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New Approaches to the Study of Early Self-regulation Development

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Editorial

Sabina Pauen

Good self-regulation skills are typically associated with a broad range of positive outcomes, including academic and social achievements, prosperity and mental wellbeing. But when and how do these skills first emerge? How can we best describe and measure them? And what determines their development? The six original papers presented in this Special Issue search for answers to these questions. The authors come from various institutions in different countries. What unites us is the hope that solid research on the very beginnings of self-regulation skills will help us to support the next generation in living a healthy and happy life.

According to recent longitudinal studies, self-regulation capacities emerge in early childhood but remain sensitive to social influences throughout the entire lifespan. They result from a combination of brain maturation processes and social influences. Whereas newborns completely depend upon their caregivers when it comes to satisfying basic needs or keeping their psychological balance, toddlers and preschoolers already show some degree of independence in this respect. Even though they still experience limitation in self-regulation of their motivational, emotional, and cognitive states, they nonetheless make great progress in gradually gaining control of their own mental processes.

The impact of caregivers on this process is analyzed and explained in more detail in the first paper of this Special Issue: Pauen and colleagues present the EDOS model (Early Development Of Self-regulation), a framework that describes structural changes in self-regulation skills throughout early childhood, thereby defining different aspects of self-regulation and specifying how caregiver's co-regulation varies with the age of the child. The author also presents the so-called PROSECO model (PROcess of SElf- and CO-Regulation). This model identifies multiple ways in which experimenters co-regulate performance of young children in laboratory settings. Both models ask how adults shape self-regulation in young children, one taking a more general approach and describing how young children are educated by their parents to apply self-regulation strategies, and the other zooming in to understand how performance of young children in instructional tasks (even tasks measuring self-regulation skills) depends on co-regulation by adults.

The second contribution (The role of coregulation for the development of social-emotional self-regulation), authored by Judith Silkenbeumer, Eva-Maria Schiller, Manfred Holodynski and Joscha Kärtner focuses specifically on social-emotional self-regulation and the process by which caregivers teach 4- to 6-year-olds to deal effectively with emotionally challenging social situations. The proposed internalization model of reflective emotion regulation states that caregivers first support children by talking about emotions (of self and others) before they guide them in generating, evaluating and selecting arguments that seem useful for responding in a socially accepted way.

To assess the complex interactions between caregivers and children in promoting children's development of self-regulation, the third contribution (Co-and self-regulation in the caregiver-child dyad: parental expectations, children's compliance, and parental

practices during early years), authored by Bechtel-Kühne, Strodthoff and Pauen presents a newly developed questionnaire (IMMA 0-6 IMpulse MAnagement in the parent-child dyad form 0 to 6 years of age) and the empirical relations between parental ideas and practices on the one hand, and children's behavioral responses on the other hand. This new tool can help researchers as well as practitioners to assess what happens in parent-child dyads or - at least - how caregivers perceive this process.

The fourth contribution (A Review of hot executive functions in Preschoolers), authored by Nancy Garon addresses an aspect of self-regulation that seems highly critical when it comes to acquiring self-regulation skills, namely how children learn to suppress a dominant behavioral response in order to make an alternative choice. The author provides a detailed task analysis of two experimental paradigms often used to assess "hot executive function skills", but also discusses implications referring to the general hot-vs.-cool EF debate.

The fifth paper (Impact of instructional modality and emotional valence on the reflective emotion regulation of expression in preschool children) by Kromm, Hettwer, Kärtner and Holodynski also addresses "hot" processes of self-regulation - in this case emotion regulation. The authors are mainly interested in the ability of children to mask their true feelings when being instructed to do so. This masking process requires self-regulation skills. As revealed in the paper, children's competence not only varies with age, but also with the nature of the instruction. Interestingly, verbal instructions were not as efficiently as iconic instructions.

Finally, the sixth contribution (Self-regulation in preschooler's everyday life: exploring day-to-day variability and within- and between-person structure), authored by Ludwig, Haindl, Laufs and Rauch, asks about the short-term stability of self-regulation skills. The authors demonstrate that young children's self-regulation skills strongly vary on a day-to-day basis, and also differ when it comes to self-regulation of emotions, behaviors, and attentional states.

In sum, we approach early development of self-regulation from rather different perspectives, providing the reader with new theoretical models, detailed methodological analyses, and new empirical data on the role of co-regulation and task demands for assessing self-regulation development in young children.

Heidelberg, December 2016 Sabina Pauen

On behalf of the Research Council of FoF4

Understanding early development of self-regulation and co-regulation: EDOS and PROSECO

Sabina Pauen and the EDOS group[1]

1 Introduction

As demonstrated by the Dunedin Multidisciplinary Health and Developmental Study from New Zeland that followed up over 1000 participants from birth to adulthood, self-control in childhood is more important than socioeconomic status (SES) or IQ in predicting adults' physical health, wealth, life satisfaction, addiction, crime, and parenting of the next generation (Moffit/Arseneault et al. 2011; Poulton/Moffitt et al. 2015). Hence, it seems important to know how self-control is associated with self-regulation and how corresponding skills develop throughout early childhood (for a discussion of different factors potentially contributing to this development see Leve/DeGarmo et al. 2013).

To promote research along these lines, we first provide the reader with a brief overview over existing theoretical approaches to define the concept of self-regulation (1). Based on some conceptual clarifications, we introduce the EDOS (Early Development Of Self-regulation) model (2). Here, we assume that newborns rely on the help of caregivers who coregulate their physiological and mental states and behavior. Later, children gradually develop the ability to self-regulate. Any theoretical model explaining age-related changes in self-regulation during early childhood thus needs to account for the transition from co- to self-regulation. The EDOS model addresses this issue, describing the complex interplay of external and internal regulation in more detail. The third section of this report will take a closer look at implications of coregulation for measuring self-regulation skills in laboratory tasks (3). As will be demonstrated, any instructed task presented to a given child involves coregulation provided by the experimenter at different stages of the process, starting with the preparation of the material and ending with the feedback provided following each trial. To describe the how coregulation influences children's performance we propose the PROSECO model (PROcess of SElf- and CO-Regulation) and highlight its relevance for instructional settings.

2 Concepts and models

2.1 The concept of self-regulation

Self-regulation is typically used as an umbrella term for rather divergent aspects of adaptive behavior (e.g. Grouzet/Sokol et al. 2013; Matthews/Schwean et al. 2000). Hence, one can find many different definitions and models describing processes and mechanisms of self-regulatory control (e.g. Bridgett/Oddi et al. 2013; Diamond 2013;

1 The EDOS group includes the following researchers who all contributed to developing the EDOS- and the PROSECO model (listed in alphabetic order): Bechtel, Sabrina / Cierpka, Manfred / Gärtner, K. / Hertel, Silke / Holodynski, Manfred / Kärtner, J. / Rauch, Wolfgang A. / Reuner, Gitta / Sidor, A. / Voigt, Babett / Vonderlin, Eva / Wissner, Julia.

Hofmann/Schmeichel et al. 2012; Zhou/Main 2012), sometimes referred to as “executive functions”, “effortful control”, or “emotion regulation”.

Executive functions (EF) allow for conscious control over thoughts and behavior directed toward a goal (Carlson 2005; Miller/Marcovitch 2015; Zelazo/Müller et al. 2003). Following the predominant view (e.g. Diamond 2013; Garon/Bryson et al. 2008; Miyake/Friedmann et al. 2000), three separable albeit interconnected executive functions can be identified in adults: (a) *working memory* or *updating* allows us to keep different aspects in mind and mentally manipulate them at the same time, (b) *attention shifting* enables us to change the focus of our attention flexibly, and (c) *response inhibition* helps us to suppress dominant responses. Studies on executive functions in early childhood are still rare, because it is difficult to design tasks suitable for testing infants and toddlers on these skills (McGuigan/Núñez 2006). Hence, we still do not know whether the structure describing EF in school-aged children (e.g. Lehto/Juujärvi et al. 2003) and adults (e.g. Huizinga/Dolan et al. 2006) is also valid for younger children (Garon/Bryson et al. 2008). The few existing studies addressing this issue suggest a lack of cohesion and stability of EF measures during early toddlerhood (see Miller/Marcovitch 2015 for a recent overview) and leave open the question whether EF functions get differentiated or become integrated in early childhood. In general, executive functions are considered to undergo important qualitative and quantitative changes with age (Diamond 2002; Wiebe/Lukowski et al. 2010) which can be explained by a combination of brain maturation and environmental influences (Diamond/Lee 2011; Diamond 2012).

The components of inhibition and attention shifting also play a key role for *effortful control* (Liew 2012). Effortful control is typically interpreted as one important dimension of a given child's temperament, describing how well children are able to control their attention, to inhibit a dominant response, and/or to activate a subdominant response *(*Kochanska/Knaack 2003; Rothbart/Bates 2006). Some researchers interpret effortful control as one sub-component of executive functions (Diamond 2013; Fuster 2008) while others argue that both concepts are more likely to reflect variations in research approaches (studying inter-individual differences vs. intra-individual changes) than differences in developmental constructs (Zhou/Chen et al. 2012). In general, one can say that executive functions and effortful control show a high degree of conceptual overlap but each highlight different aspects of the general phenomenon of self-regulation.

