new set of adequate behavior (namely lying still) at bedtime.

RIB and WM skills are seen as important cornerstones of shifting abilities (Bechtel, 2014; Diamond, Carlson, & Beck, 2005; Garon et al., 2008): Relevant information needs to be updated, the focus of attention shifted, and impulses that correspond to dated information have to be inhibited. However, if other EF components are involved in shifting, how can it be delineated as an independent component? Especially complex inhibition that implies a rule change (e.g. touching incongruent body parts upon a signal) seems very closely related to shifting skills. Bechtel (2014) and Garon et al. (2008) point out that in shifting, an *arbitrary* rule is learned first, and then this rule is ignored to attend to a new one. In complex inhibition, on the contrary, this first rule is not arbitrary. It is rather a *dominant impulse to begin with* (e.g. touching a body part corresponding to its verbal label). For shifting, this dominant impulse is built up over multiple trials in a given task, e.g. when sorting stimuli according to a certain criteria. However, one can always argue about the distinction between simple and complex shifting since there are no clear criteria to decide whether a certain impulse is inherent or recently acquired.

In a laboratory context, shifting capacities in toddlers and preschoolers (from age three onwards) are often tested using the 'dimensional-change-card-sort' (DCCS) task (Zelazo, 2006; Zelazo et al., 2003). In this task mentioned in relation to the CCC-Account, bivalent test cards are presented, e.g. depicting rabbits and boats, either colored red or blue. Hence, they can be sorted either according to the color or to the shape dimension. The experimenter first explains the rule, and then asks the child to sort six cards according to this rule. The task comprises two phases. In the first 'Preswitch Phase', cards are sorted according to one dimension. In the second, 'Postswitch' phase, sorting according to the other dimension is requested. Three-year-olds mostly perseverate in this task, i.e. they keep sorting according to the first rule. Five-year-olds most of the time manage to shift to the new rule when they are told to do so (Zelazo, 2006).

Besides the DCCS, only few tasks exist to measure shifting in young children, especially for toddlers below three years of age. 'Reverse categorization' (Carlson, Mandell, et al., 2004) is one such task that can be applied from 24 months onwards. Children are first required to sort big objects into a big container and small objects into a small container. Following this, a 'silly game' is introduced by the experimenter. It involves putting the small objects into the big container and vice versa. Between two and three years of age, performance on this task increases tremendously. While only 20 % of two-year-olds manage to shift to the new rule, 85 % of three-year-olds manage to do so (Carlson, 2005). However, as the tendency to sort according to size might be dominant to begin with and is thus not acquired in the first phase of the task, reverse categorization is often seen as capturing complex inhibition rather than shifting (Bechtel, 2014).

Due to the lack of shifting tasks for young toddlers, Bechtel (2014) and Pauen and Bechtel-Kuehne (2016) have developed a simplified, three-dimensional version of the DCCS, which was also implemented in the current study (please see methods section 13.1 for a detailed description of the task). This task requires less verbal understanding and the three-dimensional set-up facilitates comprehension and renders the relevant sorting dimensions more salient.

The above outline of EF components and how they are assessed in development illustrates why we chose the respective tasks for our investigation. In the following, I will cover the implications of EF in pretend play, arguing why it is relevant to investigate both emerging capacities along with each other.

7.3. Implications of EF in Pretend Play

The relation between EFs and pretend play have long been discussed (Lillard, Lerner, et al., 2013), and research indicates that some kind of relation exists. The causal direction of this relation is not known to date. This issue will briefly be addressed before empirical evidence on the relationship is evaluated in the subsequent section.

7.3.1. Direction of Effects

In their frequently cited review on the effects of pretend play on development, Lillard and colleagues discuss three possible relationships between pretend play and other developmental outcomes. Pretend play might either be (a) crucial to optimal development; (b) just one path of many to achieve optimal development (equifinality); or (c) an epiphenomenon or byproduct of some capability, not contributing to development itself. As outlined in section 4.3, Vygotski (1967) supposes that pretend play is crucial for optimal development and promotes self-regulation skills. He assumes that pretend play is the activity by which children learn to separate referent from object. Children come to understand that meaning can be defined rather by the context in a given situation than by physical properties of an object. These latter properties and the affordances must be inhibited. Thus, children come to develop abstract thought and inhibition skills through pretend play (Vygotski, 1967). EF development is being promoted by exercising these skills in the realm of pretend play.

Piaget, on the contrary, did not view pretend play as a means of developing cognitive skills, but rather as an epiphenomenon of this development (section 4.3 describes this position in more detail). However, there is also good reason to assume that EFs are not an outcome of pretend play but rather support the development of pretend play. WM, SHF and RIB are still quite immature before preschool age (e.g. Garon et al., 2008), and this may contribute to toddlers' difficulties in thinking flexibly about artifacts, which might exacerbate tasks of object-substitution pretense.

Research still has to go a long way before answering the question of the causal relationship between pretend play and EFs. Even on a correlational level, clear relationships are not well established, and this seems to be a necessary precondition for conceptualizing high-quality training studies that have the potential to test causal effects. The following paragraphs summarize existing empirical findings on EF and pretense. Many studies have only investigated certain components of EF (e.g. inhibition); others have studied different components and found differential effects that are best interpreted in combination. On these grounds, the different components will not be looked at consecutively but rather, each study will be discussed separately, taking into account how the given author interprets the concept of EF and its components.

7.3.2. Implications of EF components in Pretend Play

WM refers to the ability to constantly update a given representation, while keeping track of more than one representation at the same time (Bechtel, 2014; Miyake et al., 2000). Amsel et al. (1996) investigated whether children (3- and 4-year-olds) represent true and pretend states of affairs together as a counterfactual proposition (i.e. this is a banana and this also is a telephone), or separately as distinct representations (real context: this is a banana; pretense context: This is a telephone), by examining 3- and 4-year-olds' memory for each state of affairs. They supposed that when children form one *single* counterfactual representation of an object, they should remember the true and the pretend identity of an object as soon as they remember the action performed in the pretense context (i.e. making a phone call). Results showed that children's memory for actions, and an object's identities in a pretend context, appeared to be unrelated, indicating that each identity is represented separately.

This suggestion is also supported by findings from Gordon and Olson (1998) from the domain of theory of mind (ToM) research. In dual tasks on ToM, three to five year-olds displayed WM performance to be highly correlated with the ability to simultaneously hold in mind different states of affairs (see also Olson, 1989, 1993). Several studies conducted with preschool and elementary school children support this finding for ToM tasks (H. L. Davis & Pratt, 1995; Jenkins & Astington, 1996; Keenan, Olson, & Marini, 1998). Based on these findings, Albertson and Shore (2008) speculated that WM skills are involved in managing multiple representations in pretend play as well. In object-substitution pretense, children have to quickly change between potentially conflicting answers and to correctly remember the new, atypical meaning of the object. On these grounds, the authors expected a strong relation between performance in object-substitution tasks and WM skills. To test this assumption, they investigated three- and four-year-old's memory of typical and atypical meaning of one object that was used in pretend play. Additionally, children were tested with a battery of tasks on complex inhibition (Carlson & Moses, 2001) and WM capacity.

Remembering at least one identity correlated with complex RIB and WM tasks. Remembering both identities only correlated with complex RIB. Albertson and Shore (2008) interpreted their findings as supportive of the claim that children represent both object identities (pretense/real) separately and that EFs are involved in managing these representations. In children below two years of age, the structure of pretense- and real-identity representation might differ. WM might therefore play a different role in children below 3 years of age – an issue that has not yet been investigated.

RIB has been assumed to play a crucial role in pretend play and especially in object-substitution pretense. A reason to assume that RIB is implicated in object-substitution pretense is that RIB skills emerge quite early, around the first birthday, as indicated by success on Piaget's A-not-B task (Diamond, 1985). Thus, some proficiency is already present when first object-substitution pretense occurs slightly later, at around 18 months. It is supposed that RIB skills allow for suppression of the true identity of an object in favor of the pretense identity (Hopkins et al., 2016). Concerning the mechanism, Tomasello et al. (1999) assume that children in their second year fail on object substitution because they cannot inhibit sensory-motor reaction schemes that are activated when they perceive an artifact associated with familiar schemes. RIB may thus be crucial to support the beginnings of symbolic play. Several studies with older children provide support for this idea.

A frequently cited study is that of Elias and Berk (2002), on the relation between socio-dramatic play and self-regulation, which is closely related to our conception of RIB. They observed socio-dramatic play in 3- and 4-year-olds and their self-regulation in two settings: clean-up and circle time. Sociodramatic play was related to later self-regulation in these settings, especially for high impulsive children. Results thus suggest that sociodramatic experiences foster self-regulation especially in these high impulsive children.

Kelly and Hammond (2011) conducted a study with a small sample of children ($N = 20$) between four and seven years of age. They administered a modified version of the Day/Night-stroop task (Archibald & Kerns, 1999) to assess inhibitory control. At this point it must be noted that this task would at least count for complex inhibition in the sense of the current working definition, if not even shifting skills are most needed for this task. Children first learn to say 'sun' in response to a picture card of a sun and moon in response to a moon picture. In a second phase, they ought to say sun in response to the moon card and moon in response to the sun card. This is based on the stroop-task for adults (Stroop, 1935), which surely is an inhibition task for them. Yet, it only becomes such a task because adults have an abundant routine in reading words, thus it is hard to ignore the semantic meaning of a word. It is a matter of debate in how far the response 'Sun' to a corresponding picture is such a prepotent response in young children.

Performance on this sun/moon-stroop task was correlated with pretend-play behavior in a structured situation, administered in the context of the Test of Pretend Play (V. Lewis & Boucher, 1997; V. Lewis, Boucher, & Astell, 1992) and percentage of time spent in spontaneous pretend play during a free play phase. The authors conclude that better inhibition is associated with higher production of pretend play, accounting for 16 – 30 % of the variance. Lillard (2015) notes, that the ToPP tasks itself might require response inhibition.

Carlson et al. (2014) investigated the relation between executive functions and pretense representation in preschool children. The authors applied impulse control tasks and conflict tasks. Impulse control tasks require that the child resists a tempting reward which elicits a well-established dominant response (e.g. cookies eliciting appetite). The authors found the impulse control task to be correlated with performing pretend actions. In conflict tasks, children learned a rule for solving a cognitive task (e.g. sorting cards according to one specific criterion). Subsequently, they were asked to apply a second rule instead (e.g. sorting cards according to a different criterion). This latter task corresponds to what is defined as SHF in the current work. Understanding a pretense-reality distinction was related to such SHF performance. In a regression analysis, Carlson and colleagues found that the understanding of pretense versus reality significantly predicted EF scores; the ability to perform pretend actions marginally predicted EF scores. This study thus indicates that inhibition and shifting are involved in pretend play.

Van Reet (2015) supposes that the early emergence of inhibitory control, shortly before toddlers show first instances of pretense, is indicative of its facilitating effect for pretense. In her study, 3- and 4-year-olds were tested on their pretend-play performance both before and after tasks of inhibitory control. The author was interested whether engagement in such tasks would alter subsequent pretense behavior. Conflict inhibitory control tasks were found to enhance ensuing pretense performance. Furthermore, when the pretense task was administered first, scores from this task correlated with conflict inhibitory control. Results thus indicate a relation between both skills. Again, conflict inhibitory control closely relates to what we conceptualize as shifting. In a second experiment with a different sample, Van Reet (2015) replicated the findings. Additionally, tasks for simple delay impulse control were given (Kansas Reflection Impulsivity Scale for Preschoolers (KRISP), Gift Delay, Tower Building, and Delay of Gratification). These tasks did not boost performance on subsequent pretense tasks, although some correlations with pretense performance were found. Possibly, delay and conflict tasks differ on an aspect that is of special relevance for pretense.

Hopkins et al. (2016) investigated 3 to 5-year-old’s pretense production and understanding of at different levels of decontextualization in an object-substitution pretense task. Additionally, they administered several EF tasks, e.g. grass/snow task (Carlson & Moses, 2001) as a measure of conflict impulse control, digit span (forward and backward, for working memory), head-toes-knees-shoulders (HTKS), and day/night. Half of the participants received these EF task before, the other half after the pretense task. The effect of EF on pretense production could not be evaluated because of ceiling effects in the pretense task. But the authors suggest that an effect might become apparent in a younger sample. On the other hand, in pretense understanding, there was no ceiling effect. Yet, the effect of EF on pretense understanding was inconsistent, as there was a complex interaction with age and with task order: Younger children seemed to benefit from higher EF scores, older children did not. Some children with lower EF scores outperformed children with higher scores. Furthermore, this effect was mainly made up by children who received the EF tasks first. The authors conclude that EF may not be as relevant for understanding pretense in others, because it is not necessary to inhibit own motor responses. This contradicts Carlson et al. (2014) who found especially understanding of pretense to be related to EF in four-year-olds.

Further insight on the issue of RIB being implicated in pretend play comes from research on ‘fantasy orientation’ – meaning the child’s individual propensity to engage in fantastical and pretense themes (Sharon & Woolley, 2004; Singer & Singer, 1992). Pierucci, O'Brien, McInnis, Gilpin, and Barber (2013) investigated this propensity with several measures. They found four-year-olds exhibiting high fantasy orientation to display better cognitive inhibition and attentional shifting skills than children with low or moderate levels of fantasy orientation. One exception was pretense as one component of fantasy-orientation (e.g. whether children pretend to be an animal or a person other than themselves). This latter component did not relate to any EF performance. Based on these findings, Thibodeau, Gilpin, Brown, and Meyer (2016) conceptualized an intervention study with 3- to 5-year-olds, investigating whether EF development can be fostered by engagement in fantasy-oriented play. This study responds to the call of Lillard, Lerner, et al. (2013) for systematic investigations of the causal role of play in EF development. In the intervention groups, children participated in either fantasy-oriented or non-fantasy-oriented pretend play with an experimenter or they did business as usual in the control group. EF was assessed using a forward digit span task for WM (H. L. Davis & Pratt, 1995), a day/night-stroop task for RIB (Gerstadt et al., 1994) and the DCCS for SHF (Zelazo, 2006).

Altogether, no significant difference in performance at post-test between the intervention group and the control group was detectable. However, after a five-week intervention period, WM and RIB skills in the fantasy-oriented play intervention group increased. In the remaining groups (a non-fantasy oriented play group and a business-as-usual control group) no such increase was observed. No change was observed for performance on the DCCS, possibly due to ceiling effects on this task. On a descriptive level, the authors note that certain types of imaginative behavior might be more beneficial for EF than others: Within the fantasy-oriented play-group, some children rather displayed a reality-pretense orientation (e.g. pretending to go to a restaurant) others displayed a fantasy-pretense orientation (e.g. pretending to be a fairy). This latter group of children performed better in the post-test WM task, suggesting that fantasy-oriented pretense is even more beneficial. Despite some limitations, these results permit first insight into causal relationships between play and EF. It is to be noted, however, that in both studies on fantasy orientation presented here, the *fantasy* aspect seemed to play a crucial role for EF. Possibly, it is these fantastical themes in particular that foster EF development, and not pretense per se.

To sum up, findings with toddlers and children up to 7 years of age are still inconclusive (Lillard, 2015), but first hints for possible relations can be found in the literature. Early studies indicated a relation between broad constructs, such as self-regulation and complex socio-dramatic play in a natural setting (Elias & Berk, 2002). Further studies systematically investigating the role of individual EF components in pretense brought more detailed insights, repeatedly emphasizing the role of RIB (Kelly & Hammond, 2011; Van Reet, 2015), but also that of SHF (Carlson et al., 2014). Some indications can also be found for WM (Albertson & Shore, 2008). However, inconclusive results on the relation have also been attained (Hopkins et al., 2016). With focus on fantasy orientation which has shown to relate to EF in certain aspects (Pierucci et al., 2013), a training study has already been implemented, which has yielded mixed results, however (Thibodeau et al., 2016). The authors argue that there may be a distinction between fantastical and non-fantastical pretense, but this is a matter of further investigation.

Almost all findings reported here concern children from at least three years upwards. EFs are still rarely investigated in children below two years of age, as outlined in section 7.2. So the relation between EF and PP, especially in younger children around 24 months needs to be further examined. In this highly dynamic phase of development in both fields, with symbolic awareness on the outset, a more thorough understanding of the relation between EF and pretend play is needed. Such an understanding is also inevitable to conceptualize comprehensible training studies that have the potential to test the direction of causal relations. The present work will fill this gap. We tested EFs along with different object-substitution tasks in three studies, assuming that different components of EFs are differentially related to various aspects of pretend play.

8. THEORETICAL APPROACH AND RESEARCH QUESTION

It has long been assumed that object substitution pretense is related to several domains of cognitive development, as it is a signature case for representational and thus possibly also symbolic thinking. Existing work on object-substitution pretense indicates a distinct developmental timeline (Fein, 1975; Jackowitz & Watson, 1980), starting well below three years of life. Especially when exploring its very beginnings we need to consider a given child's functional knowledge about the objects involved in an object-substitution pretend game (see Chapter 3), as different cognitive capacities might be involved depending on the degree of knowledge about the conventional use of the objects used for demonstration.

The current work strives to shed light on the emerging flexibility in object substitution pretense around the second year of life (i.e. 22 to 26 months), clarifying the role object familiarity and basic cognitive skills (i.e. different EF components) for showing flexibility in imitating pretense actions involving object substitution. Following the cultural learning account described by Rakoczy (2003) we assume that pretense, like instrumental actions, is learned by means of socio-cultural transmission and that young children already appreciate pretense as an intentional action form. Furthermore, we state that imitation is one important means of socio-cultural transmission. Based on this insight, we conducted an imitation study with an experimenter modeling different pretense actions for the child, and taking children's imitative behavior as critical outcome variable.

This corresponds with a number of studies on early object substitution pretense (Fein, 1975; Jackowitz & Watson, 1980; Watson & Fischer, 1977). Modeling can certainly increase children’s performance compared to what we observe during the same period of spontaneous behavior (Jackowitz & Watson, 1980). But modeling and imitation allow for a more controlled and systematic measurement of the highest possible skill levels regarding object substitution pretense with different objects. Findings indicating that “children do not blindly imitate in play what they do not understand but instead demonstrate the behaviors that they can comprehend and control” (Jackowitz & Watson, 1980, p. 545; McCall, Parke, et al., 1977; see e.g. Watson & Fischer, 1977) additionally warrant the imitation design as reasonable choice. We also tried to ensure children's understanding of the pretense act by taking into account their verbal comments on their own actions. As the primary focus of the current study was not on imitation behavior as such but rather on using imitation rate as outcome measure, we decided to abstain implementing a baseline phase (object manipulation without target action).

Research on early understanding of pretense in others also helped us to specify the age at which children should be tested with our task. Findings indicate that children show an early sensitivity for pretense acts at around 15 months, and high consensus exists that around their second birthday, toddlers can understand pretense in others when asked implicitly (e.g. via thought pictures, see Harris & Kavanaugh, 1994). Rakoczy et al. (2005) also demonstrated that at around 18-24 months, toddlers start to distinguish between pretense and instrumental acts, but instrumental acts were imitated more at that age, suggesting that children around their second birthday are on the verge of actually understanding so much in pretense that they are able to imitate it. We base our rationale for the current studies on these arguments.

8.1. Study 1: Emerging Flexibility in Object Substitution with familiar Artifacts (With and Without Function Conflict)

The three developmental trends that have been widely agreed upon to characterize pretend play development have been outlined in section 4.1. Decontextualization seems most relevant to describe the increasing flexibility children display in their object substitution pretense over time. They need fewer cues (e.g. from objects) and still manage to establish a reference between a real world object and its pretended counterpart. Hence, children start pretending with replica objects (toys) made for the specific purpose of pretending (see also 6.3). These objects deliver abundant contextual cues. Later, children can also use ambiguous objects which offer fewer cues, yet they still struggle with objects providing cues that conflict with the intended use (e.g. using a banana as a telephone). Based on previous findings on early social support in object substitution pretense (e.g. Striano et al., 2001; Tomasello et al., 1999), and early development of symbolic understanding (DeLoache, 1995, 2004; DeLoache et al., 1997), we propose that the increasingly decontextualized acts of early substitution can be located on a continuum of growing symbolic awareness. At a low level of symbolic awareness, young pretenders make use of the contextual cues delivered by objects that closely resemble their referents in form and function. Following the idea from Fein (1975), symbol-referent mapping is easiest when it comes to toy replicas because form and function provide context cues. At a somewhat higher level, children need fewer cues to establish a relation between an object and its referent and children become capable of using ambiguous objects. Nonetheless, they still struggle with conflicting contextual cues, which can only be handled at an even higher level of symbolic awareness. As supposed by Fein (1975) and later apprehended by Hopkins et al. (2016), the conflicting cues possibly exacerbate the mapping task because they induce a conflict that the child needs to resolve. This is also what Tomasello et al. (1999) refer to in their *triune representation problem*. The conflict described here probably arises from young children's appreciation of object function. A sensitivity for artifact function is apparent from very early on (Träuble & Pauen, 2007); even young preschoolers assume that objects are designed to serve a certain purpose (German & Johnson, 2002), and from their second birthday on children think normatively about object function (Casler et al., 2009).

We suppose that a higher level of awareness for symbol-referent mapping and arbitrary relationships between symbols and their referents helps in resolving this conflict. *Figure 3* displays the assumed continuum of symbolic awareness required for different types of pretending and shows which of the studies to be presented next addresses which level of symbolic awareness.

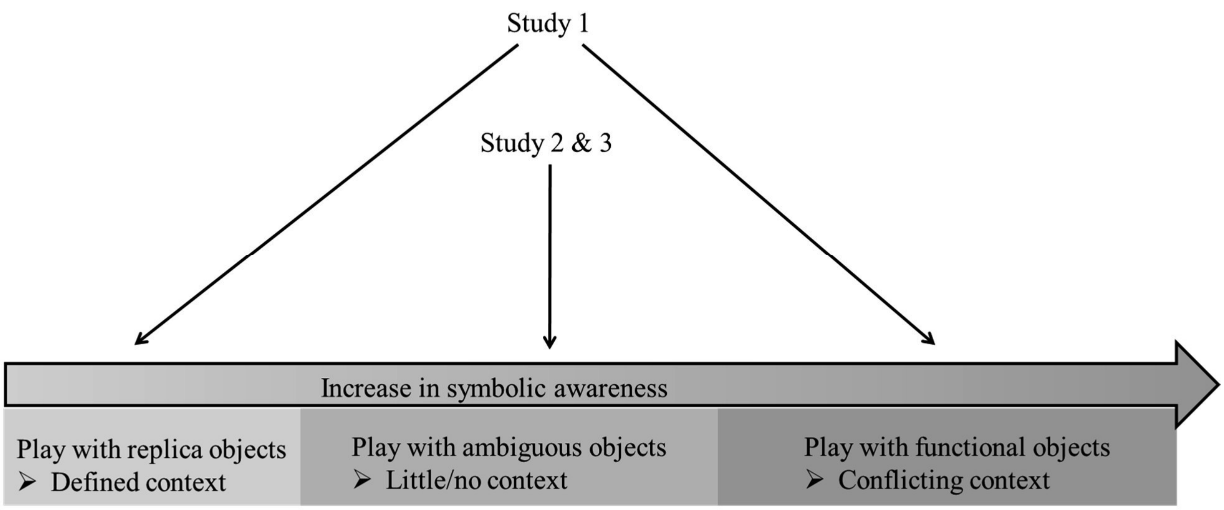

Figure 3. Different degrees of symbolic awareness required by different types of pretend play and their relation to Study 1, 2, and 3.

Study 1 contrasts conditions on the opposing ends of the displayed continuum: Children were presented with familiar objects that had a well-established status function. Flexibility in object substitution pretense was assessed by eliciting imitation of conventional and unconventional actions with these familiar artifacts. In the conventional condition, the objects were used to demonstrate their culturally determined function (e.g. brushing with a comb, eating with a spoon). In the unconventional condition, the object-action couplings were altered (e.g. brushing with a bottle, eating with a comb). Thus, imitation of the conventional action required a low level of symbolic awareness, as each object provided visual cues associated with the actions to be executed. When imitating the unconventional action, however, conflicting contextual cues needed to be dealt with. This latter task may require some appreciation of the arbitrary relationship between symbols and their referents. We thus hypothesize that 22- and 26-month old toddlers display different imitation rates for the two types of actions, with older children revealing higher imitation rates in the unconventional action condition than younger children, thus expressing an increase in flexibility of thinking about the symbolic function of toy artifacts. This assumption was tested, using a 2 x 2 within-subject design contrasting both age groups and probing imitation rates for conventional (phase 1) vs. unconventional (phase 2) action demonstrations with familiar toy replicas.

8.2. STUDY 2: TESTING THE FLEXIBILITY OF OBJECT SUBSTITUTION WITH UNFAMILIAR ARTIFACTS AND FAMILIAR ACTIONS

Considering stage three of the model depicted in Figure 3, it becomes apparent that object knowledge should play an important role for predicting pretense performance. Compare a young toddler who uses a remote control to make a phone call to a proficient preschooler showing the same kind of action at a more mature level of pretending. Both display the same observable behavior, but underlying mental processes differ, varying with the child's knowledge about the meaning of remote controls. Children do not experience a function conflict when treating the remote control as a mobile phone unless they are already knowledgeable of the '*true*' function of the remote control. Hence, their object knowledge predicts whether or not they experience a conflict and their performance indicates their flexibility in thinking about toy replicas.

While the early sensitivity for and the normative orientation towards object functions might keep young children from using objects in an unconventional fashion, this is conceivably not the case for objects without any predefined function. Reconsidering Figure 3, we can assume that object substitution with ambiguous objects is located somewhere between play with replica objects and objects with function conflict because visible object features are not associated with specific actions yet. Thus we assume that imitation of actions with unfamiliar objects is more challenging than imitation with familiar artifacts because the child needs to learn a new action-object coupling in the first case whereas she can refer to already existing action-object associations in the second case. However, as it comes to an *unconventional action* with a familiar artifact, substitution should be more challenging than imitating different object functions with an unfamiliar artifact, because unfamiliar artifacts do not deliver any *conflicting cues* - simply because the association between a given appearance and function is not strong yet.

To test these assumptions, Study 2 used unfamiliar artifacts for the same kind of substitution task as in Study 1, while the actions were simple, but not yet associated with any specific object yet. Each child again took part in two conditions subsequently, with the action-object couplings being exchanged from phase 1 to phase 2, as this has also been the case in Study 1. We speculate that in Study 2 children display a lower imitation rate for the initial object-function relation than for conventional actions in Study 1 (both presented during phase 1).

Furthermore, we assume that children display a comparably smaller discrepancy between imitation rates in phase 1 and phase 2. This would express a higher flexibility in switching between the two functional meanings of the objects, thus ascertaining that the conflict induced by knowledge about object functions exacerbates the substitution task.

Children were required to imitate familiar actions. Possibly, even a single demonstration established a certain status function for the object, as it has been the case in previous studies (Casler et al., 2009). Even more flexibility in object substitution may be attained when both action and artifact are unfamiliar. Study 3 set out to investigate this issue, based on the rationale covered in the following.

8.3. Study 3: Testing the Flexibility of Object Substitution with Unfamiliar Artifacts and Unfamiliar Actions

We reason that on a continuum of symbolic awareness, it should be easiest to imitate actions and use objects that are new the child, thus inducing no kind of conflict since they do not yet have any symbolic meaning. The argument is drawn from two insights: (1) The distinction between pretense and false-belief tasks (Custer, 1996; Kühn-Popp et al., 2013; Meinhardt et al., 2012; Woolley & Wellman, 1993), and (2) the distinction between symbolic and non-symbolic relations (DeLoache et al., 1997), see section 2.4.1. The former insight indicates that false belief tasks are more challenging than pretense tasks because a reference to the real state of affairs has to be made. The latter insight illustrates that a structurally similar task is more challenging when a symbol-referent mapping (e.g. between a small and a large doll) has to be made; as compared to when it is believed that it is all about one single entity (e.g. a large doll that has been shrunken to be a small doll). Taken together, these findings suggest that children manage a given imitation task more easily when the task requires fewer references between a pretense and reality. We thus assume that children would, in comparison to study 2, show an even decreased discrepancy between the imitation rates of an initial and a subsequently presented object-function-relation. To test this assumption, Study 3 asked children to imitate unfamiliar action on unfamiliar artifacts, and to subsequently imitate a switched object-function relation.

Studies 1 to 3 thus pose different challenges for toddlers. Conceivably, we assume that the three EF components WM, SHF and RIB are differentially related to performance in the target tasks. Study 4 presents findings on the EFs in all children tested in Studies 1, 2, and 3. It also elaborates on the relations between EF and object substitution.

8.4. Study 4: Testing the Relation between Executive functions and Object Substitution Outcomes (EF with Studies 1-3)

Previous studies indicate that some relation between EFs and object substitution pretense can be expected (see Chapter 8.3.), at least in somewhat older toddlers and preschoolers (e.g. Carlson et al., 2014). In short, since object substitution inducing a function conflict requires children to keep in mind more than one potential meaning of a given object (Albertson & Shore, 2008), to inhibit their dominant response (Kelly & Hammond, 2011; Van Reet, 2015), and to shift their attention away from the conventional meaning of that object (Carlson et al., 2014), we assume that EFs are positively related to imitation performance following unconventional demonstrations in Study 1. Following an unconventional demonstration, a conceivable reaction on the side of the child would also be to correct the experimenter instead of imitating her. Possibly, the child grasps the object that really corresponds to the action, or she grasps the same object as the experimenter but then performs the action that conventionally matches the object. Such corrective actions would mark limitations regarding flexibility of thinking about artifacts, and thus we suppose it to be negatively related to shifting performance.

In Studies 2 and 3, the substitution task induces a lower degree of cognitive conflict because in Study 2, objects are unfamiliar and in Study 3, objects as well as actions are unfamiliar. Thus, inhibition and shifting skills might not so much be related to the imitation of the switched object-function specifically, as it probably is the case in Study 1. If children already form an association between a given artefact and a demonstrated action during phase 1, then shifting skills would nevertheless be needed to imitate an unfamiliar object-function-relation during phase 2.

9. Study 1: Familiar Actions and Familiar Artifacts

Study 1 investigates the emerging flexibility in object substitution pretense with highly familiar artifacts of everyday use . In one block of trials (Conv-Condition) 22- and 26-month-old toddlers were encouraged to imitate the conventional use of each artifact (e.g. drinking from a baby bottle). This requires only limited symbolic understanding, conceptualized as an awareness of a possibly arbitrary relation between a symbol and its referent. In the other block of trials (UnConv-Condition) children were encouraged to imitate a conventional action with an artifact conventionally associated with a different action (e.g. drinking from a mobile phone).

We assume that children of the tested age range find it rather easy to copy conventional actions, as previous findings agree that pretense production starts in the second half of the second year (Bretherton et al., 1984; Haight & Miller, 1993; McCune, 1995; Rakoczy, 2003), and implicit pretense understanding at about 24 months of age (Harris et al., 1993; Walker-Andrews & Harris, 1993; Walker-Andrews & Kahana-Kalman, 1999). Copying a switched object-function relation (as in the UnConv-Condition) is expected to be more difficult because children experience a conflict between their knowledge about the conventional meaning of the artifact and its demonstrated use that matches the identity of a different artifact. Hence, we hypothesize that imitation rates in the UnConv-Condition should be lower than in the Conv-Condition. We further assume that in 22-month-olds, this discrepancy is even more pronounced than in the 26-month-olds, based on findings ascertaining the second year as a highly dynamic phase for pretense development (Lillard, 2015).

A verbal object labeling task was used to ensure that subjects knew all the objects. An increase in performance on mapping labels and actions to the corresponding objects from 22 to 26 months was expected for this labeling task.

9.1. METHOD

9.1.1. Participants

Data was collected in a middle-sized German University town. The final sample consisted of *N* = 72 children who all took part in both conditions and were split between two age-groups: *N* = 38 22-month-olds (mean age: 22 months, 16.18 days; range 21 months, 1 day – 22 months, 29 days; 18 females) and *N* = 34 26-month-olds (mean age: 26 months, 10.24 days; range: 25 months, 19 days – 26 months 25 days; 17 females). Infants' names were drawn from birth announcements and families were contacted via mail and/or phone calls. Another *N* = 10 children aged 22-months and *N* = 11 children, aged 26 months were tested but had to be excluded from data analysis due to fussiness or refusal to cooperate (*N* = 14), experimenter error (*N* = 1), interference of mother or siblings (*N* = 2), technical problems with the video equipment (*N* = 1) or because it became apparent that they were not able to understand the instructions due to language problems (*N* = 3). This is a normal drop-out rate for toddlers. All children included in the final sample came from families of a European decent with a middle-class socioeconomic background. The majority of caregivers (*N* = 59) had a university or college degree. *N* = 9 only had a high school diploma. *N* = 4 caregivers did not disclose their educational background. Eight children from each age group grew up bilingually.