In the literature, executive functions have primarily been discussed in the context of solving intellectual problems while *emotion regulation* has primarily been discussed in the context of dealing with social and motivational challenges (e.g. Fox/Calkins 2003; Liebermann/Giesbrecht et al. 2007). Since emotional/motivational processes are typically associated with activations in the ventro-medial prefrontal cortex, and cognitive processes are typically associated with activity in the dorsolateral prefrontal cortex, some authors suggest a distinction between "hot" and "cold" self-regulation (Zelazo/Müller 2002; Zelazo/Cunningham 2007; Zelazo/Carlson 2012). Following Zelazo and colleagues the temperature of a given self-regulation task always varies with the specific mixture of hot and cold processes induced (e.g. Zelazo/Carlson 2012). As these arguments reveal, our understanding of self-regulation has improved substantially during the past decade but still requires further specification.

In the present context we define self-regulation as a purposeful mental activity that serves to modify ongoing cognitive, emotional or motivational target processes in order to adapt to a given situation (see also Figure 1).

In this context, *target processes* induced by a specific task, and *self-regulatory mechanisms* required to deal with these processes should be distinguished. Both can diverge in temperature. For example: it may well be that a given situation elicits emotions in a child (i.e. hot target processes) which can best be regulated by re-evaluating the situation in cognitive terms (i.e. by applying cold self-regulatory strategies). Whereas the temperature of a given task depends on the target processes activated, the temperature of self-regulation depends on the nature of the control processes resulting. Hence, it seems important to specify (a) whether a given situation is meant to induce cognitive, motivational and/or emotional target processes, (b) to what extent it actually elicits which type of target process in a given individual, and (c) what kind of regulatory strategies the individual applies to deal with the target processes activated.

Furthermore, we would like to point out that all three target processes are conceptually distinct from each other and may come into play at different stages of dealing with a given situation, as illustrated by the following example: When faced with a tricky problem, we may first get involved in cognitive target processes. If we are unable to solve the problem at once, we may need to motivate ourselves to go on, thus regulating our motivational status. And if we finally get frustrated because we really seem unable to find a solution, emotions come into play and need to be dealt with. Emotions and motivations can both be called “hot” because they are both associated with activities in similar brain regions and typically co-occur, but at the same time, they still remain discriminable target processes.

With respect to mechanisms of self-regulation, we differentiate between *up-regulation* and *down-regulation* (Bonanno/Papa et al. 2004), thus highlighting the fact that our mental system needs to continuously evaluate the relevance of ongoing target processes, and to determine which processes should be modified. Up- and down-regulation of any internal process can be achieved in multiple ways, involving distraction, focusing on certain aspects, changing perspectives, self-instructions, or self-calming. The application of such strategies will eventually lead to a modification of target processes, resulting in more or less appropriate adaptive behavior. Hence, we would also discriminate between *mechanisms* and *strategies* of self-regulation.

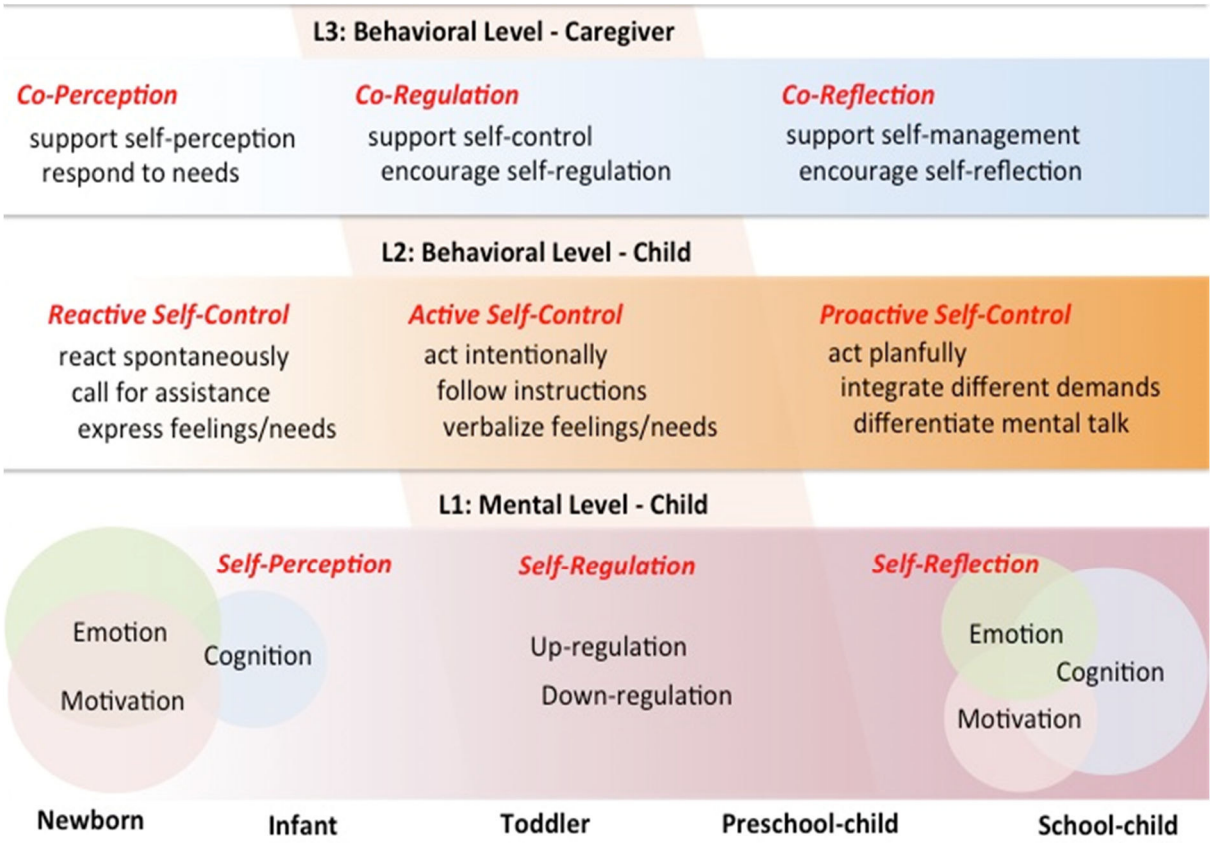
In sum we conclude that self-regulation is a complex human capacity. When talking about early childhood, we still know only little about how emotional, motivational, and cognitive processes interact, and how strategies of self-regulation develop.

2.2 The EDOS model

In line with existing work, we consider self-regulation skills to be multi-determined, but emphasize that the development of self-regulation strategies in early childhood can partly be explained by the internalization of coregulative strategies (Eisenberg/Spinrad et al. 2010; Holodynski/Seeger et al. 2013): Very young children are without any doubt highly dependent upon their caregivers when it comes to regulating their internal states. According to the predominant view, inter-personal regulation gradually leads to intra-personal regulation. Following Papoušek (2004) as well as Ho-

Iodynski and Friedlmeier (2006) who focus on co-regulation of emotional and motivational processes, infants first give unspecific signals, leading parents to act exploratively in order to meet the needs of the child. With age, signals of the child get more specific and the child acts more intentionally, thus enabling parents to deal with perceived needs and emotions more efficiently. In the next step, parents assist the child in learning how to regulate internal states in a more autonomous way (e.g. by providing reminders), until the child finally becomes able to show self-regulation even in the absence of any prompt from the caregiver. This gradual progress of "emancipation from the caregiver" is likely to be modulated by various internal and external factors (e.g. biological dispositions, child temperament, parental strategies, external stressors). In an attempt to (a) provide conceptual clarification, (b) describe general developmental trends across the early years, and (c) analyze when and how coregulative behavior of caregivers shapes the self-regulation skills of the child, our group proposes the EDOS model illustrated in Figure 1 and explained in more detail.

Figure 1: Early Development Of Self-regulation (EDOS)



Source: Own representation

Within the EDOS model we distinguish between three levels of analysis: ***Level 1*** refers to the internal (mental) level of the child, distinguishing different target processes to be regulated (motivational, emotional, cognitive processes), as well as different mechanisms of self-regulation (up-regulation, down-regulation). ***Level 2*** focuses on the behavioral level of the child, including active self-control, and ***Level 3*** addresses the interpersonal level, referring to behaviors of the interactive partner that aim at supporting

self-regulation in the child (i.e. co-regulation). Development from infancy to elementary school years is described as a process of gradual internalization leading to more reflective levels of self-directed activities. We assume that intervention strategies from caregivers (L3) are implemented in social interactions with the child at the behavioral level (L2), and that the internalization of corresponding experiences is crucial for the development of internal self-regulation and self-reflection (L1).

2.2.1 Level 1: Mental state of the child

The EDOS model distinguishes between target processes and self-regulatory mechanisms and strategies. ***Target processes*** refer to different aspects of the mind, namely to motivational, emotional, and / or cognitive processes induced by a given situation. Together these three components explain human mental activity from birth on. Basic needs and emotions dominate early infancy, and can hardly be discriminated from each other at this age, as illustrated by a large overlap of the corresponding fields (see Figure 1). This is due to the fact that any need elicits a corresponding emotion more or less automatically. Cognition becomes more prominent and influential with each year, increasing its overlap with emotional and motivational states while contributing to their differentiation at the same time. More complex and cognition-based emotions emerge during toddlerhood (e.g. guilt). With regard to motivational processes, basic needs are complemented by motivations, preferences, and personal interests, all showing a strong cognitive component (e.g. the motivation to please a specific person; the preference for a specific activity or topic). At this stage, emotional and motivational processes are still highly correlated but they can already get in conflict with each other (e.g. when a child is disappointed by a present but wants to please the giver). It seems important to note that motivational states gain importance for dealing with cognitive and emotional processes, because the child's behavior becomes increasingly intentional and self-determined with age. Consciousness gradually emerges as a result of brain maturation, cognitive growth, and social communicative experiences.