9.1.2. Material and Procedure

Children were accompanied by their caregivers, and tested in a quiet laboratory room specifically equipped for this purpose. First, children participated in the Pretend Play Task (PPT) consisting of two Pre-Phases (Warm Up, Mapping Labels), the Demonstration and Imitation Phase for both blocks (Conv, UnConv), and one Post-Phase (Mapping Actions), all taking place on the floor, with the experimenter sitting vis-a-vis to the child and her caregiver. In the next step, children's performance in three executive function tasks was assessed including a Shifting Task, a Working Memory Task and an Inhibition Task, especially developed for this age group (see Bechtel, 2014; Pauen & Bechtel-Kuehne, 2016). These EF tasks were administered in all of the subsequently presented studies. Methods and results will be described as Study 4 in section 13.

Pretend Play Task (PPT). We used five everyday items objects that children know from their homes: (A) a toothbrush, (B) a comb, (C) a cell phone, (D) a spoon, and (E) a baby drinking bottle (see Figure 4). In addition, a stuffed animal was used for demonstration. The objects were presented in a flat box for familiarization, and later in a selection-box with separate compartments.

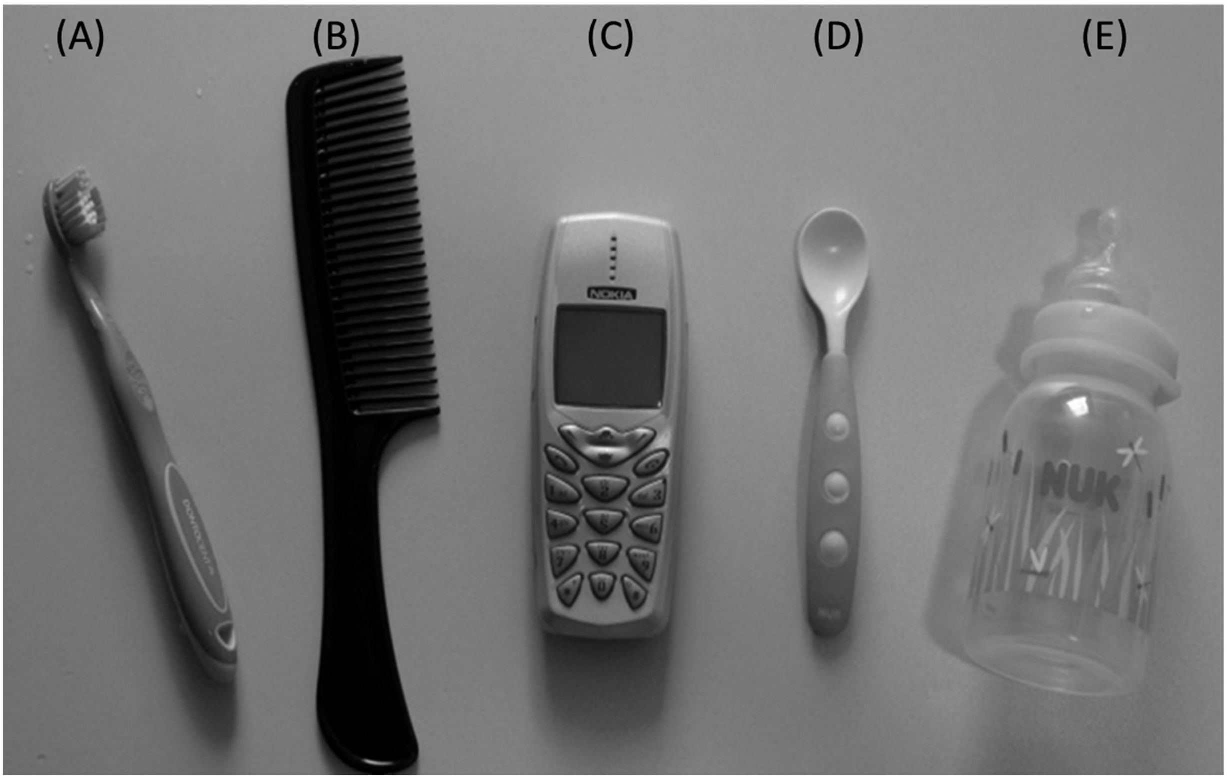

Figure 4. Material used for demonstration and imitation in the pretend play task.

Pre-Phase 1: Warm up. The experimenter offered all five items in a flat box, inviting the child to explore them by saying “Look at what we’ve got here!”. The child was encouraged to take objects out of the box. If the child was very shy, the experimenter asked the mother to pick up each object, and to look at it, but without naming it or starting to play. This phase served to familiarize children with the material and the situation and lasted two minutes.

Pre-Phase 2: Mapping Labels. In the subsequent phase, we sought to assess whether the children were familiar with the artifacts we used for the pretend play task. The five objects were sorted into the selection-box (order randomized). The experimenter asked the child to point at each object consecutively, by asking for example: “Where is the spoon? Can you show me the spoon?", naming the item without pointing or looking at it. This was considered to be an appropriate familiarity measure since children are likely to know the label when being familiar with a given object. Recent research indicates that labels for common objects are acquired as early as six months of age (Bergelson & Swingley, 2012).

Main Phase: Demonstration and Imitation. After eliciting the child's attention (e.g. by saying his or her name), the experimenter picked up one of the objects, looked at it and then addressed the child again: "Look, what I'm going to do now!" For about 12 seconds each, she then performed a pretend action with the object (drinking, eating, phoning, combing, brushing teeth) first on her own body, then on the body of the stuffed animal. The demonstrated action was always presented in a pretend mode (e.g. when using the comb the experimenter would not actually comb her hair but rather move the comb slightly above her hair without even touching it to highlight the pretense character of the action). Actions were always accompanied by a matching vocal expression, exaggerated gestures and smiling (e.g. combing action: "Ah – pretty!", again to highlight the pretense character) but without labeling the object.

Following the demonstration, the experimenter placed the object back in the box. While looking at the child, the experimenter said: "Did you see this? Can you do it, too?" The box was then turned around so that the objects faced the child, but their spatial positions relative to the child was changed. That way we ensured that the child had to actively search for the target object instead of grasping towards the location last highlighted by the experimenter. The stuffed animal was placed next to the box. Following the first touch of one artifact, the child had 50 seconds to start playing with the chosen object, before being asked to return it. The child was allowed to pick up only one object at a time, but could pick up different objects in sequence. When the child picked up a second object within the first 50 seconds after first touch, she was allowed to play with the next object for another 50 seconds. All in all, the maximum play-time for each trial was two minutes.

This phase included two blocks of trials (order varied systematically across participants of each sub-sample. ***Block 1*** (*Conventional Condition, Conv-Condition)* included the demonstration of five conventional actions (e.g. brushing teeth with toothbrush). In ***Block 2*** (*Unconventional Condition, UnConv-Condition),* the actions that are conventionally associated with the objects were demonstrated with a different object (e.g. brushing teeth with a spoon or spooning with a comb). Each object and each action were thus presented twice, but in different combinations on both occasions. The given within-subject design allowed us to study differences in imitation performance regarding functional-play and symbolic-play activities, and to compare performance across age groups.

Post-Phase: Mapping Actions. At the end of the PPT, the five objects were again sorted into the selection box. The experimenter then asked the child: “I want to do this again!”, thereby pretending do one of the five actions with the appropriate vocal expression but without using any object as prompt, before she looked at the selection box and asked: “Which one shall I take for doing this? Can you give me one?”. Reactions of toddlers in this phase revealed whether the unconventional demonstration influenced the mapping of actions to the respective artifacts or whether their previous mapping of conventional actions was robust to experimental manipulation.

9.1.3. Data Coding and Statistical Analyses

All testing sessions were video recorded, and videos were later coded by trained student assistants, blind to the hypotheses, and mostly not involved in the process of data collection.

Pretend Play Task. For both comprehension tasks (Pre-Phase 2: Mapping Labels, Post-Phase: Mapping Actions), the number of correctly identified objects was coded. For Mapping Actions, we differentiated between choices of objects used in the Conv-Condition and the UnConv-Condition. For the imitation phase, we coded whether the child did imitate a demonstrated action and which object she picked. To insure that the child's actions were actually linked to the previous demonstration, we considered only the first two actions performed during a period of 50 seconds starting with the first touch of any target object on any given trial.

Overall-Imitation Rate informed us about the number of imitated actions regardless of object choice across both conditions. This score ranged from 0-20, as there were 5 trials per condition and two actions of the child could be coded per trial. *Correct Imitation* was coded only if the child had imitated the action and picked up the same object as the experimenter (range: 0-10 across both conditions). Furthermore, we coded the number of *Corrective Imitations* for the UnConv-Condition. Here, children could either pick up the demonstration object but perform the conventional action (*Action Correction*), or they could imitate the demonstrated action, but choose the artifact conventionally used for this purpose (*Object Correction*). For each child and trial, both types of corrections were coded separately and added up (range: 0-10 in the UnConv-Condition).

9.2. RESULTS

9.2.1. Preliminary Analyses

Two independent student research assistants both coded the data set of 17 children (12 %). Based on this data, we computed intra-class coefficients (Field, 2013; Hallgren, 2012). Values for agreement were good to excellent throughout (Greve & Wentura, 1997), with ICC_{just} = .98 for overall imitation rates, based on the mean over all five objects. The following values were computed for each of the five objects separately, providing mean and range of the values of agreement: Mean *ICC* = .90 (range .80 - 1.00) for correct-imitation in the Conv-Condition, mean *ICC* = .91 (range .86 – 1.00) for overall- and correct-imitation in the UnConv-Condition, and mean *ICC* = .85 (range .78 - .91) for corrective actions. Hence, we conclude that imitation scores are highly reliable.

To check whether sample characteristics influenced imitation rates, effects of gender, order of test phases as well as bilingualism were analyzed via Mann-Whitney-U-Tests. None of these variables had a significant effect on either pretend play or executive function performance (all *ps* > 0.05). Hence, all subgroups were collapsed for further analyses. Each dependent variable was checked for normal distribution. Whenever applicable, non-parametric tests were applied.

9.2.2. Comprehension Performance

Mapping Labels. In this phase, 22-month-olds identified *M* = 4.00 (SD = 0.22) of five objects correctly, and 26-month-olds identified *M* = 4.68 (*SD* = 0.72) objects correctly. Both means were thus very high and clearly exceeded chance level (0.2 x 5 = 1 as chance level over 5 trials) at 22 months: t (37) = 13.64; $p < .001$, as well as at 26 months: t (33) = 29.49, $p < .001$). We conclude that children of our sample had good knowledge about the artifacts presented. As expected, performance improved with age, t (70) = -2.59; $p = .004$.

Mapping Actions. When children were asked to choose one of the objects suitable for repeating a demonstrated action at the end of the pretend play phase, they only rarely handed the object used in the UnConv-Condition in both age groups (22 months: *M* = 0.66, *SD* = 1.02; 26

months: *M* = 0.32, *SD* = 0.48;). This rate was below chance level (22 months: *t* (37) = -2.07, *p* = .046; 26 months: *t* (30) = -7.94, *p* < .001). In contrast, objects used in the Conv-Condition were handed more frequently (22 months: *M* = 1.76, SD = 1.40; 26 months: *M* = 2.74, *SD* = 1.37), exceeding chance level (22 months: *t* (37) = 3.35, *p* = .002; 26 months: *t* (30) = 7.10, *p* < .001. (Please note that *N* = 3 children from the 26-month-olds had to be excluded from this analysis due to fussiness in this phase of the experiment).

A mixed 2x2 analysis of variance with age (22 vs. 26 months) as between-subject factor, condition (Conv vs. UnConv) as within-subject factor, and mean number of object-choices as dependent variable revealed a main effect of condition, *F* (1, 67) = 63.69; *p* < .001; Partial Eta-Square = 0.49, with the conventional object being chosen significantly more often than the unconventional object. Furthermore, a significant interaction between condition and age was observed, *F* (1, 67) = 8.85; *p* = .004; Partial Eta-Square = .12. The object used in the Conv-Condition was chosen significantly more often by the older toddlers, *t* (67) = -2.92; *p* = .005, whereas no comparable age difference could be observed for choices referring to objects used in the UnConv-Condition (*p* = .097). This finding is in line with the assumption that conventional knowledge about familiar artifacts increases with age, thus confirming the results of Mapping Labels Task.

9.2.3. Imitation Performance

Overall Imitation. Overall imitation rate (i.e. action imitation regardless of object choice) was somewhat lower in 22-month-olds (*M* = 7.13, *SD* = 4.05) than in 26-month-olds (*M* = 7.85, *SD* = 4.00), but this group difference was not significant (*p* = .405). The majority of participants (i.e. 71 % of the 26-month-olds and 73 % of the 22-month-olds) enhanced at least one of their actions either verbally or by adding meaningful actions which had not been demonstrated by the experimenter (e.g. pressing the buttons of the cell phone before holding it to the ear).

Correct Imitation. When considering only the instances of Correct Imitation (i.e. action imitation performed with the same object as during demonstration), a Mann-Whitney-U test with the sum of Correct Imitations in the Conv- and UnConv-Condition revealed the same general age trend as for Overall Imitation: When correcting the alpha level for three tests, 26-month-olds showed Correct Imitation marginally more often across conditions (*M* = 5.94; *SD* = 2.74) than 22-month-olds (*M* = 4.55; *SD* = 2.73; *U* = 458.00, *z* = -2.13; *p* = .033). Importantly, both age groups were more likely to imitate actions with objects when the action-object coupling was consistent with their previously acquired world knowledge (i.e. in the Conv-Condition) than when this was not the case (22-month-olds, Conv: *M* = 2.95, *SD* 1.59; UnConv: *M* = 1.61, *SD* = 1.53; *T* = 64.50, $p < .001$; 26-month-olds, Conv: *M* = 3.65, *SD* = 1.54; UnConv: *M* = 2.29, *SD* = 1.73; *T* = 45.00; p < .001). Results thus indicate that the transition from functional to symbolic play takes place around two years of age (see Figure 3).

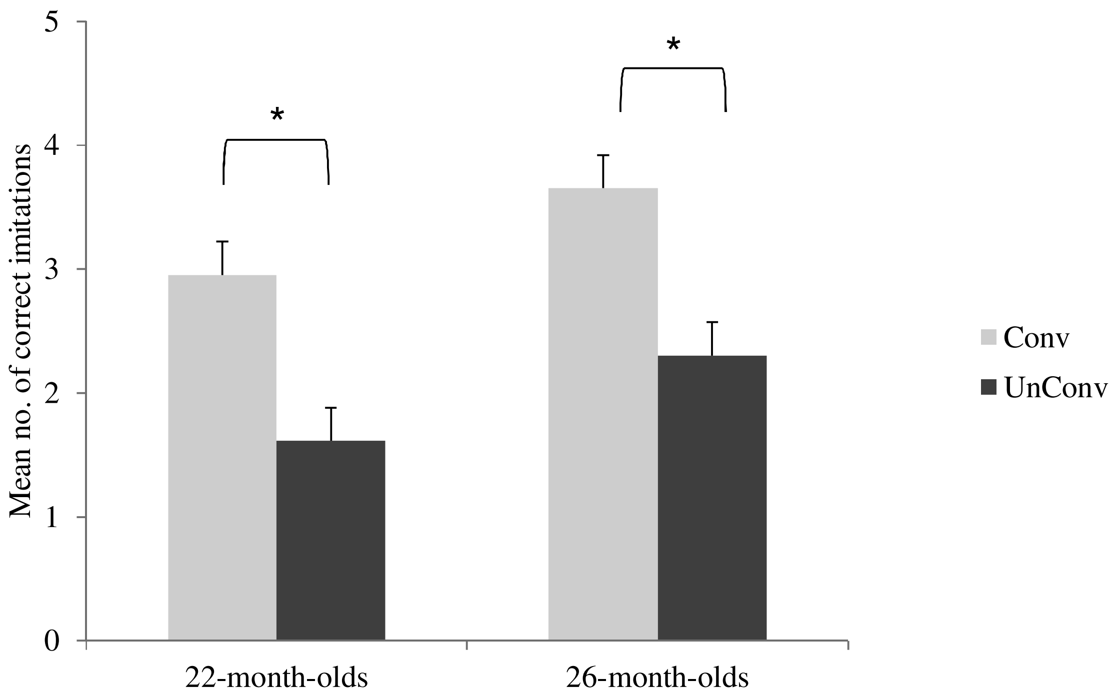

Figure 5. Mean number of correct imitations per condition (Conv, UnConv) and age group (22-, 26-month-olds).
*$p < .05$.

Corrective Actions in the UnConv-Condition. Corrective actions (i.e. correcting either the object or the action when imitating) could only be coded for the UnConv condition. They occurred about equally often in both age groups (*U* = 613.50; *z* = -0.379; *p* = .705). However, the 26-month-olds showed significantly more Correct Imitation (*M* = 2.29, *SD* = 1.73) than

Corrective Actions (*M* = 1.35; *SD* 1.28; *z* = -2,27, *p* = .023), whereas these two scores did not differ significantly in 22-month-olds (Correct Imitation *M* = 1.61, *SD* = 1.53; Corrective Actions: *M* = 1.45, *SD* 1.27; *z* = -0.39; *p* = .696).

When showing corrective actions, children could either correct the object or the action. A Mann-Whitney-U-Test was used to test the differences between both kinds of Corrective Actions and potential age differences. This analysis resulted in a significant age effect, *z* = -3.24; *p* = .001. Post- hoc tests revealed that the 26-month-olds corrected the action more frequently (*M* = 1.0, *SD* = 0.18) than the object (*M* = 0.35, *SD* = 0.11, *z* = -2.72; *p* = .007), whereas 22-month-olds showed no corresponding difference correction in actions (*M* = 0.60, *SD* = 0.12) and correction in objects (*M* = 0.84, *SD* = 0.15, *z* = -1.25; *p* = .212; see Figure 6).

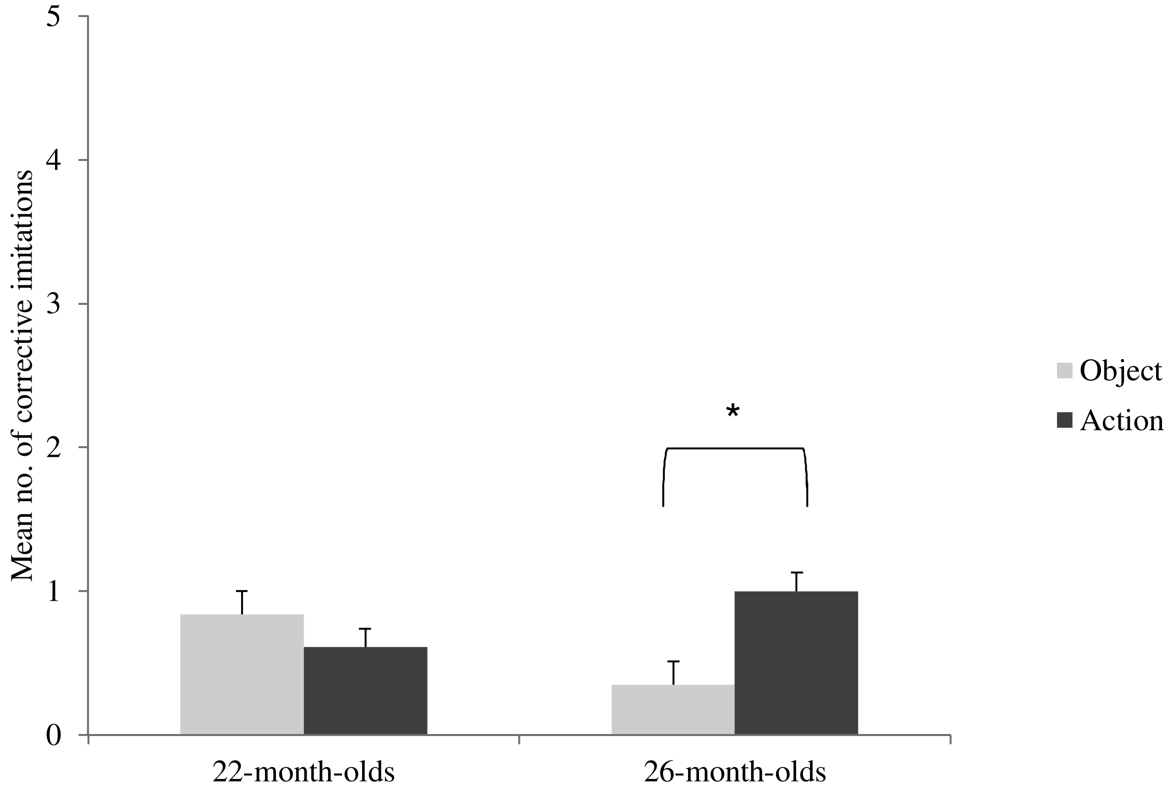

Figure 6. Mean number of corrections in object and corrections in action per age group (in the UnConv condition).

*$p < .025$.

9.3. DISCUSSION

As expected, toddlers of the tested age range were well able to accomplish the Mapping Labels Task in the beginning of the session. Thus, they have already acquired a fair amount of knowledge about the artifacts presented. Upon hearing the label, children from both age groups were well able to identify the corresponding objects. Furthermore, they were also likely to choose the items conventionally associated with a certain action in the Mapping Actions Task. Knowledge about the artifacts and their conventional function seems to increase from 22 to 26 months of age: Older toddlers were more likely to choose the conventional artifact in both tasks than younger toddlers. This is in accordance with previous findings on early development of artifact knowledge (Casler & Kelemen, 2007) as well as with the idea that artifact knowledge and its relation to verbal vocabulary develop rapidly during toddlerhood (Kemler Nelson, Russell, Duke, & Jones, 2000). As object knowledge and vocabulary development also interact with each other, progress in language development possibly played a role for this difference, but both age-groups were equally well able to follow instructions of the mapping tasks.

Both 22- and 26-month-olds were equally well able and willing to participate in the game, as displayed by the overall imitation rate which did not differ between both age groups. Older toddler's score of correct imitation across both phases was marginally higher than that for younger toddlers, which may also have to do with their increased object knowledge, but could also be attributed to their increased willingness and capacity to imitate the experimenter. Our findings are in accordance with those from Rakoczy et al. (2005), who demonstrated that toddlers had difficulties in imitating pretense acts with 18 months, but showed improved performance at 24 months of age.

Toddlers from both age groups tested were more likely to imitate conventional demonstrations correctly than unconventional demonstrations, thus confirming our initial assumption. Imitating a conventional action was presumed to be a straightforward task for children of the tested age range, as first pretense acts with replica objects can typically be observed around 18 months of age (Fein, 1981; Killen & Uzgiris, 1981; Weisberg, 2015) and get increasingly more frequent as children approach their second birthday (Tomasello et al., 1999). In Chapter 8, it was outlined that such a task is located at a low level of symbolic awareness, because the mapping between a symbol and its referent is rather easy. Results indicate that participants of Study 1 were well able to perform this mapping.

One question emerging might be whether children actually needed to become involved in symbolic play for imitating the observed actions. For example, Tomasello et al. (1999) questioned whether early object substitution is symbolic at all. Lillard, Pinkham, and Smith (2011) also argue that pretense comprehension might not involve symbolic understanding from early on. Several observations from our own study suggest that children were at least really engaged in pretend play: They not only copied the demonstrated actions but often added verbal cues themselves that were consistent with the pretense nature of the given object. In fact, a majority of children in both age groups (i.e. 71% and 73 % respectively) enriched at least one of the observed actions, and many showed several activities of this kind with different objects. This leads us to assume that children of the tested age range do not simply imitate what they see, but rather reveal at least some superficial understanding of the pretended meaning of the demonstrated actions (Jackowitz & Watson, 1980; McCall, Parke, et al., 1977; see e.g. Watson & Fischer, 1977).

Some theorists try to solve this ambiguity problem of interpretation by choosing to call early acts ‘representational’ instead of symbolic (Vig, 2007). We think that it may be more useful to think of symbolic awareness as a continuum. In this case, the pretense acts demonstrated in the conventional condition of Study 1 are located on a low level of symbolic awareness. Awareness of symbolic relations certainly increases over development. But even when a child is unaware of the fact that a remote control is not the same as a cell phone, and still acts as if she were talking to someone using this device, she or he is engaged in some sort of symbolic play. Furthermore, it is to be noted that all of our acts were performed in a pretense frame: We used pretense markers like smiles and exaggerated movements, or incomplete actions to mark the pretense character of our demonstration. This may have helped children to "tune in" and get into a pretend play mode that lead them to add some activities themselves. In general, we assume that children in our study were at least in partly aware of the pretense and symbolic character of the demonstrated actions. We acknowledge that our experimental design does not allow for a clear-cut distinction between pure imitation and imitation with symbolic understanding, however.

The main focus of the Study 1 was not on imitation in the Conv-Condition per se, but rather on the comparison of performance between the Conv- and UnConv-Condition. Following the unconventional demonstration, children of both age groups were less likely to correctly imitate the experimenter. This confirms our initial assumption: Imitating with objects that have a status function which contradicts its function in play is much more challenging than imitating conventional actions that match a given object. On our continuum of symbolic awareness, imitation in the UnConv Condition is thus located on a much higher level than imitation in the Conv-Condition. Research indicates that object substitutions are especially intriguing for children at this age, and some authors even argue that it occurs later in ontogeny than imaginary object pretense or body-part-as-object substitution (Bigham & Bourchier-Sutton, 2007; Tomasello et al., 1999). Tomasello et al. (1999) reasoned that object substitution involving a conflict between real and pretended function is difficult because children have to resolve the conflict between the action-motor schemes that are typically associated with the object. Vygotski (1967) spoke of affordances that are inherent in familiar objects. The reduced imitation rates in the UnConv-Condition clearly speak for the task being more challenging. It is conceivable, however, that children were not overly challenged by the conflict, but were instead less willing to follow the unconventional demonstration. I will come back to this argument later, as it might also account for our observations regarding corrective actions.

Some toddlers of both age groups showed corrective actions in the UnConv-Condition. These may result from limitations in flexibility concerning object substitution. Based on the findings reported above, we assume younger toddlers to be even more rigid and less flexible when it comes to using objects in an unconventional way than older toddlers. Even though the absolute rate of corrective actions does not differ between both age groups, we found that the rate of corrective actions in relation to the rate of correct imitations in the UnConv condition was non-significant for 22-month-olds, but significant for 26-month-olds. When they had to decide between faithful imitation and corrective acts, 22-month-olds were thus equally likely to choose one or the other, while 26 month-olds were much more likely to choose correct imitation over corrective imitation. Moreover, we found both age groups to show different kinds of corrective actions: Younger toddlers replaced the object (correction in object) whereas older children rather replaced the action (correction in action).

Potential reasons for this age difference are a matter of speculation: Possibly, automatic motor programs were activated in the 22-month-olds (see Tomasello et al., 1999), simply mirroring the actions of the experimenter, and chose the object that was conventionally associated with the demonstrated action, because they did not remember which object had been used to perform the target action. Or, maybe younger children were not willing to follow the experimenter in the unconventional act, because of their normative appreciation of object function (‘we are ought to use it this way!’, see Casler et al., 2009; Rakoczy, 2008). In contrast, 26-month-olds may have started their turn with the intention to imitate faithfully and were able to correctly remember which object the experimenter had been used. Once they had chosen the object, however, they possibly fell for the motor-reaction schemes associated with that object (Tomasello et al., 1999). This might have led them to perform the object-matching action instead of imitating faithfully. Likewise, children may have tried to communicate their conventional knowledge and normative appreciation to the experimenter by correcting the seemingly "wrong" actions demonstrated by the experimenter. Then, whatsoever, it would be the question why they chose this form of correction instead of correcting their object choice in first place, like the younger toddlers did.

Some children performed corrective actions, yet at the same time also imitated correctly within the same trial more than once ($N = 2$ of 22-month-olds; $N = 4$ of 26-month-olds). This indicates awareness of both, the real as well as the pretended identity of the given object. Anyhow, we can assume that by choosing the same object as the experimenter, children took the first step towards faithful imitation and becoming engaged in pretend play. Evidently, older toddlers were more likely to successfully complete this intended act.

Twenty-two- and 26-month-olds clearly preferred the object conventionally matching the demonstrated action in the Mapping Actions Task over the object used for the unconventional demonstration. This reveals that the object substitution task did not weaken their conventional knowledge of the presented objects.

To sum up, we conclude that our task is well suitable to assess flexibility of toddlers imitation around two years of age in an object substitution task. Our results indicate that children around their second birthday still have problems to imitate an object substitution act involving a function conflict. This replicates earlier findings (Bretherton et al., 1984; Fein, 1975; Killen &

Uzgiris, 1981; Striano et al., 2001; Tomasello et al., 1999; Ungerer et al., 1981). Furthermore, toddlers reacted differently towards demonstrations of conventional and unconventional actions on respective artifacts. Imitation rates reveal that they are more inclined to imitate conventional demonstrations that unconventional ones.

Yet, we see an increase in flexibility from 22- to 26-month-olds, revealed by the ratio of corrective actions to correct imitations following the unconventional demonstration. Older toddlers were more likely to imitate faithfully while younger toddlers were equally likely to imitate faithfully and to correct the observed action. Thus, we conclude that the status function of the object has important effects on imitation rate and corrective behavior in toddlers. Corrective actions reveal that some children try to cope with the situation by changing the game according to the norms and conventions they know of. As intended, the two conditions of Study 1 varied in the level of complexity, and thus we assume that they actually are located at different levels of symbolic awareness as well (see Figure 3). We speculate that object knowledge plays an important role for the flexibility in object substitution, and Study 1 confirmed that with highly familiar objects, flexibility is rather limited, though it increases with age. Study 2 was conducted to investigate whether higher flexibility is observable in the same task when unfamiliar objects are used, thus targeting object substitution with ambiguous objects.

10. STUDY 2: FAMILIAR ACTIONS AND UNFAMILIAR ARTIFACTS

Study 1 confirmed that young toddlers are much more inclined to imitate conventional than unconventional actions with familiar artifacts. This is in line with our suggestion that object substitution is highly challenging for young pretenders. In a second step, we thus became interested to find out whether toddlers display higher flexibility when the objects are unfamiliar and thus not associated with any typical function. To explore this issue, we introduced objects that were unfamiliar (UFOs Unfamiliar Objects). We tested 26 month-olds in the same general setting as in Study 1. The actions were also identical to Study 1. Hence, the objects did not provide context cues for the actions, but the actions themselves were familiar to the child. For that reason we assumed that even a short demonstration should be sufficient to establish a status function of the UFO, as it was the case in previous studies for unfamiliar objects (e.g. Casler et al., 2009).

10.1. METHOD

10.1.1. Participants

Modes of participant recruiting and testing were the same as in Study 1. The final sample consisted of *N* = 33 children (mean age: 26 months, 14.64 days; range: 25 months, 29 days – 27 months 2 days; 14 females). All children were of European decent with a middle-class socioeconomic background. The majority of caregivers (*N* = 30) had a university or college degree. *N* = 2 only had a high school diploma. Seven children grew up bilingually.

Another *N* = 17 children were tested but had to be excluded from data analysis due to fussiness of the children (N = 10), because they failed to cooperate with the experimenter (N = 5), or because they failed to follow instructions or to be engaged in the task (N = 2), as indicated by the fact that they showed a Mapping of Actions (i.e. handing the experimenter one of the two objects that had previously been used to demonstrate a given action) in less than two cases. This additional test seemed necessary to distinguish between children who simply lost interest in the task and those who did not imitate during the Demonstration and Imitation Phase for some other reasons.

10.1.2. Material and Procedure

As in Study 1, children and a caregiver came to the department and were tested in a quiet laboratory setting. The pretend play task was administered first, with child, caregiver and experimenter sitting on the floor. Subsequently, the EF battery (Pauen & Bechtel-Kuehne, 2016) was administered at the table.

Imitation Task with Familiar Actions applied to Unfamiliar Objects (UFO_F-Acts). We used five newly designed items that were unfamiliar to the children. The items matched the objects of Study 1 in size and colorfulness, but not in shape or function (see Figure 7). To identify the objects for purposes of experimental procedure and later coding, we assigned fantasy labels, but those were not used in the experimental session. Again, a stuffed animal was used for demonstration. The objects were first presented in a flat box for familiarization, and later in a selection-box with separate compartments.