We assume that the experience of bodily results in states of ***self-perception*** which can already be perceived in very young children. According to Stern (1985) even infants show at least a rudimentary sense of the self. More specifically, the author speaks of an „emergent self" (0-2 months), or „sense of a core self" (2 to 7 months), respectively. Some time later, toddlers and preschoolers start to gain active control over their inner states, thus showing ***self-regulation*** for the first time. Specific target processes can now be up- or down-regulated in a purposeful way. For example: The up-regulation of a given cognitive aspect (e.g. voluntarily focusing on certain thoughts) may help to concentrate and/or to increase self-determination. Similarly, down-regulation leads to reducing the conscious experience of certain motivational states. The mechanisms applied to one process usually have an impact on others, thus leading to complex modifications in psychological states. To achieve up- and down-regulation, children develop specific *strategies* (e.g. self-soothing, self-instruction). With age, cognitive processes increase their impact on self-regulation of emotional and motivational states. When children grow older, they become capable of ***self-reflection***, thereby representing the self as invariant over time and space. Now they develop meta-cognition, elaborated mind-talk, and differentiated theory of mind understanding (Asting-

ton/Pelletier 2005). All these different skills contribute to improving self-awareness and self-regulation beyond early childhood (e.g. Focquaert/Braeckman et al. 2008).

The EDOS model suggests that self-regulation neither refers to processes of simply registering one's inner states, nor to reflecting on these states in an elaborated way. Children or adults involved in *self-regulation*, as defined here, purposefully modify certain mental aspects but they do not yet think through many different alternatives. The latter would imply self-reflection. Self-awareness and mechanisms of self-regulation first emerge during toddlerhood and show important further development during childhood and later years (e.g. King/Lengua et al. 2013). Self-reflections can be seen as an elaborated form of self-regulation with a strong cognitive component. Each step builds up on the previous one - without replacing it, but rather adding a new level of self-reference to the mental life of the child. This interpretation shows close resemblance with the hierarchical competing systems model (HCSM) of Marcovitch and Zelazo (2009) and the levels of consciousness model (Zelazo 2004) which describe the emergence and early development of executive functions.

Related to this issue, we should discriminate clearly between the meaning of self-regulation as a skill (disposition, temperamental characteristic), a mechanism, and a process. Conceptual clarifications in terminology will help us to improve our research by specifying what we are actually focusing on.

2.2.2 Executive functions and the EDOS model

How might different aspects of executive functions fit in the EDOS model? In our understanding, ***working memory*** links self-regulation to self-awareness. Only if the child can remember a previous mental state will she be able to become aware of any changes in this state. Furthermore, working memory may modulate the application of self-regulatory mechanisms based on cognitive processing: The better a given child can keep in mind different thoughts, feelings or motivations at the same time, the better will she be able to "decide" which one should be up- or down-regulated in order to adapt to a given situation (Giesbrecht/Müller et al. 2010).

Shifting results from a combination of up- and down-regulation. The previously predominant target process needs to be down-regulated, whereas a subdominant target process needs to be up-regulated. When the target process is cognitive, this may imply a change in attentional focus (or rule) relevant for solving the given task. In that case, shifting is linked to working memory because the child needs to keep in mind more than one rule in order to decide which one to use. When the target process is more emotional or motivational, however, shifting may require to reverse an ongoing target process (e.g. stop wanting something, stop feeling in a certain way) and/or to replace it by a qualitatively different one (e.g. become interested in something else, feeling calm). Because this is hard to achieve, the child may just try to stop expressing his wishes and feelings. Hence, shifting of motivational or emotional target processes often requires response inhibition.

In our understanding, ***response inhibition*** addresses situations in which the child needs to control the expression of a given inner state or intention, thus describing the transition from internal (mental) processes (L1) to child behavior (L2).

2.2.3 Level 2: Child behavior

While all aspects mentioned so far refer to inner mental states, most tasks designed for assessing these aspects use behavioral measures, thus confounding self-regulation with the active self-control of behavior. This is a general problem inherent to all methods measuring psychological states based on behavioral correlates. Within the EDOS model, both levels are separated to highlight that they can be dissociated – even in early childhood. A given behavior may result from different self-regulatory processes. For instance, the initial impulse to hit another person may not be expressed because the child (a) wants to avoid punishment and up-regulates a motivational target process, (b) remembers what his mother told him about hitting others, and up-regulates a cognitive target process, or (c) tries to relax and down-regulate his anger. Observable behavior does not automatically reveal which target process has been regulated in which way. At the same time, we know that the ultimate goal of self-regulation is adaptation. For that reason, behavioral measures provide a valid outcome measure for any self-regulatory process.

Level 2 also serves as the central stage for transmitting self-regulatory skills from interactive partners to the child. We assume that regulative and reflective strategies will first be implemented at the behavioral level in direct social contact between the child and a significant interactive partner before they can get internalized and serve to regulate inner states (e.g. Vygotsky/Luria 1994). Different aspects, including child characteristics (e.g. biological dispositions, temperament) and environmental conditions (e.g. family stress) may affect this process, but social interactions always play a central role – especially in early childhood.

2.2.4 Level 3: Inter-personal level: Behavior of interactive partners

Caregivers are without any doubt highly important for young children's development of the self (Cuevas/Deater-Deckard et al. 2014; Fay-Stammbach/Hawes et al. 2014; Grolnick/Gurland et al. 2002; Hughes/Roman et al. 2014; Karreman/Tujil et al. 2006). During infancy, caregivers are primarily responsible for meeting the child's basic needs and for helping the child to become aware of his/her own target processes. But with age adults also start to set limits or express expectations, thus challenging and supporting the child to develop self-control. To assist in this development, caregivers may use different strategies, varying with the child's given age. First, they may become engaged in ***co-perception*** by mimicking or verbalizing the internal states of the child, thus supporting self-perception. Soon they may also show ***co-regulation***, encouraging the child to control her behavior, or helping the child how to cope with certain internal states on her own. Finally, they may show ***co-reflection***, engaging the child in a discourse about motives, feelings or thoughts, thus enhancing self-management.

2.3 The PROSECO model

In the literature, behavior that aims at helping children to regulate their internal states are often called *coregulation* (e.g. Evans/Porter 2009; Fogel 1993) or *scaffolding* (e.g. Clark/Menna et al. 2013; Hammond/Müller et al. 2012), with both concepts being closely tied to caregiver sensitivity (Ainsworth/Bell et al. 1974). Within the EDOS framework, we use coregulation as a synonym for inter-personal regulation, assuming

that it can address hot aspects (emotional and motivational target processes) or cold aspects (cognitive processes). ***Hot coregulation*** covers aspects of emotional or motivational scaffolding (Park 2010). ***Cold coregulation*** shows many parallels to the concept of cognitive scaffolding. Both concepts often overlap: Cognitive scaffolding strategies can modulate the motivational / emotional state of a child (e.g. by increasing interest in a given problem), and emotional scaffolding may involve cognitive strategies (e.g. suggestions how to reevaluate a given situation).

Any model explaining the beginnings of human self-regulation needs to take into account the transition from inter-personal regulation (i.e. co-regulation) to self-regulation. Newborns have very limited skills to self-regulate target processes. They still lack the ability to express themselves verbally. By crying, laughing, fussing, or being attentive, infants guide adults to provide an environment that supports well-being (e.g. Holodynski/Friedlmeier 2006; Papoušek 2007; Sroufe 1996). In healthy caregiver-child relations, the caregiver is sensitive to infants' signals, prepared to fulfill the basic needs of the child (e.g. Papoušek/Papoušek 1987), but should also provide opportunities to acquire self-regulatory skills by setting limits, providing incentives, or encouraging self-control. We thus assume that corresponding strategies will work best when being adapted to the child's developmental status. Verbalization and explanations should gain importance with age, as do challenges requiring the child to deal with external expectations and demands.