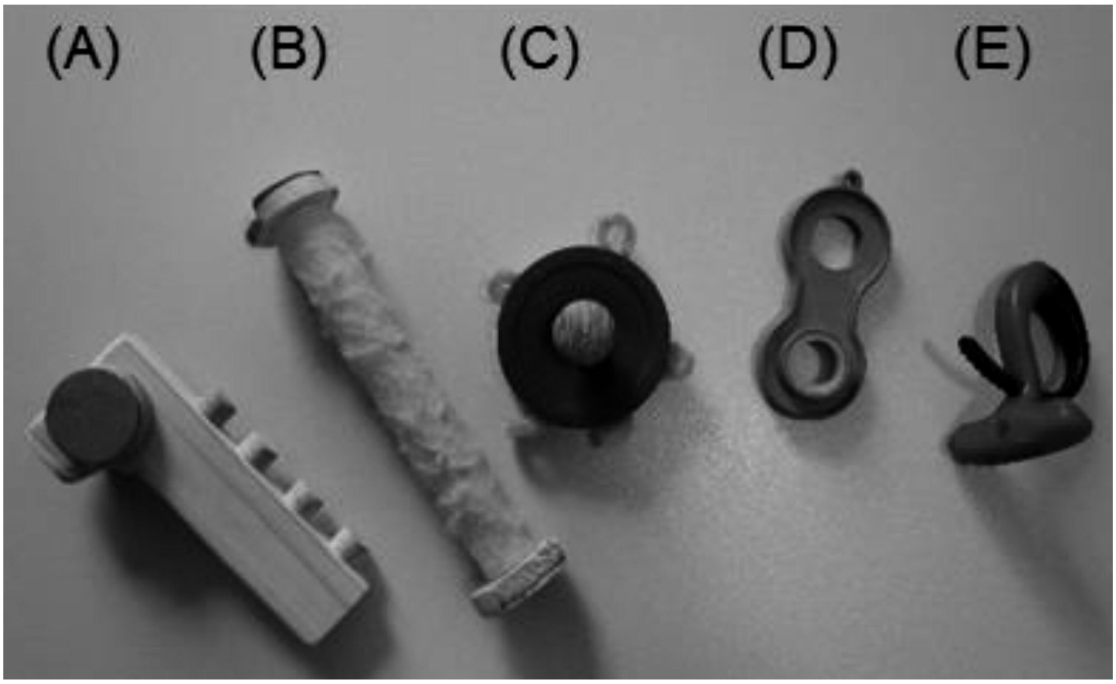

Figure 7. Material used for demonstration and imitation in the pretend play task with unfamiliar objects (UFOs). (A) Fandell; (B) Gommler; (C) Hurtel; (D) Rinkel; (E) Simmo.

The task comprised four different phases:

Pre-Phase 1: Free Play. As in Study 1, the experimenter offered all five items in a flat box, for exploration first, to familiarize children with the material and the situation for two minutes.

Pre-Phase 2: Handing Objects. In Study 1, the experiment now asked the children to label each object in the selection box (Mapping Labels Task). For Study 2, this did not make sense since the children were not familiar with the objects. To insure that procedure was similar to Study 1 we sorted the objects into the selection-box (order randomized) and stated: “Look what we have got here. Can you hand me one?” and after taking and returning the first item we continued: “And what else have we got here?” This procedure was repeated five times, to give the child the chance to handle each item at least once before the start of the demonstration phase.

Main Phase: Demonstration and Imitation. The demonstration and imitation procedure was the same as for Study 1. After eliciting the child’s attention, the experimenter demonstrated the same actions as in Study 1 (drinking, eating, phoning, combing, brushing teeth) first on her own body, then on the body of the stuffed animal. As in Study 1, actions were presented in a pretend mode and the procedure contained two blocks of five demonstrations each, which constituted the within-subjects conditions of the experiment. As the objects were all unfamiliar to the child, it no longer made sense to talk of a Conventional and an Unconventional Condition. Rather, ***Block 1*** of demonstrations was called ***Association Phase*** because children associated each object with a familiar action for the first time, and ***Block 2*** was called ***Switch Phase*** because children now had to respond to a new object-action combination. This within-subject design allowed us to investigate whether a demonstration of a familiar action with an unfamiliar object influences subsequent responses to a switch in this object-action-relation.

Post-Phase: Mapping Actions. As in Study 1, the imitation task was followed by a Mapping Actions Task. Children were asked to map the actions to the objects in the selection box on behalf of ‘dummy demonstrations’ (i.e. action demonstration without object). More specifically, the experimenter asked the child to hand her the object that matched the demonstrated action. As in Study 1, no verbal labels for the objects were used. Reactions of toddlers in this phase revealed whether children chose the object that had previously been used in the Association Phase or in the Switch Phase.

10.1.3. Data Coding and Statistical Analyses

Data coding and statistical analyses were comparable to Study 1. However, some adjustments were necessary to account for the modifications in the experimental procedure:

Pretend Play Task. For the Handing Objects Task, we counted the number of objects handed to the experimenter. For the Mapping of Actions Task following the Main Phase, we differentiated between choices of objects used in the Association Phase and in the Switch Phase. To assess imitation performance in the Main Phase, we coded which object was chosen and whether or not the demonstrated action was imitated. As in Study 1, we coded *Overall Imitation Rate, Correct Imitation Rate* for both phases and *Corrective Imitations* for the switch phase (*Action Correction/Object Correction*).

10.2. RESULTS

10.2.1. Preliminary Analyses

Two independent student research assistants coded the data set of 15 children (45 %). Based on this data, we computed intra-class coefficients (Field, 2013; Hallgren, 2012). Values for agreement were good to excellent throughout (Greve & Wentura, 1997), with ICC_{just} = .98 for overall imitation rates, based on the mean over all five objects. Again, for the remaining imitation rates we provide mean and range of the values of agreement over all five objects. For correct-imitation rates in the Association Phase: Mean *ICC* = .95 (range .82 - .99); Overall- and Correct Imitation in the Switch Phase: *ICC* = .96 (range .85 – 99); Corrective Imitation: *ICC* = .95 (range .81 - .99).

Neither gender nor bilingualism of the children had any significant effect on either pretend play or executive function performance (Mann-Whitney-U-Tests: all *ps* > 0.05). Hence, all subgroups were collapsed for further analyses. Each dependent variable was checked for normal distribution. Whenever applicable, non-parametric tests were used.

10.2.2. Handing Objects and Mapping Actions

Handing Objects. The first task after free play, children were asked to hand each of the five objects from the selection box. On average, children handed 4.24 objects (*SD* = 1.28). The majority of children (*N* = 27) handed all five objects. The number of objects handed to the experimenter did not relate to any of the other imitation measures (all *ps* > 0.05).

Mapping Actions. In this Task, the object used in the Association Phase was handed on average 1.36 times (*SD* = 1.08); the object used in the Switch Phase was handed on average 1.39 times (*SD* = 1.00). Children did not show any systematic preference for any object used in either of the two blocks of trials (*z* = -0.16; *p* = .872). Therefore, we tested whether they took each of the two objects that had previously served as demonstration object for a given action more often than indicated by chance. A t-test against chance level (two objects to be chosen from five) was carried out. The two objects associated with the demonstrated action were chosen more frequently than indicated by chance (*M* = 2.76; *t (32)* = 3.23; *p* = .003).

10.2.3. Imitation Performance

Overall Imitation. The overall imitation rate was *M* = 7.33 (*SD* = 1.61) combining performance of the Association and the Switch Phase.

Correct Imitation. A Wilcoxon Signed Rank Test revealed that the mean number of correct imitations was significantly lower in the Switch Phase (*M* = 2.00, *SD* = 1.66) than in the initial Association Phase (*M* = 3.27, *SD* = 1.61, *z* = -3.52; *p* < .001).

Corrective Actions in the Switch Phase. Corrective actions (i.e. correcting either the object or the action) were shown on average *M* = 0.64 (*SD* = 0.96) times in the Switch Phase, which is numerically lower than during the UnConv-Condition in Study 1. Children instead showed significantly more instances of correct imitation than of corrective actions (*z* = - 3.43; *p* = .001). A further analysis was carried out to differentiate between Corrections in Object versus Corrections in Action. Both means were quite low (Correction in Object: *M* = 0.42; *SD* = 0.75; Correction in Action: *M* = 0.21; *SD* = 0.60) and did not differ significantly (*z* = -1.44; *p* = .149).

10.3. Discussion

The overall imitation rate was numerically similar to the imitation rate of 26 month olds in Study 1 with *M* = 7.33 (*SD* = 1.61) actions being imitated in Study 2, compared to *M* = 7.85 (*SD* = 4.00) in Study 1. Note however, that comparisons with Study 1 can only be made on a descriptive level, as procedural differences do not permit a statistical comparison. Correct

Imitation rates were lower in in the Switch Phase than in the Association Phase, thus showing that children were less inclined to imitate the second action associated with the object than the first action. It should be noted, though, that the discrepancy between imitation rates in both phases was less pronounced than in Study 1. First, imitation rates in Study 2 and their theoretical implications will be discussed then follows an interpretation of the comparison between Study 1 and Study 2.

Why did children imitate more following the initial Association Phase than the subsequent Switch-Phase? Given that most children met the criterion of handing at least two correct objects during the Post Phase (Mapping Actions), we can rule out that general fatigue can account for this finding. Alternatively, children's imitation during the Switch Phase was reduced because they had previously associated each object with one specific action and now found it hard to step back and accept a new action-object coupling. Existing work indicates that 12-month-olds associate functions with objects even after only one demonstration (Träuble & Pauen, 2007) and that 26- to 38-month-olds perceive object function normatively following only one demonstration (Casler et al., 2009). Hence, this interpretation would be in line with the current literature. Somewhat contradicting this idea is that children only rarely showed corrective actions. This may reflect the fact that children were less sure about the "proper" action-object coupling.

When being asked to hand an object that could be used for demonstrating a specific action in the Mapping Action Task, children did not make a random choice nor did they display any clear preference for either the object used in the Association or the Switch Phase, thus suggesting that their performance reflects learning experience, but still reveals a high degree of flexibility. In comparison to Study 1, this implies that children were more willing to combine different actions with a given object (and vice versa) when the objects are unfamiliar than when they are already associated with a conventional meaning. To further explore flexibility in substitution, Study 3 was conducted, using not only unfamiliar objects, but also unfamiliar actions. We expected children to show an even smaller discrepancy in imitation rates in the Association- and in the Switch phase when both objects and actions are unfamiliar, as prior knowledge about objects or actions does not interfere in this case.

11. STUDY 3: UNFAMILIAR ACTIONS AND UNFAMILIAR ARTIFACTS

Study 3 again used the same UFO stimuli as Study 2, but combined them with unfamiliar actions (UFAs). Note that this still involves object substitution, as we establish one function for a certain object in the first phase of the experiment (i.e. Association Phase) and then use this same object in a different function during the second phase of the experiment (i.e. Switch Phase). However, we exclude one level of symbolic content – namely the reference to everyday "real" actions.

11.1. METHOD

11.1.1. Participants

Modes of participant recruiting and testing were the same as in Studies 1 and 2. The final sample consisted of *N* = 37 children (mean age: 26 months, 16,65 days; range: 25 months, 29 days – 28 months 6 days; 10 females). All children included in the final stemmed from families of European decent with middle-class socioeconomic background. Most caregivers (*N* = 32) had a university or college degree. *N* = 4 had a high school diploma. One caregiver did not provide information on educational background. Seven children grew up bilingually. Another *N* = 9 children were tested but had to be excluded from data analysis due to fussiness (*N* = 2), lack of cooperation (*N* = 2) and caregiver intervention (*N* = 1). *N* = 4 children failed to reach the criterion of handing at least two items in the last task and were therefore excluded from data analysis due to lack of involvement in the task.

11.1.2. Material and Procedure

Material and procedure were identical to Study 1. The imitation task was administered first, followed by the EF battery (Pauen & Bechtel-Kuehne, 2016).

Imitation Task with Unfamiliar Objects and Unfamiliar Actions (UFO_Unf-Acts). We used the five newly designed objects as well as the stuffed animal from Study 2. As in the previous studies, the objects were first presented in a flat box for familiarization, and later in a selection-box with separate compartments. The task included four different phases:

Pre-Phase 1: Free play. As in Study 1 and Study 2, the experimenter offered all five items in a flat box for exploration for two minutes.

Pre-Phase 2: Handing Objects. In Study 1, children were asked to map labels for the objects in the selection box in this phase. As in Study 2, children were not familiar with the objects used for this task. We thus applied the same Handing Objects Task as in Study 2.

Main Phase: Demonstration and Imitation. The demonstration procedure was kept parallel to the demonstration procedure in Study 1 and Study 2, but differed in terms of the actions demonstrated. These were the following (accompanying sounds in parentheses): (1) pounding on the heart (“dum-dum”), (2) sweeping up and down the outstretched arm (“rem-rem”), (3) rotating an object close to one ear (“uik-uik”), (4) lifting an object to one eye (“nik-nik”) and (5) lifting the chin with the object (“hm-hm”). Pretend markers were also the same as in previous studies, e.g. movements were stopped before touching the body (truncated behaviors), and the experimenter smiled and used exaggerated gestures. The task also consisted of two blocks (Block 1: Association Phase; Block 2: Switch Phase) with five trials each. (1) In the Association Phase, one action for each of the five objects was demonstrated. (2) In the subsequent Switch Phase, the very same actions were associated with a different UFO. Each action was thus demonstrated twice in two different blocks, and each object was used twice for demonstrating different actions.

Post-Phase: Mapping Actions. This task in this phase was identical to Studies 2, using the new unfamiliar actions for the ‘dummy demonstrations’: The experimenter demonstrated each action once, accompanied by the according sound but without any object as prompt. Then she asked the child to hand her one object matching this action.

11.1.3. Data Coding and Statistical Analyses

Data coding and statistical analyses were carried out parallel to Study 2.

11.2. RESULTS

11.2.1. Preliminary Analyses

Two independent student research assistants both coded the data set of 17 children (46 %). Based on this data, we computed intra-class coefficients (Field, 2013; Hallgren, 2012). Values for agreement were good to excellent throughout (Greve & Wentura, 1997), with ICC_{just} = .98 for Overall Imitation, based on the mean over all five objects. For the remaining rates, we computed values of agreement for each of the five objects separately, providing the following means and ranges: Mean *ICC* = .96 (range .89 - .99) for Correct Imitation in the Association Phase, mean *ICC* = .99 (range .97 – 1.00) for Correct Imitations in the Switch Phase, and mean *ICC* = .90 (range .71 - .96) for Corrective Actions.

To check whether sample characteristics influenced imitation rates, effects of gender and bilingualism were analyzed via Mann-Whitney-U-Tests. None of these variables had a significant effect on pretend play performance (all *ps* > .05). Therefore, all subgroups were collapsed for further analyses. Each dependent variable was checked for normal distribution and as each variable were non-normally distributed, non-parametric tests were applied.

11.2.2. Handing Objects and Mapping Actions

Handing Objects. Children handed a mean of 4.35 objects (*SD* = 1.36). A majority of children handed all five objects (N = 27). The number of objects handed to the experimenter did not relate to any of the other imitation measures (all *ps* > .05).

Mapping Actions. In the last experimental test phase, children were asked to choose one of the objects suitable for repeating a demonstrated action. The object used in the Association Phase was handed for a mean of *M* = 1.49 (*SD* = 0.84) times; the object used in the Switch Phase was handed for a mean of *M* = 1.73 times (*SD* = 1.02). Children did not show a preference for objects used in either of the two phases ($z = -0.87$; $p = .387$). Taken together, both objects were chosen above chance level ($t\ (36) = 6.39$; $p < .001$).

11.2.3. Imitation Performance

Overall imitation. Mean overall imitation rate (i.e. action imitation regardless of object choice) was *M* = 5.70 (*SD* = 4.62).

Correct imitation. Revealed by Wilcoxon Signed Rank Test, mean number of correct imitations was significantly lower in the Switch Phase (M = 1.97, SD = 1.94) than in the Association Phase (M = 2.51, SD = 2.04; z = -2.48, p = .013).

Corrective Actions in the Switch Phase. Corrective Actions (i.e. correcting either the object or the action when imitating) could be observed only rarely in the Switch Phase (M = 0.41 (SD = 0.76), and did not differ in terms of which action was imitated (z = -0.30, p = .763). Participants were much more likely to show correct imitation (z = -3.75; $p < .001$).

11.3. DISCUSSION

The overall imitation rate is somewhat lower in Study 3 than in Study 1 and Study 2. This may have to do with the use of unfamiliar objects and unfamiliar actions. Presumably, it requires more cognitive capacities to encode and reproduce completely unknown actions with unfamiliar objects than doing the same when only the objects are unfamiliar or when both (objects and actions) are familiar. Consistent with this interpretation, correct imitation rates gradually decreased from Study 1 to Study 3. Imitation rates were higher in the initial Association Phase than in the subsequent Switching Phase, thus replicating a general finding of Study 2. As already mentioned in the discussion to the previous study, this may indicate that children form a first association which may reduce the likelihood to accept a new object-action coupling - possibly reflecting children's normative orientation when learning from adult demonstrations. Corrective actions occurred less often than in Study 2. This may be due to the fact that they did not encode the initial object-action coupling in the same way as in Study 1 or 2, presumably due to the higher degree of complexity of the UFO_Unf-Acts task. This interpretation fits with the finding that participants did not display any clear preference of either the object presented in the Association or in the Switch Phase in the Mapping Action Task following the Main Phase, thus replicating findings of Study 2. Alternatively, a recency effect may have interfered with the encoding of the initial object-function relation established during the Association Phase.

12. COMPARISON OF STUDY 2 AND STUDY 3

In contrast to Study 1 that used familiar objects, Study 2 and Study 3 used unfamiliar objects. In Study 2 the experimenter demonstrated familiar actions; in Study 3, the actions were unfamiliar. Hence, familiarity with the experimental stimuli and previous knowledge about the actions demonstrated gradually decreased across studies. Whereas we could systematically vary the sequence of Block 1 and Block 2 in Study 1, this was not possible for Study 2 and 3. Here, the first demonstration phase (i.e. Block 1) always constituted the Association Phase and the second demonstration (i.e. Block 2) always constituted the Switch Phase. In Study 1, half of the children received the UnConv-Condition first, and half of the children received the Conv-Condition first. Accordingly, data of Study 1 can only be compared to data from the other two studies on a descriptive level. Studies 2 and 3, however, were similar enough in terms of their procedure to allow for statistical comparison as well.

12.1.1. Handing Objects and Mapping actions in Study 2 and Study 3

Handing Objects. When asked to hand the unfamiliar objects to the experimenter in Pre-Phase 2, children participating in Study 2 and Study 3 handed on average the same number of objects (z = -1.39; p > .164). Hence, responses were highly comparable between both studies.

Mapping Actions. In the Post-Phase, children were prompted by 'dummy demonstrations' to hand objects suitable for certain actions. We coded the number of objects they handed that matched the object-action relation presented in the Association Phase and the Switch Phase. Children from both studies showed comparable responses in the Association Phase as well as the Switch Phase, as revealed by non-significant Mann-Whitney-U tests (Association Phase: z = -0.70; p = .481; Switch Phase: z = -1.43; p = .154).

12.1.2. Imitation Performance

Overall imitation rate. As revealed by a Mann-Whitney-U-test, the overall imitation rate did not differ between Study 2 and Study 3 (z = -1.45; p = .146), although the rate was numerically higher in Study 2 (M = 7.33; SD = 1.61) than in Study 3 (M = 5.70; SD = 4.62).

Correct imitation. In both studies, rates for correct imitation were significantly lower in the Switch phase than in the Association phase. However, the numerical difference between the two phases was more pronounced in Study 2 than in Study 3 (see Figure 8). Consistent with this observation, the difference score (computed as Association Phase minus Switch Phase) was significantly higher in Study 2 (*M* = 1.27; *SD* = 1.64) than in Study 3 (*M* = 0.54; *SD* = 1.30; *z* = -2.08; *p* = .038).

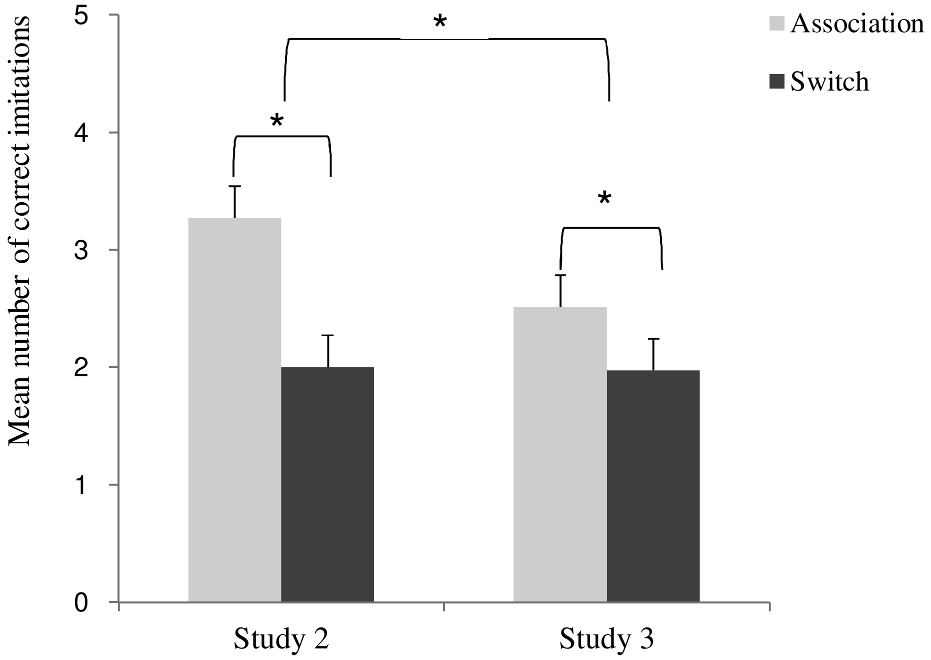

Figure 8. Mean number of correct imitations per Study (2 and 3) and demonstration phase.
*p < .05

Corrective Actions. No group difference was observable in terms of Corrective Actions shown in the two studies (*z* = -1.11; *p* = .269). In both studies, children were much more likely to imitate correctly than to correct the experimenter's demonstration. To test for a possible interaction effect here, again a difference score was computed (imitation in Switch Phase minus Correction in Switch Phase) which was then tested with a Mann-Whitney-U-test. This test yielded a non-significant result (*z* = -0.54; *p* = .587).

12.2. DISCUSSION

Performance regarding different imitation scores were largely comparable between Study 2 and 3, even though scores varied numerically with the degree of unfamiliarity (i.e. Total Imitation and Correct Imitation being slightly higher in the UFO_F-Acts than in the UFO-Un-Facts Study. The only substantial different found refers to the discrepancy between imitation rates for the Association and the Switch Phase (see also Figure 8). This implies that children were more likely to switch to a new object-function-relation when both: the objects as well as the actions demonstrated were new to them than when only the objects were unfamiliar, but the actions were familiar. Taken together, these findings strongly suggest that conventional object/action knowledge about artifacts somehow interferes with children's general tendency to imitate demonstrated actions. The more familiar a given object or action, the less inclined children seem to be to use the corresponding object in an unconventional way or to choose an object for imitation that does not match their knowledge about object-action couplings. Why may this be the case?

The tasks presented possibly require different degrees of basic cognitive skills related to executive functions. For this reason, we were specifically interested in exploring the relations between different imitation scores and different components of executive functions. The following chapters will address this issue.

13. STUDY 4: EXECUTIVE FUNCTIONS AND OBJECT SUBSTITUTION OUTCOMES

As revealed by Study 1, with age, children's flexibility to imitate even unconventional actions increases. Object substitution with function conflict requires children to remember more than one meaning of an artifact at the same time (Albertson & Shore, 2008). When using an object in an unconventional fashion, children need to inhibit their dominant response (Kelly & Hammond, 2011; Van Reet, 2015) and shift their attention away from the conventional meaning of the artifact (Carlson et al., 2014). Existing studies relating executive functions to higher order cognition mainly focused on older children, thus highlighting the explorative nature of the present study. We speculate that executive functions are positively related to imitation performance following unconventional demonstrations for the above-mentioned reasons. Especially those EF skills associated with managing cognitive conflicts, namely response inhibition (RIB) and shifting (SHF), are of interest in the present context. Working memory (WM) may also be implicated in imitating the experimenter correctly when the conventional action is demonstrated, however (compare e.g. Subiaul & Schilder, 2014). Corrective Actions (i.e. using the conventional object/performing the conventional action instead of imitating faithfully) indicate limitations regarding flexibility of thinking about artifact function. Thus, corrective actions are assumed to be negatively related to e.g. shifting performance.

For unfamiliar objects (i.e. Study 2 and 3), we assume that less conflict is induced during the Switch Phase, as fewer by contradictory context cues are present. Children do not need to consider the conventional object-function relation which possibly is engraved in their memory based on everyday experiences. Therefore, we assume that inhibition and shifting are less likely to be related to imitation performance during the Switch Phase (corresponding to the UnConv-Condition in Study 1). On the other hand, one could argue that shifting is needed in both phases of imitation even when unfamiliar objects are used because children need to learn new object-function relations (in Study 2) or even new actions (in Study 3). Compliance with the experimenter might play a role for Correct Imitation, as it does for the shifting task: Children need to join into the experimenter's way of playing. Albeit, this concerns both phases of the experiment, therefore shifting may play a role for imitation rates in both phases.

Working memory might play a role for imitation with unfamiliar artifacts, as different object-function-relations had to be remembered to correctly imitate. WM relates to the content and the amount of information children can copy from models (Subiaul & Schilder, 2014). Yet, this also concerns imitation rates over both phases of the experiment, and not so much only imitation in the Switch Phase of Study 2 and Study 3. The testing of these exploratory assumptions will be presented in the following.

13.1. METHOD

13.1.1. Participants

The executive functions tasks were administered to all participants of Study 1 to 3. This results in a sample of *N* = 72 children from Study 1 (*N* = 38 children aged 22 months and *N* = 34 children aged 26 months); *N* = 33 children from Study 2 and N = 37 children from Study 3, both of the latter tested at a mean age of 26 months. Thus, a sample of *N* = 38 22-month-olds and a total of *N* = 104 26-month-olds were analyzed. One of the tasks (WM) was adapted for the different age groups. For this reason, this task will only be compared on a descriptive level between the groups. Some children did not contribute data to all of the tasks, therefore the sample size varied for the different analyses. Table 1 gives an overview over these different samples and their characteristics, separated by study.

Table 1.

Sample Characteristics for Children from Study 1 who Contributed to the Analysis of EF Performance.

Sample Characteristics					
		22 Months		26 Months	
		N	M: m;d (SD) *Range: m;d (span)*	N	M (SD) *Range: m;d (span)*
Study 1	Total	38	22;16 (11) *21;1 – 22;29*	34	26;10 (8) *25;19 – 26;25*
	WM	36	22;16 (11) *21;1 – 22;29*	33	26;11 (8) *26;0 – 26;25*
	SHF	15	22;14 (14) *21;1 – 22;26*	30	26;11 (7) *26;0 – 26;24*
	RIB	33	22; 16 (11) *21;1 – 22;29*	31	26;11 (8) *26;0 – 26;25*

Table 2.

Sample Characteristics for Children from Study 2 and Study 3 who Contributed to the Analysis of EF Performance.

Sample Characteristics: EF from Study 2 and Study 3			
		N	M (SD) *Range: m;d (span)*
Study 2	Total	33	26;15 (10) *25;29 – 27;2*
	WM	31	26;15 (10) *25;29 – 27;2*
	SHF	26	26;13 (10) *25;29 – 26;29*
	RIB	28	26;15 (11) *25;29 – 27;2*
Study 3	Total	37	26;17 (10) *25;29 – 26;6*
	WM	37	26;17 (10) *25;29 – 26;6*
	SHF	25	26;19 (10) *25;29 – 27;6*
	RIB	34	26;16 (10) *25;29 – 27;6*

13.1.2. Material and Procedure

As already mentioned before, children were tested with the EF-battery (Pauen & Bechtel-Kuehne, 2016) after they completed the imitation task. Thus, general mode of testing (quiet laboratory setting etc.) were the same as for studies 1-3. In contrast to the imitation task, the EF battery was tested with child and experimenter sitting vis-à-vis at a table, as this setting provided better for the rather structured EF-tasks.

The *working memory (WM) task* was a modification of the ‘hide-the-pots-task’ (Bernier et al., 2010). Children were accustomed to the hide-and-seek principle via a warm-up training phase: Three boxes were placed on the table between child and experimenter and a wind-up toy was hidden in each of them on three consecutive trials. The child was prompted to point to the box containing the toy, the experimenter then opened the selected box to show whether the child made a correct choice or not. In this phase, children were allowed to search for the toy directly, without any delay. Following this familiarization phase, the toy was again hidden in one of the boxes while the child was watching, and then all boxes were covered with a piece of cloth. Only after a certain delay, the boxes were uncovered and the child was allowed to search for the toy.

Test trials varied in terms of the number of hiding boxes and the delay before being allowed to search for the toy (see e.g. Garon et al., 2008). The test trials for 22-month-olds included sets of 3 trials with (1) 3 boxes and 5 sec delay, (2) 3 boxes and 8 sec delay, (3) 6 boxes and 5 sec delay, and (4) 6 boxes and 8 sec delay. Test trials for 26-month-olds included sets of 3 trials starting with (1) 3 boxes and 8 sec delay, continuing with (2) 3 boxes and 12 sec delay, (3) 6 boxes and 8 sec delay, and (4) 6 boxes and 12 sec delay. In total, each child received a maximum number of 12 trials. Each phase involved a new toy, as this sustained the attention and the motivation of the children at a good level. The task took about 15 minutes.

The *shifting (SHF) task* was based on the dimensional-card-sort-task (e.g. Zelazo, Carter, Reznick, & Frye, 1997). To adapt for the limited vocabulary of the tested age group, verbal instructions were reduced as much as possible. Additionally, three-dimensional boxes that resembled the test items in color and shape were used to make these stimulus characteristics more salient. One was a yellow, rectangular box, the other was a green circular box. The wooden shapes that children were asked to sort were in accordance with the boxes in one dimension, but in discordance with the other dimension: They were either yellow and rectangular or green and circular. Thus, sorting according to one dimension meant that the other dimension had to be ignored.

The task comprised a training phase and two test phases with six trials each. In the two test phases, sorting according to two different rules (color or shape) was requested. As sorting according to shape turned out to be quite demanding for children of the tested age range, a training phase for shape-sorting was implemented.

Training Phase. In this phase, white wooden shapes were used as sorting stimuli. These white shapes did not induce any conflict because their color corresponded to neither of the boxes. The experimenter demonstrated sorting of white round and rectangular wooden shapes into the two colored boxes, according to shape. She sorted one round and one rectangular target into the corresponding box and stated joyfully: „Yes, this is where it belongs!"

Following the demonstration, the child was prompted to sort six shapes into the boxes consecutively. Correct sorting was praised by the experimenter. When the child sorted incorrectly, the experimenter said: "No, too bad, this is not where it belongs" in a sad tone of voice. The experimenter retrieved the wooden shape from the box at the end of each trial. Order of stimuli was quasi-randomized.

Sorting by Color. In this phase, the experimenter announced the start of a new game. The colored wooden shapes were introduced along with the first sorting rule: green shapes had to go into the green box, and yellow shapes into the yellow box. The experimenter demonstrated sorting on one example of each kind. The same feedback was provided as during training.

Sorting by shape. For this last phase, again a new game was announced. The rectangular shapes now had to go into the rectangular box; the circular shapes went into the circular box, regardless of their color. The experimenter demonstrated sorting for one example of each kind. Again, emotional feedback was given as in the previous phases. All through the task, neither the color nor the shape of the stimuli were labeled explicitly. Instead, color was highlighted with a smooth, holistic movement over the flat surface of the stimulus while shape was highlighted by tracing the outer rim of the shape with the index finger. The task took about five minutes.

The *response inhibition (RIB) task* was inspired by tasks on snack delay (Kochanska et al., 2000; Voigt et al., 2012) and on the forbidden toy task (Carlson, 2005; M. Lewis, Stanger, & Sullivan, 1989), see Bechtel (2014) for a detailed description of the derivation for this task. The experimenter asked the child to place both hands underneath the table. She placed a transparent bowl with ten pieces of cookies on the table in front of the child (within reach), covered with a piece of cloth. The experimenter then stated: „Wait until I'm back, wait for me, please!", thereby uncovering the bowl. Then, the experimenter left the room for two minutes. The caregivers were instructed to read in a book at this point of the experiment and not to intervene should their child decide to eat the cookie before the experimenter returned. This served to insure that the child did not seek advice from the accompanying caregiver on whether to follow the instruction or not. Material for all three tasks is depicted in Figure 9.