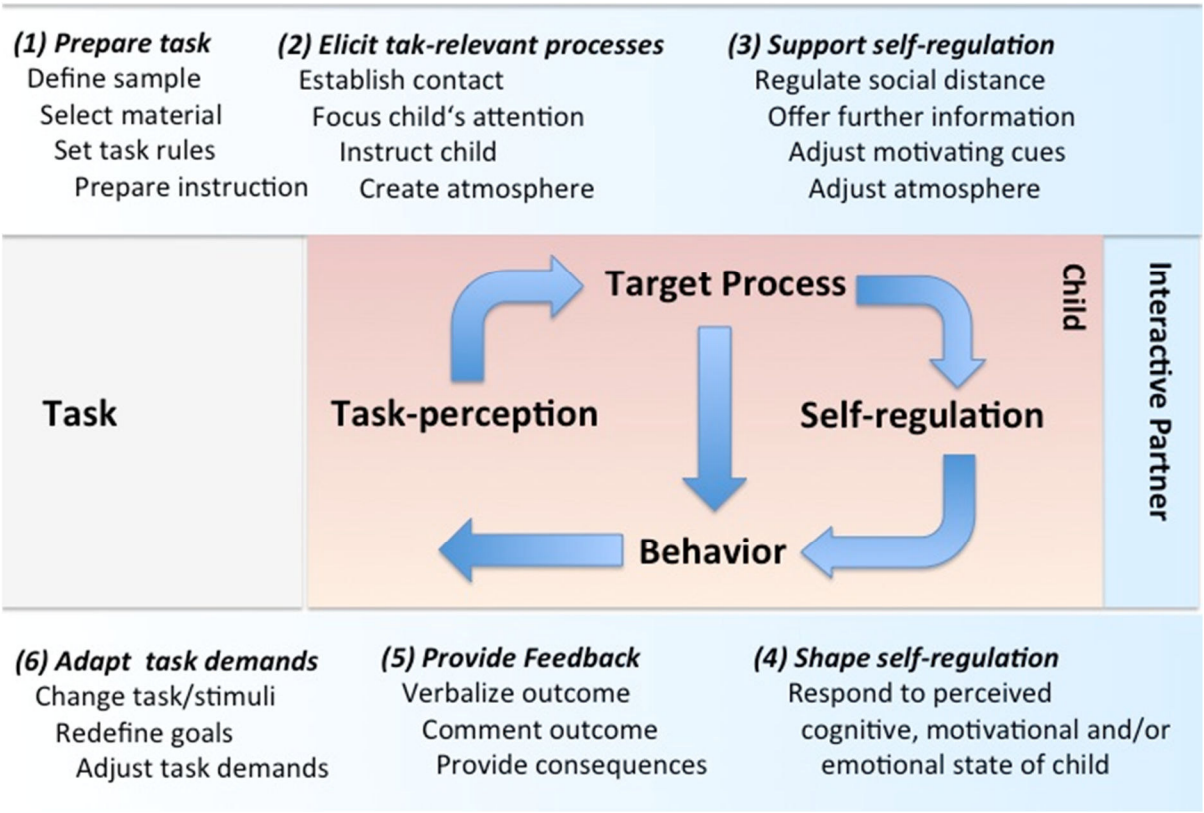
3 Co-regulation in instructional settings

Co-regulation and scaffolding strategies also play an important role with respect to cognitive processes (e.g. Bernier/Carlson et al. 2010; Neitzel/Stright 2003). Parents, teachers, and other adults teach the child to adapt cognitive processes by using means such as verbal instructions. To describe how interactive partners co-regulate the child in task-related contexts, we developed the so-called PROSECO model (PROcess of SElf and CO-regulation; see Figure 2). This model can also help to describe in more detail how experimenters interact with young children in laboratory settings:

Before the child even enters the lab or starts working on a given task, the experimenter/teacher *(1) prepares the setting.* She chooses a task, selects the material, sets the rules, and provides the instruction. Because the degree of self-regulation required by the child depends upon the goodness of fit between the child's needs and the task demands, this preparation phase reflects some kind of "prospective co-regulation". When the child actually visits the room, the experimenter/teacher (2) *elicits task-relevant target processes* by establishing contact, explaining or demonstrating what needs to be done, and focusing the child's attention on specific aspects as well as the procedure. Following this introduction phase, the experimenter/teacher may (3) *support self-regulation* in a more individualized way. She may offer additional task-relevant information, or adjust motivational and emotional cues to ensure that the child is well prepared to meet task demands (i.e. to self-regulate). Once the child has started to actually work on the task, the experimenter/teacher may perceive participants' responses and may want to (4) *shape self-regulation* by responding to the child's cognitive, motivational or emotional needs as displayed at the behavioral level while the child is still in the progress of dealing with the task. Often, this may include reminders of the instruction, reassuring the child emotionally, or motivating the child.

Supporting and shaping self-regulation are closely related. Whereas *supporting* is primarily relevant before the child actually starts to deal with the task, *shaping* only becomes relevant once when the child is already working on the task. As soon as the child shows a clear behavioral response to a given trial, the experimenter/teacher may (5) *provide feedback* by verbalizing the outcome, commenting on it, providing consequences (e.g. a reward), or reassuring the child (if necessary). Before the next trial/task begins, she may or may not (6) *adapt task demands*, by changing the stimuli, redefining the goals, and/or adjusting task difficulty. Figure 2 illustrates this process.

Figure 2: PROcess of SElf- and CO-Regulation in dyadic task settings (PROSECO)



Source: Own representation

Not all processes mentioned so far apply to any given task, and not always can we separate different sub-processes from each other in any strict sense (e.g. when it comes to tasks probing inhibition or shifting skills, the first step also includes the instruction to self-regulate). The purpose of our PROSECO model is to offer a general conceptual framework for specifying potentially relevant co-regulative interventions by interactive partners (e.g. experimenters, parents, teachers). Prospective self-regulation, as well as hot and cold co-regulation can be summarized under the heading *task-focused co-regulation* because they jointly serve to help the child in dealing with a given task.

Importantly, the PROSECO model suggests that the temperature of a given task is influenced by interactive partners who may either induce or modify ongoing cognitive, motivational, and/or emotional states in the child. The impact of such interventions on young children's performance in laboratory tasks (including tasks to assess self-regulation capacities) have long been neglected. Future work needs to put them in

focus. More specifically, we need to specify (a) during which phase of the experimental procedure co-regulation is provided in which way, (b) whether the experimenter offers a low, medium, or high degree of co-regulation, and (c) whether the co-regulation provided focuses on cognitive, motivational or emotional target processes.

4 Summary and concluding remarks

The main goal of this contribution was to show that developmental psychology can stimulate discussions leading to conceptual clarifications regarding self-regulation in many ways: First, we suggest a general distinction between mental activities and behavioral expressions related to self-regulation. A given person may show self-regulation at the mental level but no action at the behavioral level (e.g. when trying to remain calm in a moving situation). Alternatively, she may respond to external demands, thus showing adaptive behavior, while not being able to deal with the feelings accompanying this behavior (e.g. when following an order non-voluntarily to avoid punishment). We assume that the mental and the behavioral level become gradually separated during early childhood.

At the behavioral level, *reactive-, active-, and proactive self-control* should be discriminated to highlight the fact that behavioral responses may involve more or less conscious control. Spontaneous (reactive) responses of toddlers are not the same as well-planned behaviors that can only be observed in older children. Similarly we suggest to discriminate between *self-perception, self-regulation and self-reflection* at the mental level, assuming that these three capacities build up on each other, but require different degrees of consciousness. With regard to all capacities mentioned so far, the nature of the *target processes* (i.e. cognitive, motivational, emotional) should be distinguished from the *mechanisms* (i.e. up- and down-regulating) or *strategies* (e.g. self-instruction) underlying their modification.

Apart from the important question how we shall best speak about self-regulation and related terms, developmental psychologists are also highly interested in exploring how self-regulation skills are affected by external social interventions, often referred to as *co-regulation*. As we all know, a newborn infant is completely dependent upon her caregivers' ability to correctly identify her mental and physiological needs, thus helping the child to reach or maintain a physiological and emotional balance. With age, this vital need of coregulative interventions gradually decreases, while the ability to show self-regulation increases. This requires constant adjustments of coregulation by the caregiver. We claim that the adjustment of caregiver's interventions to this development, and the goodness of fit of the coregulative activities are highly predictive for the successful acquisition of self-regulation skills throughout development. This does not deny the impact of biological predispositions of the child for this process, but highlights the relevance of social experiences.

Furthermore, we need to keep in mind that coregulation as a critical factor influencing performance in experimental or learning task administered to children. More specifically, we claim that conditions of the task setting and the behaviors of the experimenter /teacher supporting self-regulation of the child in dyadic interactions are highly relevant for predicting child performance. Only if we keep in mind that corresponding outcomes are always a product of internal and external influences will we be

able to interpret findings regarding early development of self-regulation in a comprehensive way (Pauen 2002).

To describe the general development of self-regulation, we proposed the EDOS model, and to describe the process of co- and self-regulation in task-oriented settings, we proposed the PROSECO model. As stated at the beginning of this report, early self-regulation development seems to be highly predictive of success and wellbeing in later life. By conducting basic research on the nature and the development of self-regulation skills we may become able to design programs for promoting corresponding skills from early on, thus helping children to fully unfold their potentials.

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The Role of Co-regulation for the Development of Social-Emotional Competence in Early Childhood

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1 Introduction

Social interactions in the family, in preschool and in other early childhood settings offer a wide range of possibilities for preschoolers to obtain and practice competencies in the social-emotional domain: for instance, successfully dealing with peer conflicts by applying problem solving skills or emotion regulation strategies, coping with own emotions, cooperating in joint activities (Denham et al. 2007; Eisenberg et al. 1997; Eisenberg et al. 2004). How do preschoolers acquire social-emotional competencies and how do caregivers contribute to this development? In this paper, we address these questions by emphasizing that caregivers play a constitutive role in the child's social-emotional development, especially by co-regulating emotionally challenging situations. After defining the concept of social-emotional competence, we focus on the role of emotion regulation to children's functioning in social interactions and relationships. Regulating own emotions in a reflective way enables children to satisfy their needs in a socially coordinated and desirable way, which is considered an important developmental task in 4 to 6 year-olds (Holodynski et al. 2013; Sroufe 1996).