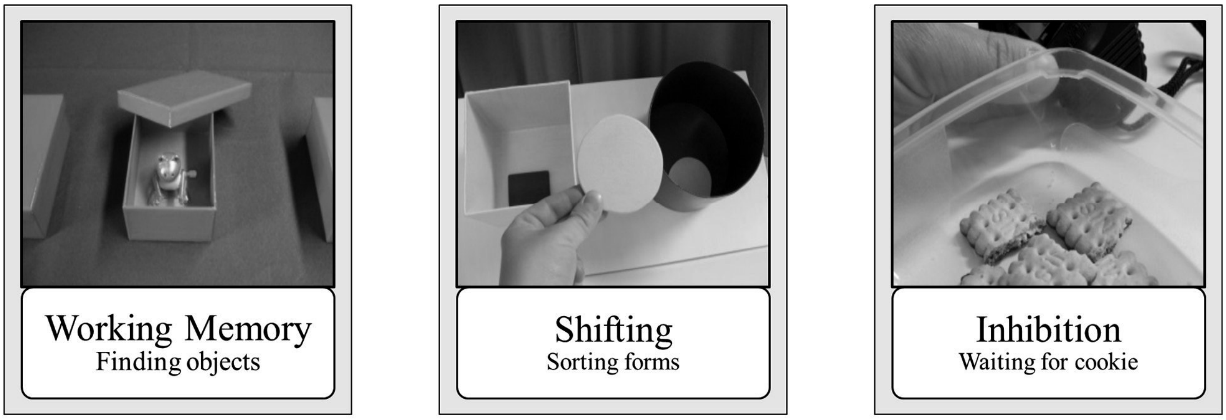

Figure 9. Material for Executive Function Task Battery developed by Pauen and Bechtel-Kuehne (2016). Reprinted with permission of Sabrina Bechtel-Kuehne.

13.1.3. Data Coding and Statistical Analysis.

All sessions were videotaped and coded by trained research assistants blind to the hypothesis who were mostly not involved in data collection for the given subject.

For the WM task, the number of correct trials (i.e. retrieval of toy) was analyzed. A maximum score of i = 12 correct trials (4 phases with 3 trials each) could be reached. For SHF, only data of those children who managed to sort five out of six shapes correctly in the training phase was included in the analysis. This served to insure that children were actually able to sort according to shape. We counted the number of correct trials of the two switching phases as shifting score. Again, the maximum score was i = 12 (2 phases x 6 trials each). For all analyses of the working memory and the shifting performance, we used percentage of correct trials. For the

RIB task, latency in seconds until the first cookie was eaten was measured. Since the experimenter left the room for 120 seconds, this was also the maximum latency achievable for the children. In addition, the number of children who waited until the experimenter had returned was recorded.

13.2. RESULTS

Mean EF scores with standard deviations are given in Table 3. Kruskal-Wallis-Tests revealed that there was no significant difference in performance on any of the EF tasks for the different subsamples of 26-month-old children (all *ps* > .10). A sample of $N = 17$ of Study 1 were double-coded by two independent researchers. Accordance for the EF-tasks was $ICC_{just} = 0.99$ for working memory, $ICC_{just} = 0.85$ for shifting and $ICC_{just} = 0.99$ for response inhibition. Hence, coders were well able to code data on all three EF components reliably, thus replicating earlier findings by Pauen and Bechtel-Kuehne (2016).

Table 3.

Number of Valid Data Sets, Mean Performance Regarding Each EF Task with Standard Deviations per Age Group.

EF Performance					
		22 Months		26 Months	
		N	M *(SD)*	N	M *(SD)*
Study 1	WM	36	52.78 *(17.82)*	33	59.60 *(20.43)*
	SHF	15	60.37 *(17.01)*	30	61.39 *(20.70)*
	RIB	33	41.97 *(48.13)*	31	76.61 *(55.30)*
Study 2	WM			31	62.10 *(19.70)*
	SHF			26	62.50 *(17.20)*
	RIB			28	76.61 *(50.22)*
Study 3	WM			37	53.60 *(20.18)*
	SHF			25	68.67 *(14.69)*
	RIB			34	86.47 *(49.15)*

Note. Working Memory and Shifting: Percentage of Correct Trials; Response Inhibition: Waiting Time in Seconds.

13.2.1. Age-Group Comparison

A comparison of performance across age groups was only possible for the data of Study 1, as these were matched and had received similar treatment in the imitation task before. As revealed by Table 3, only few children had to be excluded from the sample for the working memory task and the response inhibition task. But in the shifting task, only $N = 15$ children of all 22-month-olds reached the criterion of the Preswitch Phase. A rather large subgroup ($N = 19$) could not sort the stimuli by shape on 5 out of 6 trials correctly. Hence they were not included in the final sample. *N* = 3 children had to be excluded due to fussiness displayed only in this task. Results of 22-month-olds in the shifting task should thus be interpreted with caution. For 26-month-olds, the drop-out rate was within the normal range.

As some of the critical outcome variables were distributed non-normally, non-parametric Mann-Whitney-U-Tests (one-sided) were used for all statistical age comparisons. For working memory, statistical tests are not indicated as age-adapted delays were used. But on a descriptive level, it still seems that older toddlers performed better in finding the hidden objects (*Mdn* = 66.67% of all test trials) than younger toddlers (*Mdn* = 50.00%), despite the higher level of difficulty of the task applied. Older toddlers waited longer before taking a cookie in the response-inhibition task as indicated by significantly higher latency scores (*Mdn* = 16.00 for 22 month-olds versus *Mdn* = 120.00 for 26 month-olds; $z = -1.78$; $p = .038$). Also, significantly more children waited for the entire period of 120 seconds in the older age group (18 out of 31) than in the younger age group (8 out of 33); $X^2(1) = 7.58$, $p = .006$. For shifting, no increase in performance from 22 to 26 months can be reported ($z = -0.24$; $p = .404$), which will be discussed in light of the high dropout rate for the 22 month olds.

13.2.2. Intercorrelations Between EF-Measures

The intercorrelations between the different EF tasks are denoted in Table 4 and Table 5. As apparent from Table 4, among 22-month-olds, no significant correlation was found between any of the three EF tasks (all *ps* > .10). Among the 26 month-olds, SHF and RIB were correlated substantially in each of the different subsamples (see Table 5). WM did not correlate with any of the other tasks.

Table 4.

Spearman Correlations Between Different EF Tasks in Study 1.

Intercorrelations EF Performance Study 1					
22 Months			**WM**	**SHF**	**RIB**
	WM	N	.	14	31
		r (*p*)	.	-0.31 *(0.92)*	0.034 *(0.85)*
	SHF	N	.	.	14
		r (*p*)	.	.	-0,112 *(0.70)*
26 Months			**WM**	**SHF**	**RIB**
	WM	N	.	29	30
		r (*p*)	.	-0.27 *(0.16)*	0.28 *(0.14)*
	SHF	N	.	.	27
		r (*p*)	.	.	0.56** *(0.00)*

Note. ** $p < .01$, two-tailed.

Table 5.

Spearman Correlations Between Different EF Tasks in Study 2 and Study 3.

Intercorrelations EF Performance Study 2 and 3					
Study 2			**WM**	**SHF**	**RIB**
	WM	N	.	25	30
		r (*p*)	.	-0.13 *(0.53)*	-0.02 *(0.93)*
	SHF	N	.	.	23
		r (*p*)	.	.	0.46** *(0.03)*
Study 3			**WM**	**SHF**	**RIB**
	WM	N	.	25	34
		r (*p*)	.	0.24 *(0.24)*	0.25 *(0.15)*
	SHF	N	.	.	23
		r (*p*)	.	.	0.56** (*0.01*)

Note. ** $p < 0.01$, two-tailed.

13.2.3. Relations between Executive Function Performance and Pretend Play

Exploratory analyses were carried out to test for relations between executive functions and pretend play behavior. All analyses were based on Spearman's correlations which can be used to analyze non-parametric data (Field, 2013).

Study 1. In 22 month-olds, no significant correlations were found between any two measure of pretend play behavior and executive function performance. In 26 month-olds, however, we did find a significant negative correlation between shifting and mean number of corrective actions. Children who performed better in the shifting task displayed fewer instances of corrective actions than children with lower shifting skills ($N = 26$; $r = -.44$, $p = .025$). Please note that *N* = 4 children had to be excluded from this analysis, as they had shown corrective as well as correct imitation on the very same trial. This response is not directly comparable to those showing corrective actions only.

Study 2. None of the correlations between any of the EF components and Pretend Play performance reached significance, except for response inhibition that was marginally correlated with correct imitation in the Switch Phase (*N* = 30; *r* = .36; *p* = .052).

Study 3. Shifting correlated positively with Overall Imitation (*N* = 25; *r* = .42; *p* = .039), as well as with Correct Imitation in the Association Phase (*N* = 25; *r* = .44, *p* = .027) and in the Switch Phase (N = 25; *r* = .43, *p* = .032). No other correlations were significant.

13.3. DISCUSSION

13.3.1. EF Performance

In Study 1, performance increased significantly for WM and RIB from 22 to 26 months of age. Performance in the SHF task did not increase. This might be attributed to the large number of 22-month-olds who had to be excluded because they failed to reach the initial learning criterion. Yet, a larger proportion of 26-month-olds reached the criterion, which also indicates some increase in performance in the SHF task.

This implies that EFs undergo substantial changes when children turn two years of age and that the EF tasks presented here are useful to investigate this process (Bechtel, 2014; Pauen & Bechtel-Kuehne, 2016). Most EF studies focus on older toddlers or preschoolers (Garon et al., 2008), but as indicated here, important developments take place earlier than that (e.g. Cuevas & Bell, 2014). As indicated by our results, 26-month-olds are capable of solving a simplified version of the DCCS, even though the standpoint of the CCC-account supposes that as the ability to use higher-order rules might be tied to self-reflection capacities, true shifting should nit evolve this early (Zelazo, 2006). The high dropout-rates for the 22-month-olds corroborate the assumption that SHF is a skill developing later than other EF components. Yet, developmental steps that take place before full mastery of the DCCS in its original version should not be ignored. More studies (ideally with longitudinal design), should further investigate EF development in the potentially critical period between 22 and 24 months.

SHF and RIB overlap conceptually. As apparent from section 7.1, some definitions for so called complex inhibition (e.g. Carlson et al., 2014) apply for what we call shifting. As expected, performance in these two EF tasks correlated significantly at 26 months of age, over all three studies. No such correlation was observed for 22-month-olds, however. This may be due to the small sample size among the 22-month-olds and the large number of dropouts in the Preswitch Phase of the shifting task. Yet, Pauen and Bechtel-Kuehne (2016) also found no relation between SHF and RIB in 24-month-olds, despite the fact that drop-out rates were lower in this study. In consequence, we presume that the relation between SHF and RIB emerges at some point in the investigated age range and appears to be relatively stable by 26 months of age. Future studies need to test similar age groups longitudinally, applying the same tasks to investigate the stability of relations between shifting and response inhibition in toddlerhood.

This finding adds to the debate (see section 7.2) on whether EF is fractionated or unitary to begin with, and follows a developmental line of differentiation or integration. Some studies found a one-factor solution to provide the best fit (Brydges et al., 2014; C. Hughes et al., 2010; Wiebe et al., 2008; Wiebe et al., 2011). Yet, our own data rather supports other findings which challenge this differentiation model. The study by Howard et al. (2015) indicates that during preschool years, integration of initially unrelated executive processes takes place, and speaks against the existence of some kind of a unified executive resource in the age range tested. Combined with the findings from Pauen and Bechtel-Kuehne (2016) the presented data suggests that a relation between SHF and RIB emerges later. One reason could be that with increasing skills, children learn how to employ one resource (e.g. RIB) to solve a task from a different domain (e.g. SHF).

Our results show WM to be rather unrelated to the other two EF tasks in the investigated age range (see also Pauen & Bechtel-Kuehne, 2016). This seems plausible given the conceptual overlap between SHF and RIB. As tasks on SHF and RIB did not pose high demands on memory capacity or updating, it is conceivable that WM demands are rather low in these ‘conflict’ tasks. This also coincides with other recent findings reporting WM to be distinguishable from RIB and SHF from relatively early on (Lee et al., 2013; Lee et al., 2012; M. R. Miller et al., 2012; Van der Ven et al., 2012). It is to be noted, whatsoever, that we had only two different points in time for cross-sectional testing, as it was not our primary focus to explore the early structure and development of EF components. To accomplish such an issue, longitudinal studies assessing the components with a multi-method design would be necessary (see Pauen, 2016). Our focus was rather to provide first evidence on the interplay of early EF performance and pretend play behavior, as assessed in our object substitution task.

13.3.2. Relations Between Pretend Play and EF Performance

WM was not associated with pretend play in 22- and 26-month-olds, in none of the three studies, despite the fact that imitation probably requires memory skills (Subiaul & Schilder, 2014). However, imitation as such was not very complex in our design – it required merely memorizing a simple action over a very short time. Updating memory played only a minor role in our specific pretense paradigm, as the object-function relation was only switched once between both blocks of the task.

Possibly, the WM task also differed in nature from the kind of memory capacity required to succeed in the substitution task. In our WM task, children were required to encode and update spatial locations. In the substitution task, they had to encode the identity of objects. Presumably, other WM tasks are better suitable to reveal a relation to pretense capacities. Yet, for toddlers in the tested age range, only a limited choice of tasks exists anyway. It thus seems to be necessary to develop more WM tasks for toddlers that ask for memory of identity rather than for memory of spatial location.

Not surprisingly, findings on the relation between WM and pretense are sparse altogether. Most studies refer to theory of mind research (e.g. Gordon & Olson, 1998). The study by Albertson and Shore (2008) introduced in section 7.3.2 stated that real and pretend identities are probably stored separately and thus, pretense requires WM capacities to manage these multiple representations. WM performance, however, was only related to remembering at least one identity, not to remembering both identities. We conclude that WM, as assessed in the present case, does not play any major role for pretense.

Contrary to our expectations, performance in the UnConv condition of Study 1 was empirically unrelated to performance in the Response Inhibition Task. Tomasello et al. (1999) suggested that children fail to accomplish object substitution tasks because they fail to inhibit sensory-motor-reaction schemes that are activated by familiar objects. Accordingly, in the current study, it was assumed that RIB capacities would relate to pretense performance because they help to inhibit the dominant response of acting conventionally in the UnConv condition. As outlined in section 7.3.2, several studies implicate this relation. Children with better RIB performance were shown to display better pretend play performance (Carlson et al., 2014; Kelly & Hammond, 2011; Van Reet, 2015). One conceivable reason for this discrepancy with previous findings might lie in the different age ranges tested. Existing findings refer to children between three and seven years of age. Participants in the current investigation were much younger. Research indicates that EF capacities undergo substantial changes in early years (S. E. Miller & Marcovitch, 2015; Pauen & Bechtel-Kuehne, 2016) and our own results add to this picture: The relatively stable correlation between SHF and RIB observed in 26 month old children was not detectable in 22-month-olds yet, and was also neither found for 24-month-olds by Pauen and Bechtel-Kuehne (2016). Possibly, this early inconsistency in inhibition skills masks early relations to pretend play performance.

Another argument refers to the temperature of the inhibition task and the pretense task. The RIB task used was a “hot” task, requiring children to resist the temptation of eating cookies. Conceivably, the pretend task did not involve any primary temptation. We argued that via everyday experiences with the function of objects, certain affordances evolve, which essentially constitute the challenges described in the triune representation problem (Tomasello et al., 1999). Children in Study 1 had to face this triune representation problem. Yet, there is still a difference between such affordances and the drive to satisfy a primary impulse. One could therefore argue that our pretense task was rather a ‘cool’ task, which might explain the lack of correlation between performances on both tasks. In line with this argument, no relation between performance in the cookie-task and transfer performance in a tool-learning task was observed by Pauen and Bechtel-Kuehne (2016).

We expected that in substitution tasks with unfamiliar objects, RIB would be implicated to a lesser extent than in tasks with familiar objects. Taken that we did not find any correlation in Study 1, it is comprehensible that there was no such relation in Study 2 or Study 3, except for one marginally significant correlation between RIB and correct imitation in the switch phase. This is quite interesting, as RIB did not relate to any other imitation measure over all three studies.

SHF, in contrast to RIB, revealed more of a relation to pretend play performance: In Study 1, 26-month-olds who displayed more advanced shifting skills, performed fewer corrective actions in the UnConv condition. We conclude that, in the older age group, children with higher shifting skills were more flexible in object substitution than children with lower shifting skills. In addition, children’s attitude towards authorities may also have contributed to this relation: In the UnConv condition, children needed to shift their attention away from conventional artifact function to accomplish the requested object substitution. Better shifting skills possibly supported this attentional shift. However, to join into the experimenter’s game, participants needed to follow her instructions. This requires commitment and compliance in both the shifting and the object substitution task. Possibly, children who displayed corrective actions frequently were not as inclined to follow the experimenter’s lead. Maybe they did not conceive of her as an authority who indicated how the game is played. Therefore, compliance and commitment might have played a role for the observed relation between SHF and the number of corrective actions in the pretend play task.

In Study 2, SHF was not related to any of the imitation rates in the substitution task. We speculated that possibly, SHF is not related with imitation performance in the Switch Phase, as there is less conflict when artifacts to be substituted are unfamiliar. Yet, it was assumed that possibly, the overall imitation rate would correlate with shifting performance, as commitment and compliance, which both support performance in the Shifting Task, could be relevant in the Substitution Task as well. This was not the case, whatsoever. Even more intriguing, in Study 3, the expected relation was observed: Overall imitation rate as well as imitation rates in both phases separately correlated positively with shifting performance. Thus, in Study 3, children with better shifting skills were also better able to imitate the demonstrated, unfamiliar actions. And moreover, SHF was related to both imitation rates. Thus, SHF capacities go along with better ability to imitate both demonstrated actions. Together with the finding that the only relation between EF and pretense performance was a marginally significant correlation between RIB and correct imitation in the Switch Phase of Study 2, we can speculate that shifting plays some role in object substitution with unfamiliar artifacts, but more so when both the action and the object are unfamiliar.

14. General Discussion and Outlook

The purpose of a discussion is not the victory, but the gain.

Joseph Joubert (1754 – 1824)

The current work investigates flexibility of object substitution pretense with familiar and unfamiliar objects, as well as the implication of EFs in these different substitution tasks. Results indicate that the imitation of conventional actions with familiar objects is easily accomplished by two years of age. Furthermore, toddlers show a significant increase in flexibility regarding unconventional object use from 22 to 26 months of age, as illustrated by the fact that older children showed more imitation in the unconventional condition than the younger group did (Study 1). 26-month-olds also reveal more flexibility in substituting objects for different functions when these objects are unfamiliar objects (Study 2), and even more flexibility when objects and actions are both unfamiliar (Study 3). In sum, this set of findings reveals that functional object knowledge can interfere with imitation performance and flexibility to use one object in association with different actions. This points to the conclusion that object substitution, as a more advanced form of pretend play, shows important developments around the second birthday.

Study 4 investigates developmental changes in Executive Functions (EF) from 22 to 26 months, based on the data of Study 1, as well as the relation between performance in Working Memory (WM), Shifting (SHF), and Response Inhibition (RIB) on the one hand, and performance in each object substitution task (see Study 1 to 3, on the other hand), based on the data of 26-month-olds only. Overall, our findings show that children around two years of age undergo major changes in the assessed capacities, as performance in most EF tasks and the object substitution task improves with age. Performance in the presented object substitution tasks is well in accord with results reported in the literature (Fein, 1975; Killen & Uzgiris, 1981; Rakoczy et al., 2005; Tomasello et al., 1999), suggesting suitability and validity of the paradigms for the age-range tested.

14.1. INCREASED FLEXIBILITY IN OBJECT SUBSTITUTION WITH FAMILIAR OBJECTS FROM 22- TO 26 MONTHS OF AGE

Our studies' focus was on the flexibility of young toddlers in object substitution pretense. We reasoned that an imitation task involving familiar objects and actions that are conventionally associated with these objects, corresponds to object substitution with replica objects. These objects closely resemble artefacts used in everyday life (in our case we even used real items; see Figure 4). Thus, the mapping of the symbol and its referent should be very easy (Fein, 1975; Hopkins et al., 2016). Results of Study 1 support this assumption: Even the younger age group tested (22-month-olds) performed very well on imitating the demonstrated conventional actions, even when this demonstration was preceded by an unconventional use of the artifact.

As discussed already (see Study 1), some theorists might question whether elicited imitation truly reveals pretense capacities: Imitation might also be possible without an understanding of the observed behavior (see Rakoczy, 2003). Possibly, children were not required to undertake any mapping at all. In our study, however, demonstrated actions were clearly embedded in a pretend play context (i.e. we demonstrated the actions in an exaggerated fashion and did not truly perform the action). The majority of children imitated demonstrated actions with verbal or procedural enhancements (e.g. by pressing the buttons of the cell phone before starting a conversation with an imagined person). Therefore we argue that participants of our study grasped the pretense character of the situation, at least to a certain extent. This assumption is in line with the cultural learning account for pretense (Rakoczy, 2003), which treats imitation as an expression of the underlying understanding of intentional acts. Imitation is seen as a means of acquiring pretense, and even young children are accredited with an apprehension of pretense as an intentional activity. The current investigation adds to this debate, as our results indicate that children of the tested age range are well able to imitate the pretense acts, but also enhance them semantically. Thus, we conclude that they do more than just mirroring the motor schemes observed in the experimenter.

Asking children to imitate unconventional acts lead to different findings: 22- and 26-month-olds displayed lower imitation rates for unconventional demonstrations. This supports previous findings reporting difficulties in object substitution pretense with function conflict for young toddlers' and even preschoolers' (Bigham & Bourchier-Sutton, 2007; Hopkins et al., 2016; Jackowitz & Watson, 1980; Killen & Uzgiris, 1981; Tomasello et al., 1999).

The literature proposes several explanations for this phenomenon. Fein (1975) and later Hopkins et al. (2016) took reference to the mapping of symbol and referent, which is easier when the cues provided by the objects are in accordance for the pretense and the real identity. Conflicting cues exacerbate the mapping task and thus hinder a successful object substitution of dissimilar objects. For this mapping process, symbolic awareness is likely to play a critical role. Relating a symbol and its referent is not a trivial task, and research on the development of this skill has shown that even 30-month-olds struggle with understanding symbolic relations (DeLoache, 1991). It is thus conceivable that subjects in the current study were not proficient in this mapping, either. It is not clear, however, whether early object substitution gets by completely without any symbolic awareness, as some would argue that even the simplest pretense act of a child closing her eyes and pretending to sleep, as described by Piaget (1951), is symbolic.

Dividing sharply between symbolic and non-symbolic acts is difficult, and to our knowledge no empirical evidence exists that would justify such a clear dividing line. Instead of using different terms, e.g. representational versus symbolic (Vig, 2007), we think of symbolic awareness as a continuum (see Figure 3 in section 8). We argue that high symbolic awareness supports object substitution with function conflict, because children are more acquainted with the sometimes arbitrary relation between a symbol and its referent. The more you learn about symbolism in language and in signing, the more you encounter symbols that do not resemble their referents at all. This may help children to learn that *any thing* can stand for *anything,* also in the case of objects with a set status function.

Tomasello et al. (1999) has argued that children cannot inhibit motor-reaction-schemes that are activated by familiar objects, and called this the triune representation problem, based on DeLoache's (1995) account of the dual representation problem with symbols in general. Fein's (1975) and Tomasello et al's (1999) accounts both focus on cognitive conflicts that children need to resolve in the given situation.

Another conflict could arise on the level of normative understanding: Possibly, children struggle not only with conflicting object knowledge on a purely cognitive level, but also with conflicting normative conventions on a socio-cognitive level. As indicated by previous studies, children in the tested age range view artifact function normatively (Casler et al., 2009) and appreciate that objects are made for a certain purpose (Casler & Kelemen, 2007). So perhaps children do not only have to overcome the affordances inherent in the object, but also have to resolve the situation that a person behaves contrary to what conventions would demand. In any case, children need to draw on resources to resolve these conflicts, and our research supposes that EFs might be relevant in this context.

When considering that normative understanding may play some role in explaining our results, social factors like commitment and compliance are important as well. Some children showed corrective actions, suggesting that they tried to resolve the conflict between the knowledge about the conventional use of the given artifact and the demonstrated action. Interestingly, corrective actions were used less often by children exhibiting better shifting performance. We cannot decisively say, however, whether children performed corrective actions because they simply fell for the affordances of the object, or whether they tried to communicate the 'correct use' to the experimenter. As mentioned before, commitment and compliance may both have influenced performance in the object substitution and in the Shifting Task. The results of Study 1 do not allow us to distinguish between a normative and a cognitive explanation for the conflict which children evidently experienced in the Unconventional Condition.

Future studies could address this issue by evaluating normative protest, like in the study by Casler et al. (2009). Possibly, studies on normative understanding of pretend games, like the '*daxing-studies*' (Rakoczy, Warneken, & Tomasello, 2008) could be inspiring here: Framing the unconventional action with a name for that absurd behavior might increase children's readiness to join in. If inhibiting the motor reaction schemes is the primary issue, performance should stay the same. Yet, a frame needs to be instigated verbally, which is difficult to do with children at the verge of acquiring language. Children in the daxing study were 25 to 38 months old, and though both age groups showed normative protest, the older children did so on a more explicit level. Possibly, creating appropriate instructions to set the frame is a challenge to meet when trying to disentangle normative and cognitive conflicts.

In addition to the finding that 22- and 26-month-olds showed a preference for conventional object-function relations, Study 1 also reveals an increase in flexibility which is quite striking considering the rather narrow age range. In the Unconventional Condition, 22-

month-olds were equally likely to correct and to imitate the observed action, while 26-month-olds were more likely to imitate faithfully despite their increased object knowledge. This implicates that even during this short period of time, some development takes place that seems to enable toddlers to take a more flexible stance towards unconventional object use in a pretend play context.

14.2. Increased Flexibility with Decreased Reference to Reality: Object Substitution with Unfamiliar Objects

Study 2 and Study 3 reveal higher flexibility in object substitution with unfamiliar actions. These studies target the mid-range of the symbolic-awareness-continuum. As expected, children showed lower imitation rates in the initial association phase, which is in accordance with findings stating that object substitution with ambiguous objects is more difficult than substitution with replica objects (Jackowitz & Watson, 1980). However, the discrepancy between the two phases is far less pronounced than in Study 1. Between Study 2 and Study 3, statistical comparisons reveal an interaction between Study and Condition. Thus, the discrepancy between imitation rates of both phases is lower when actions as well as objects are unfamiliar as compared to actions being familiar and only objects being unfamiliar. We assume that the less reference to reality is provided, the more flexible young toddlers are in accepting different (pretense) identities of a given artifact. This is in line with findings implicating that false belief tasks are distinct from pretense tasks (Kühn-Popp et al., 2013; Meinhardt et al., 2012), with false belief tasks being more challenging than pretense tasks, presumably because the real state of affairs has to be considered in the former but not in the latter case (Custer, 1996; Woolley & Wellman, 1993).

We conclude that children experience less conflict when objects do not deliver cues for a real identity and thereby imply that a normative way of using them does exist. However, some association is probably being formed between any unknown object and the first action demonstrated, as children imitate more in the first than in the second phase of Study 2 and Study 3. Possibly, children simply associate the first action with the object and experience an affordance for this action in the second phase which hinders them from imitating the switched function. Alternatively, they perceived the first object function as normatively related to the object and were not willing to go along with a second function. As in Study 1, we cannot differentiate between both options.

In continuing this line of research, it may be interesting to conduct a series of studies with a more fine-grained manipulation of object knowledge. The studies presented here targeted two contrasting situations: Highly familiar and completely unfamiliar objects. Accordingly, we had a performance near ceiling in the comprehension task of Study 1 while an assessment of object familiarity in Studies 2 and 3 was not applicable at all. Maybe, object knowledge could be manipulated experimentally to check whether flexibility in substitution tasks actually correlates with degree of object knowledge. Such a finding would further support the assumption that object knowledge plays a role for early flexibility in object substitution pretense.

14.3. IMPLICATION OF EXECUTIVE FUNCTIONS IN OBJECT SUBSTITUTION PRETENSE

Concerning EFs, the current investigation provides first evidence for empirical relations between different components (i.e. between SHF and RIB) at 26 months of age, but not at 22 months. Pauen and Bechtel-Kuehne (2016) who used the same EF battery as we did reported no corresponding correlations at 24 months of age. These findings seem of interest when it comes to discussing whether early EF is a unitary concept or whether different EF components can be differentiated even in very young children. We do not claim to deliver concluding evidence here. Rather, our findings strengthen the request for multi-method – repeated measurement studies on all three components (Garon et al., 2008). Our data suggests that it is reasonable to consider early toddlerhood for conducting such studies.

Studies on the relation between EF and pretend play at two years of age are sparse and yielded mixed results so far (see Lillard, Lerner, et al., 2013 for a review). Pretend play is commonly advertised as an important developmental factor also for self-regulation and EFs. Yet, it does not seem clear yet, whether existing empirical evidence truly justifies such a role of pretend play (Bergen, 2013; Lillard, Hopkins, et al., 2013; Walker & Gopnik, 2013). Longitudinal and well-controlled training studies are needed to clarify this issue. As apparent from section 7.3 on the relations between EF and pretend play, a more thorough investigation of correlations between EF and pretend play seems useful to conceptualize corresponding studies that might help to answer this question.

The findings presented here may serve as a valuable starting point to meet this end. Our results reveal certain relations between EF (i.e. SHF) and flexible object substitution to emerge at around two years of age (Study 1), and furthermore EF (i.e. SHF and to a lesser extent RIB) to be implicated in imitating new actions overall (Study 2 and Study 3). The new method used in the current investigation seems suitable for studying these issues and provided first insights. Certainly, our results are not exhaustive. The expected relation between imitation rates in the Unconventional Condition of Study 1 and EFs was not found. For future studies, it might be advisable to tease apart how much of the conflict induced in the substitution task is normative in nature and how much refers to automatic activation of motor reaction schemes. A substitution task that is less dependent on commitment and compliance and rather focuses on the conflict elicited on the level of motor-reaction-schemes might be more closely related to a simple inhibition task as was used here.

In conclusion, the findings presented in this thesis reveal first insights into a highly dynamic phase of development in pretend play and executive functions, as well as first hints on early relations between the two domains. It has been demonstrated that flexibility in object substitution pretense depends on object knowledge and that children are more flexible when fewer reference to familiar entities is requested. Future studies could focus on investigating normative and cognitive shares of the conflict that children obviously experience when they are ought to imitate a switched object-function-relation. Additionally, studies with more differentiated levels of object familiarity would give further insights into the relation between object knowledge and flexibility in object substitution.

The objective of relating pretend play with executive functioning remains highly fascinating. Future studies might manage to reveal how children become more and more proficient in using resources from different domains flexibly. Such insights are highly relevant, as they not only deepen our knowledge about a single developmental process, but rather complement the picture of development as an integrative process. Thus, they take us a step further in understanding how helpless babies lying in our arms at birth become autonomous children, with their own, unconventional ideas on how to turn the world upside down in (but not limited to) pretend play.

14.4. PERSONAL CLOSING WORDS

First of all, thanks to the reader for going along all the way to this point. It has been an exciting journey to write this thesis, and I hope it was an enjoyable journey to read about. To begin with, I promised some fun, and as this thesis is about toddlers and play, you hopefully also had some fun along the way. To close, I shortly want to return to Mary, the girl we encountered in the introduction. She has grown to be a grey old lady over all these pages, but let us reconsider her early years. Starting out as an infant mouthing every object irrespective of its function, she learned to apply normative rules and to use objects conventionally, which limited the scope of possible actions a little – before she burst with unconventional ideas of the million ways to use a hammer. The results of this scientific work illustrate little bits and pieces of this process, but a lot more is to discover. For example, we do not know yet whether Mary's normative understanding or mere associations and the automatic activation of certain motor reactions formed from everyday experiences with object functions lead to the conflict she experiences when an object is used in an unconventional fashion. And we cannot say at which age she first felt this conflict. But we might conclude that around her second birthday, she probably started to find a way to resolve it.

As my focus was so much on pretend play in the work context, I was not beyond to have an eye on this phenomenon in private, as well. With an infant who became a toddler, a toddler, who became a preschooler, and a preschooler who became a schoolboy, I was able to observe the many different, captivating stages of pretense, and I must say that this topic will keep fascinating me for much longer.

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