We suggest a conceptual model – the internalization of reflective emotion regulation – that proposes a gradual transition from interpersonal regulation (co-regulation) of children's emotions to intrapersonal regulation (self-regulation) of emotions. Assuming that self-regulation of emotions evolves from the co-regulation of emotionally challenging situations through children's caregivers, the mechanisms underlying this developmental shift are addressed. Ideally, this transition proceeds through caregiver-child interactions, which provide children with age-appropriate strategies of emotion regulation. We postulate four specific types of regulation strategies: (1) distraction, (2) reappraisal, (3) soothing, and (4) response modulation. By applying these strategies, caregivers support children's emotion regulatory development proceeding through three developmental levels. In each level, caregivers typically provide particular regulation tools that fit children's developmental status. Initially, caregivers adopt all aspects of emotion regulation. As children get older, caregivers give specific prompts and, finally, use increasingly more metacognitive prompts to support children's self-regulation of emotion. Based on this model, we will discuss potential directions for future research.

2 Social-emotional competence and emotion regulation

Social-emotionally competent behavior is characterized by two aspects: First, *social competence*, which manifests itself in effectiveness in social interactions, characterized by a given individual's ability to meet personal needs while maintaining positive relationships with others. Second, *emotional competence,* which manifests itself in emotional expression that is accepted in a given culture, a reflective understanding of own emotions and those of others, and an effective emotion regulation (Rose-Krasnor/Denham 2009). In early childhood, remarkable achievements take place in the realm of social-emotional development that parallel the increasing challenges associated with social interactions at different ages (Saarni 1999).

Following a transactional, multilevel model of social-emotional competence (Rose-Krasnor/Denham 2009), effectiveness in social interactions – characterized by positive engagement with peers and appropriately regulated emotions – is considered to be an important developmental task. Different skills and motivations contribute to managing one's own and others' needs in social interactions. These underlying skills of social-emotional competence include self-regulation, social and emotional awareness, perspective taking, social problem-solving, as well as empathy and prosocial behavior. In this paper, we focus on *emotion regulation* for mainly two reasons; First, because of its relevance for functioning well in social interactions and peer-relations; Second, because of its association with major developmental changes in the preschool period. Several studies have shown that emotion regulation has important implications for the general psychosocial adaptation and the acquisition of social skills (e.g. Calkins/Howse 2004; Eisenberg et al. 2000; Sroufe 1996). Appropriate emotion regulation leads to a decrease in maladaptive behavior (Denham/Burton 2003; Izard 2002; Raver 2004). Considering social behavior, children with higher competencies in emotion regulation behave socially more appropriate and have fewer conflicts with peers (Denham et al. 2007; Eisenberg et al. 1997; Spinrad et al. 2006), while children with difficulties in emotion regulation show increased aggressive behavior and externalizing problems (Eisenberg et al. 2000).

In the literature, the concept of emotion regulation has been defined in multiple ways. In a broader sense, every action associated with the modification of emotions could be seen as emotion regulation (Thompson 1994). However, from a developmental perspective, we find it critically important to distinguish the regulation *by* emotion from the regulation *of* emotion (Gross/Thompson 2007; Holodynski et al. 2013). Both constitute developmental achievements during children's development, but occur at different ages. Regulation *by* an emotion refers to an action readiness that is inherent to the emotion itself (Frijda 1986), e.g. the avoidance of gaze in situations of (social) over-stimulation or fleeing in situations of fear. This process develops relatively early in ontogeny, and will, in the following, be referred to as the *emotional regulation of actions* (Holodynski/Friedlmeier 2006). Regulation *of* an emotion, mostly defined as the 'extrinsic and intrinsic processes responsible for monitoring, evaluating and modifying emotional reactions, especially their intensive and temporal features, to achieve one's goal' (Thompson 1994: 27), refers to

situations when the individual first experiences an emotion and then tries to regulate it, e.g. the avoidance of gazing at an attractive gift in a situation that requires the delay of gratification. Thus, the emotion and its associated action readiness is no longer the motivating force of behavior, but the target process that becomes regulated. In this case, emotion regulation is based on the volitional inhibition or modification of an elicited emotion so that the dominant action readiness of an emotion is not enacted but replaced by a subdominant behavioral alternative (Campos et al. 2004; Holodynski et al. 2013).

This form of emotion regulation requires a series of sophisticated higher-order competencies, most importantly taking a psychological distance from one's own emotions and applying self-regulation strategies (i.e. executive functions) in order to volitionally inhibit and modify emotional experience of behavioral inclinations in terms of situational demands. These competencies have been addressed within the concept of hot executive functions (Zelazo et al. 2010). In the following, this process will be referred to as *reflective emotion regulation* (Holodynski et al. 2013), which is the main focus of this article.

Typically, reflective emotion regulation is needed in contexts that require the individual to delay the satisfaction of a given motivation, or to decide among conflicting motives either within or between individuals. Viewed within a broader developmental framework, reflective emotion regulation can be considered as one dimension of a broader self-regulatory system integrating a series of psychological functions, such as motivation, perception, volition, and goal-directed behavior (Campos et al. 2004; Gross/Thompson 2007; Zelazo et al. 2008). To coordinate these functions effectively and autonomously is critical for behavioral adjustment and constitutes a primary developmental achievement. In this sense, self-regulation of emotions comprises the application of these functions to one's own emotions. Achieving self-regulation of emotions refers to those components of reflective emotion regulation that the child is able to perform without the support of others. In the following sections, we will address the question of how self-regulation of emotion develops, and which factors contribute to this development. We especially draw attention to the constitutive role of caregivers supporting this development.

2.1 The constitutive role of co-regulation for child development

Vygotsky's socio-cultural perspective suggests that higher psychological functions such as thought or language are culturally shaped. They develop in social interactions (Vygotsky 1997/1931). Development proceeds from an *inter*personal regulation of behavior and underlying psychological processes to an *intra*personal regulation of these processes. Social interactions with caregivers are significant because caregivers provide culturally rooted tools that are internalized as mental functions in the course of development. Ideally, caregivers operate in the *zone of proximal development*. Vygotsky (1998) suggested that children may function at two different levels: First, the actual level of development, referring to the level at which a child functions without support, i.e. by him- or herself. Second, the proximal level of development, referring to the level at which children function when scaffolded by a more competent partner. Through providing physical and psychological

tools in interactions, caregivers help children to advance their actual level of development. These general principles can similarly be applied to the development of emotions and emotion regulation. Both developments can be explained as a shift from interpersonal regulation (co-regulation) to intrapersonal regulation (self-regulation; Holodynski et al. 2013; Sroufe 1996).

2.2 The role of co-regulation in emotional development

According to the internalization model of emotional development, infants initially possess precursor emotions that need to be regulated interpersonally (Holodynski/Friedlmeier 2006; see also Calkins/Hill 2007; Sroufe 1996). More specifically, before infants integrate the components of an emotion (i.e. appraisal, physical reaction, expression, and feeling) and their contextual embedment (i.e. cause, action) into a fully functioning system, caregivers co-regulate the infant's emotional behavior and experience.

In this co-regulatory process, the rudimentary and unfocused infant expressive behavior becomes refined into a differentiated, contextually fine-tuned repertoire of expressions and their related emotions, for instance by the caregiver's monitoring and mirroring of the child's affect-expressive behavior (Bennett et al. 2005; Gergely/Watson 1999; Holodynski/Friedlmeier 2006; Malatesta/Haviland 1982; Schore 1994; Sternberg/Campos 1990). During this phase, the regulation *by* emotion, i.e. the *emotional regulation of actions* is shared between child and caregiver: Caregivers respond to infants' emotions by interpreting their expressive behavior as an appeal for satisfying certain needs. Infants' crying, for instance, typically leads caregivers to sooth them. Children learn about these contingencies, and internalize them. As a result, caregivers' co-regulation efforts decrease whereas self-regulation skills develop gradually (Sroufe 1996). Caregivers support this process by encouraging children to perform motive-serving actions themselves instead of performing these actions for their child, and, in tandem, children less often appeal to their caregivers. As a result, children show the motive-serving behavior more often, for instance, by comforting themselves. Conceptually, the function of children's expressive behavior shifts away from appealing to caregivers towards performing self-regulatory activities (Friedlmeier/Holodynski 1999).

2.3 The role of co-regulation in the development of reflective emotion regulation

In the current literature, there are many correlational studies supporting the assumption that primary caregivers also play an important role for their children's development of reflective emotion regulation in at least two important ways: First, caregivers support children in developing emotional awareness. Emotional awareness can be defined as the conceptual awareness of subjective feelings, associated causes, appraisals and consequences of an emotion (Fogel 2009; Teper et al. 2013). Second, once this foundation is laid, caregivers support children in establishing a repertoire of effective emotion regulation strategies (Morris et al. 2007).

2.3.1 Establishing emotional awareness

A precondition for reflective emotion regulation is the ability to distance oneself psychologically from a current emotional episode, taking a bird's eye view, in order to evaluate the current episode in terms of causes and consequences (Bischof-Köhler 2000; Giesbrecht et al. 2010; Holodynski et al. 2013; Lyons/Zelazo 2011; Saarni 1999; Teper et al. 2013). Typically, toddlers start labeling emotions in their second year, they relate emotions to specific situations in their third year and their naïve theory changes from a behavioral to a more mentalistic understanding of emotions in their fourth and fifth year (Meerum Terwogt/Stegge 1998). Importantly, emotion-related language is the central tool for emotional awareness and distancing and both are related to advanced levels of emotion regulation (Carlson/Beck 2009; Cole et al. 2010; Holodynski et al. 2013; Müller et al. 2009).

One particular way in which caregivers promote this ability in preschoolers is through conversations about emotions, including labeling feelings and relating these to specific causes, appraisals, expressions, behavioral inclinations, and potential ways to regulate emotions (Denham 1998; Morris et al. 2007). This *emotion talk* sensitizes children for inner feelings. It facilitates the development and further differentiation of a *theory of emotion* that can be defined as coherent scripts linking emotional experiences with specific verbal labels, expressions, causes, appraisals, and regulation strategies.

Research has identified a style of parenting characterized by a high use of emotion talk to be associated with developing appropriate emotion regulation capacities (Ellis et al. 2014; Garner et al. 1997; Gottman et al. 1997; Wilson et al. 2014). This style of parenting, linked to parents' appreciation and acceptance of emotions and their regulation, is called *emotion coaching*. Emotion coaching means empathic listening, validating the child's emotions, guiding emotion regulation, and teaching the child problem-solving skills (Gottman/DeClaire 1998). In contrast, a dismissive or disapproving parenting style is linked to avoiding or punishing the expression of negative emotions of the child. These punitive and minimizing responses are associated with lower levels of competence in children's emotion regulation (Denham et al. 2007; Eisenberg et al. 1998; Fabes 2001; Lunkenheimer 2007). While most of this research is correlational, Havighurst and Harley (2007) developed an intervention program that aims at fostering children's emotion regulation competencies via supporting core features of parents' emotion coaching. An evaluation study revealed that the intervention group had lower levels of negative emotionality and problem behaviors as compared to a waiting control group (Wilson et al. 2012). Hence, empirical research indicates that emotion coaching is one central strategy to support the development emotional awareness and the self-regulation of emotions.

On a more general level, there are a number of approaches describing three processes through which caregivers support the development of emotion regulation and emotional awareness (Denham et al. 2007; Eisenberg et al. 1998; Hooven et al. 1995; Morris et al. 2007): (1) Caregivers provide models for competent emotion regulation through their own emotional expressiveness and emotion regulation (*modeling*); (2) *contingent re-*

sponding to children's emotions and (3) intentional *teaching* or *coaching* of emotional issues (Eisenberg et al. 1998). While contingent responding refer to caregivers' encouragement or discouragement of children's emotional expressions, teaching and coaching entail caregivers' use of deliberate instructions to help children link expressions, situations, and words into coherent scripts. All three mechanisms are relevant for establishing emotional awareness. Being aware of one's own emotional experience enables the child to achieve the second level of self-regulation of emotion: the acquisition of an effective repertoire of emotion regulation strategies.

2.3.2 Establishing a repertoire of emotion regulation strategies.

A large variety of regulation strategies help each one of us to modify our emotions. Examples for such strategies are distraction, reappraisal of the emotion-eliciting event, or positive self-instructions (e.g. Gross/Thompson 2007; Larsen/Prizmic 2004). During the preschool period (i.e. 4 to 6 years of age), children master an increasing repertoire of effective emotion regulation strategies. Early in the second year, a significant developmental achievement consists in social referencing and the self-initiation of interpersonal regulation. Hence, searching for social support is considered as a rudimentary form of self-regulation of emotion (Holodynski 2006). During the second and third year, there is a transition from passive to more active strategies and, as a consequence, the first truly self-regulating strategies emerge, namely distracting oneself from the emotion-eliciting event and self-soothing (Bridges/Grolnick 1995; Calkins/Hill 2007; Friedlmeier/Holodynski 1999; Spinrad et al. 2004). The development of executive functions facilitates managing to inhibit emotional or motivational impulses (Zelazo et al. 2010). Together with normative development that enables children to follow social norms (Rakoczy/Schmidt 2012), children refine their skills to inhibit and transform an emotionally triggered action readiness and to generate alternative ways of responding that allow them to satisfy their needs in socially coordinated and accepted ways. Finally, advances in language and symbolic skills, social cognition and perspective taking (Sodian/Thoermer 2006) allow children to acquire increasingly complex cognitive regulation strategies, as, for example, self-instruction or reappraisal strategies, changing the evaluation in a given situation as well as affective and behavioral responses (Gunzenhauser et al. 2014).

There are four general types of self-regulation strategies that focus on the different components of an emotion: (1) distraction, focused on the elicitor of an emotion, (2) reappraisal, focused on the appraisal component, (3) soothing, focused on the feeling component, and (4) response modulation, focused on the action-readiness component, including expressive and bodily reactions (Gross/Thompson 2007). The four types of self-regulation strategies all emerge during the preschool years (Chen 2015; Morris et al. 2011).

For each of these regulation strategies, a shift from co- to self-regulation can be observed during the first years. Overall, there is a gradual transition from co- to self regulation (Grolnick et al. 1998, Holodynski/Friedlmeier 2006; Kopp 1989). While initially dis-

traction and soothing strategies are adopted by the caregiver, children increasingly apply these strategies themselves (Bridges/Grolnick 1995; Friedlmeier/Trommsdorff 2001; Sroufe 1996). Furthermore, there is initial evidence for a shift from more substitutive strategies (e.g. distraction, soothing) to more instructive and reflective ways of co-regulation (e.g. prompts for reappraisal or response modulation). These age-dependent changes support children's emotion regulation competence concurrently and prospectively (Morris et al. 2011; Putnam et al. 2002, Spinrad et al. 2004). Accordingly, co-regulation through preschool teachers in the day care setting varies with children's age: Whereas responses to toddlers' negative emotions mainly focus on soothing and distraction, preschoolers are often provided with verbal instruction to show self-regulation (Ahn/Stifter 2006).

To summarize, research has demonstrated the important role of caregivers in supporting the development of self-regulation of emotions through emotion coaching and co-regulation in emotion episodes that is well coordinated with a child's developmental level. Building on these grounds, a combination of emotion coaching plus specific ways of co-regulating children in emotionally challenging situations catalyzes children's development of emotional self-regulation. Most approaches share the assumption that emotion regulation shifts from co-regulation by caregivers to self-regulation by the child. It is important to note here that this shift does not occur abruptly but self-regulation gradually emerges from co-regulation of emotions. To our knowledge, there is no elaborated theoretical model that specifies how this shift occurs. To address this issue, we outline a conceptual model that specifies the type and amount of co-regulation that seems optimal and adaptive given the developmental level of the child.

2.4 The internalization model of reflective emotion regulation

The internalization model of reflective emotion regulation (see Figure 1) is based on the assumption that children's emotions are initially regulated by their primary caregiver (Sroufe 1996). During the preschool years, children increasingly take over control by internalizing components of reflective emotion regulation. But how does self-regulation of emotions develop? And what are the critical factors contributing to this development?

Imagine a situation in which a child is sad because it forgot the favorite toy at home and now wants to play with it. The caregiver can co-regulate the child's frustration on three general levels. (1) The mother could soothe the child by comforting and/ or she could distract it by initiating another fun game. That means the mother regulates the sadness of her child by carrying out the successful actions on behalf of her child (adopted emotion regulation). (2) The mother could instruct her child to carry out a specific regulation strategy, e. g. a soothing strategy (to take a deep breath) or a distraction strategy (to take an attractive alternative activity that can distract the child from her sadness). Here, the mother does not directly regulate her child's emotion, but instruct a concrete regulation strategy (co-regulation by specific prompts). (3) The mother could encourage her child to reflect the situation and think about possible strategies how he or she could regu-

late his or her frustration (co-regulation by meta-cognitive prompts). These examples illustrate that caregivers can support emotion regulation on different levels of co-regulation that allows a child an increasing self-regulation of his or her emotion.

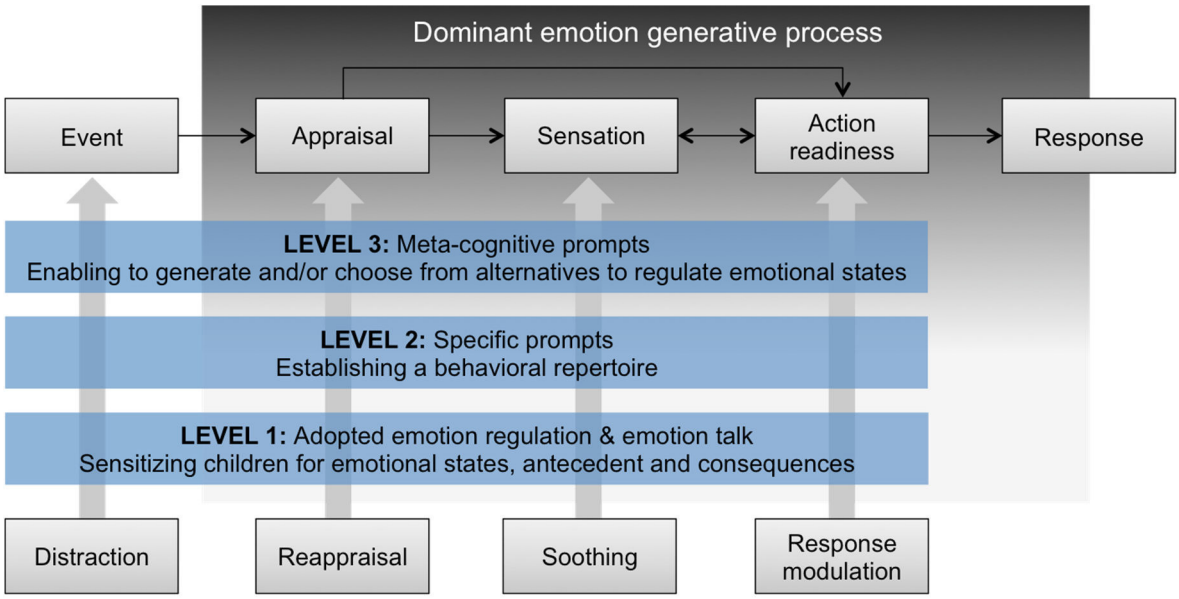
Following a functionalistic understanding of emotions, an emotion represents an action-readiness that is triggered by an appraisal of an occurring event in motive-relevant terms, in order to change the situation in a way that serves the satisfaction of the person's needs and concerns by showing specific expressions, body-related reactions, and subjective feelings (Barrett 1998). This understanding is in agreement with general functionalistic emotion theories as conceptualized by Frijda (1986), Lazarus (1991) and Scherer (2004). Events are first perceived and evaluated (e.g. a child sees another child eating yummy cookies). Based on this appraisal, adaptive body reactions occur (e.g. salivary production increases), and certain automatic response tendencies emerge (e.g. to approach the cookies). These response tendencies are experienced as sensations or feelings of a given quality (e.g. a sudden craving for cookies). Sensations and feelings lead to motivational states (e.g. to get a cookie), and goal-oriented behaviors (e.g. to walk towards the other child), eventually resulting in a target-directed behavior (e.g. to take a cookie from the plate) (Holodynski/Friedlmeier 2006).

Based on the model of emotion regulation suggested by Gross and Thompson (2007), four different types of emotion regulation strategies can be distinguished and we can specify at which level of processing certain regulation strategies operate in order to shift from the dominant to a subdominant, but more desirable, behavioral response (Figure 1): (a) *Distraction strategies* shift the focus to a new target and thus trigger a new line of consecutive mental processes eventually resulting in a different emotion. In our example, a caregiver might direct the child's attention to an attractive toy to help it forget about the cookie. (b) *Reappraisal strategies* are tailored towards taking a fresh look at the same target, thereby modifying the activation of response tendencies and subsequent processes. In our example, the caregiver could tell the child that cookies are not a yummy as they look. (c) *Soothing strategies* directly address the intensity of experience, including both the intensity of subjective feeling and the physiological arousal, while leaving the elicitor and its appraisal unchanged. In our example, the caregiver could soothe the child by hugging and comforting it. (d) *Response modulation strategies* directly operate on the level of the behavioral inclination and either inhibit the impulse or transform it to a socially acceptable form. Having their main impact on the level of observable behavior, response modulation strategies also include strategies that are tailored towards redirecting more basic behavioral impulses to socially acceptable behavioral responses. In our example, the caregiver could tell the child to politely ask the other child whether it would like to share (see bottom of Figure 1). Thus, many strategies that are often referred to as problem-focused coping (Lazarus/Folkman 1984) are subsumed under response modulation strategies.

The core feature of the internalization model of reflective emotion regulation addresses the "as-yet-unresolved" issue of co- and self-regulation (Gross/Thompson 2007:

8). More specifically, it specifies different levels on which caregivers co-regulate relevant episodes in developmentally appropriate ways by providing tools that fit the developmental status of the child and that can be internalized as self-regulation strategies. From this perspective, development proceeds from an interpersonal regulation of behavior and underlying psychological processes to an intrapersonal regulation of these processes. In her study on maternal meta-emotion coaching in children's self-regulation of negative emotions, Cook (2005) provides evidence for a distinction between a co-regulation that instructs the child to carry out a specific regulation strategy and a co-regulation that encourages more self-reflection and prompts the child to generate and chose an appropriate regulation strategy. This is also in line with the concept of emotion coaching (Gottman/DeClaire 1998) and the proposed strategies on providing the child with psychological tools of self-regulating his or her emotions.

Figure 1. The internalization model of reflective emotion regulation



Source: own representation

We have adopted this distinction between a type of prescribing co-regulation and a type of meta-cognitively oriented co-regulation and propose the internalization model of reflective emotion regulation. This model is inspired by the internalization model of emotional development (Holodynski/Friedlmeier 2006) and postulates three different levels on which caregivers co-regulate children's emotions and the implications that the specific level of co-regulation has for child development:

Level 1 (*adopted emotion regulation and emotion talk*): Initially, a caregiver adopts all components of reflective emotion regulation without involving the child in any way. Thus, it is the caregiver who decides whether and how an emotion needs to be regulated and it is her who offers help in emotion regulation. Level 1 co-regulation strategies can have their starting points at the event (i.e. distracting the child), at the sensation component (i.e. soothing the child) or at the action readiness component (i.e. inhibiting the child's

impulses). A central strategy is emotion talk: Within talks about emotions between caregivers and children, children get sensitized for internal feeling states, how they are related to causes and consequences in behavioral terms and which emotion regulation strategies could be chosen (Dunn et al. 1991; Morris et al. 2007). Therefore, emotion talk is promotive at all levels of co-regulation, but is of central significance at the first level of co-regulation through supporting the emotional awareness.

Level 2 (*co-regulation thru specific prompts*): At this level, the caregiver instructs the child to self-regulate specific aspects, involving certain strategies of reflective emotion regulation within social interactions. Co-regulation is characterized by providing the child with specific prompts that she or he can apply for regulating her or his emotion without further assistance. Co-regulation strategies can have their primary impact at every point in the emotion generative process. For example, the caregiver might instruct the child to defocus the emotion-eliciting event (i.e. distraction), to take a deep breath (i.e. soothing), to follow a specific rule (i.e. response modulation) or he might provide the child with an alternative look at the situation (i.e. reappraisal). This level helps the child to establish a basic repertoire of effective behavioral routines to regulate emotions. As reported earlier, children's skills to inhibit and modulate emotional impulses refine during the preschool years (Zelazo et al. 2005, 2010). While specific prompts that demand to execute, but not yet to generate, responses as distraction, soothing or socially acceptable behavior responses presumably are applied in the late toddler and early preschool years, specific prompts to reappraise are thought to start later, as cognitive regulation strategies demand symbolic and language skills to change a situation's meaning and lead to affective and behavioral responses in consequence (Sodian/Thoermer 2006).

Level 3 (*co-regulation thru meta-cognitive prompts*): At this level, caregivers use meta-cognitive prompts to transfer further parts of a reflective emotion regulation to the child. As in level 2, co-regulation strategies can have their impact at every component in the regulation process, but child's part in the process is demanded more increasingly. For instance, the child is prompted either to generate alternative appraisals (e.g. "Did it really happen this way?"), or distractive, soothing or behavioral responses (e.g. "What could you do now?", "How could you distract/sooth yourself?"), or to choose from a set of alternative appraisals or responses and execute the self-chosen alternative (e.g. "What would you like to do instead: go outside, paint a picture or play with the others over there?"). This level of co-regulation helps a child to actively explore and evaluate alternative regulation strategies and to volitionally choose and execute a specific strategy from a set of alternatives. As reappraisal prompts are considered as more challenging to children's developmental competencies, meta-cognitive reappraisal prompts likewise are supposed to start later in development than meta-cognitive prompts related to behavioral responses. Further, as evidence about caregivers' co-regulation indicates (Morris et al. 2011; Putnam et al. 2002; Spinrad et al. 2004), we suppose that, together with a developmental decrease in emotion intensity (Holodynski 2006), co-regulation strategies of distraction and soothing decline, independent from the level of co-regulation.

To conclude, the internalization model of reflective emotion regulation assumes that children proceed through these three levels at different ages for each of the above-mentioned regulation strategies. This is of special relevance when it comes to applying more complex and cognitively demanding regulation strategies like reappraisal or response modulation strategies which come into play some time later than other strategies such as distraction which are less demanding in cognitive terms. Across the preschool years, children become more and more aware of emotional states in themselves and others, and they improve their abilities to apply more complex and more effective regulation strategies. For acquiring each of these more complex strategies, caregivers provide scaffolding at the different levels of development.

Rising through these different levels of co-regulation, children regulate emotions in increasingly self-regulated ways. All regulatory activities are initially applied without conscious awareness (see also Gross/Thompson 2007). Differing from other approaches (e.g. Crick/Dodge 1994; Lemerise/Arsenio 2000) we postulate a formative phase during the preschool period in which self-regulation is constituted by the way in which caregivers co-regulate emotionally challenging episodes. This allows us to define the components of caregivers' co-regulation that seem critical to describe the gradual transition from co- to self-regulation.

3 Conclusions and future directions

In this paper, we highlighted the constitutive role of co-regulation through caregivers for the development of emotion regulation in early childhood, based on theoretical and empirical findings about the positive developmental impacts of caregivers' emotion coaching and caregivers' co-regulation that is adjusted to the child's developmental level. We postulate that the transition from interpersonal co-regulation of the child's emotions to intrapersonal self-regulation of emotions proceeds through critical caregiver-child interactions. Based on a process model of emotion regulation that distinguishes different phases, ranging from perceiving and evaluating a given event to showing a behavioral response, and different co-regulating strategies to modify each sub-process, we proposed three developmental levels of co-regulation, each requiring a different way of scaffolding from the caregiver.

Our model makes a number of assumptions that are associated with a specific cultural model, namely the model of psychological autonomy, which is prevalent in Western educated urban middle-class (Keller 2007; Keller/Kärtner 2013). According to this cultural ideal, sensitizing children for their internal mental states and making these the dominant frame of reference for behavior is of primary importance and this is also what characterizes emotion regulation: becoming aware of and deliberately regulating emotional responses by rational reflective agency (Kärtner 2015). Beyond this reflective psychological approach, there are other, more external, mechanisms by which emotions and their expression can also be regulated effectively, for example via strategies such as shaming or threatening. These strategies may be similarly effective in that they reduce the enact-

ment of undesirable behavior, however, they do not rely on reflection but are based on different mechanisms. Importantly, cultures differ considerably in the degree to which these different strategies of socializing emotions are valued and practiced (Röttger-Rössler et al. 2013; Röttger-Rössler et al. 2015) and future research should systematically take culture-specific norms and preferences into account in analyzing the development of emotion regulation. To test the internalization model of reflective emotion regulation, experimental research and intervention studies are required. Such studies are able to reveal causal and sustainable effects of underlying co-regulation processes. Furthermore, they can demonstrate its constitutive role in the development of children's social-emotional competence. Bearing in mind that emotion-regulation has significant impacts on development, our model provides a theoretical basis for concepts in the field of intervention, training, and counseling for designing programs that foster children's self-regulation of emotions by focusing on developmentally appropriate co-regulation practices of caregivers.

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The Role of Co-regulation for the Development of Social-Emotional Competence

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Co- and self-regulation in the caregiver-child dyad: Parental expectations, children's compliance, and parental practices during early years

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1 Introduction

Self-regulation refers to a process of changing cognitive, emotional, or motivational states in order to adapt to a given situation (e.g. Hofmann et al. 2012; McClelland 2010; Pauen et al. 2016). In comparison to children with poor self-regulation skills, children who have learned to regulate their inner states and to control their behavior reveal more social skills (Eisenberg et al. 2011; Müller et al. 2012), better school performance (Blair/Peters Razza 2007; Valiente et al. 2013), higher reasoning capacities (Richland/Burchinal 2013), and better health as adults (Drechsel 2007; Moffitt et al. 2011).

Existing evidence shows that self-regulation skills improve dramatically during early childhood (Carlson et al. 2005; Garon et al. 2014; Johansson et al. 2015; Miller/Marcovitch 2015; Zelazo et al. 2003; for a review see Diamond 2013; Garon et al. 2008). Infants and toddlers still strongly depend on other people to regulate their inner states (e.g. Kochanska et al. 2000; Lewis/Carpendale 2009; Posner/Rothbart 2000). Parental co-regulation is not only required to meet children's basic needs (e.g. being fed), but also to manage their emotional states, to guide their behavior, and to teach them about social rules.

Situations requiring compliance of the child provide a major learning field for developing self-regulation in social situations. Since caregivers' co-regulation seems to provide a fundamental basis for explaining the development of self-regulation (Fox/Calkins 2003; Holodynski/Friedlmeier 2006; Kiss et al. 2014), more studies are needed that examine the interplay between self- and co-regulation in the parent-child dyad (Kiss et al. 2014; Morris et al. 2007), especially during early years of life. The present report addresses this issue.

1.1 How do caregivers shape self-regulation development in young children?

Social experiences are a central determinant of self-regulation development. According to some authors, toddlers gradually internalize caregivers' co-regulation strategies (Cierpka/Cierpka 2012; Holodynski/Friedlmeier 2006; Kopp 1982). Empirical evidence supports the idea that parental behavior has an important impact on self-regulation development (e.g. Kim-Spoon et al. 2012; Lengua et al. 2007; Otterpohl et al. 2012). Many studies along these lines focus on the impact of parental control (Karreman et al. 2006). While "positive parental control" is characterized by teaching and encouraging behaviors, "negative parental control"

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comprises criticism, harshness, and even physical interventions. A meta-analysis by Karreman et al. (2006) revealed that positive parental control is associated with better self-regulation in the child, whereas negative parental control is associated with poor self-regulation.

More specifically, negative co-regulation behaviors (e.g. anger, physical, and verbal control expressed by the caregiver) have been found to go along with poor physical and emotional self-regulation of a child (Calkins et al. 1998). If children's needs and feelings are not sufficiently addressed during infancy and early toddlerhood, this may lead to affective dysregulation and negative cognitive, social, and behavioral outcomes later in childhood (NICHD 2004). Children who are neglected in social and emotional terms may even show severe physical and mental deficits (The St. Petersburg – USA Orphanage Research Team 2008); see also van der Horst/van der Veer 2008).

In contrast, positive co-regulation (e.g. supportive reactions, encouragement, scaffolding) seems to support the development of self-regulation in early childhood (Gunzenhauser et al. 2014; Hammond et al. 2012; von Suchodoletz et al. 2011). Positive co-regulation is most beneficial when it is well-adapted to the current needs of a child (Bibok et al. 2009; Maccoby/Martin 1983). Supporting this view, consistent positive responsiveness has been shown to promote social and cognitive development (Landry et al. 2001).

In sum, existing evidence suggests that negative parenting strategies have a negative impact on children's self-regulation development while positive parenting strategies have a positive impact. Nonetheless, a number of important questions regarding the specific mechanisms and dynamics of parental influence on children's self-regulation still remain to be answered, as illustrated by the following examples:

Regarding the mechanisms that might explain the impact of parental co-regulation in children's self-regulation development, Darling and Steinberg (1993) emphasize the role of parental values, attitudes, and goals associated with self-regulation. Several studies seem to support this view (Hastings/Grusec 1998; Kuczynski 1984; Leerkes 2010; Miguel et al. 2012; Richman/Mandara 2013; Rowe/Casillas 2011), while others failed to show corresponding relations (e.g. Bornstein et al. 2001). Hence, more studies are needed to explore the specific relation between parental expectations (beliefs, parenting goals) regarding self-regulation of children and parental co-regulative practices in interactions with their child.

Apart from questions related to parental influences we may also ask how children's self-regulation competencies affect parental co-regulation. Given the fact that interactions are per definition bi-directional in nature, it seems not only important to know how parents affect the self-regulation of their children, but equally important to explore how children influence the co-regulative behavior of their parents.

1.2 How do children shape their parents' co-regulation?

From early on, children differ in their temperament and their mental capacities (e.g. Calkins/Fox 2002; Rothbart 1986; Thomas/Chess 1977), thus triggering different response tendencies in caregivers. A "difficult temperament" (i.e. negative emotionality, less positivity, higher irritability and activity, see Thomas/Chess 1977) has often been found to influence parenting practices. For example, it has been shown that mothers' well-being can be negatively

influenced by children showing low levels of positivity and high levels of negativity (Sidor et al. 2013), thus leading to less positive affection of the mother towards her child and more self-reported parental control behaviors (Laukkanen et al. 2014). Pointing in the same direction, numerous studies reveal that a difficult temperament of the child induces feelings of helplessness and stress in parents (Gelfand et al. 1992; Oestberg/Hagekull 2000), which may in turn promote negative co-regulation strategies (see also Papoušek 2004). It should be noted, though, that existing evidence on how child temperament influences parental behavior is mixed (Paulussen-Hoogeboom et al. 2007), presumably due to differences in context variables and methodological approaches.

Further evidence for the impact of individual child characteristics on parenting behavior comes from studies showing differential treatment of siblings. Not only families of children with disabilities (Quittner/Opipari 1994) but also families with normally developing children reveal differential parental behavior towards their children (even twins; see Deater-Deckard et al. 2001). Younger siblings and children with difficult temperament typically receive more attention by their mother than older and less difficult ones. However, the more negative affect the children show, the more parental negativity they receive (Jenkins et al. 2003; Quittner/Opipari 1994).

Since negative and positive parenting practices both affect children's self-regulation development (Calkins et al. 1998; Gunzenhauser et al. 2014; Hammond et al. 2012; NICHD 2004; von Suchodoletz et al. 2011), disadvantageous differentiation could have negative consequences. Indeed, receiving more positive maternal control in comparison to one's sibling is associated with less problematic child behaviors like negativity and non-compliance and with higher levels of responsiveness to one's mother (Deater-Deckard et al. 2001). Of course, no final causal conclusions can be drawn from such correlations. The effective direction remains to be clarified in longitudinal studies.

1.3 Combining both perspectives

As demonstrated so far, child characteristics have an important impact on parental co-regulation, and parental co-regulation influences children's self-regulation development. This interactive view is widely accepted today (Blair et al. 2014; Fox/Calkins 2003; Kiss et al. 2014; Putnam et al. 2002). Hence, modern models take both aspects into account. For example, the Tripartite model by Morris et al. (2007) assumes that caregiver characteristics have an indirect impact on children's self-regulation development, mediated by variables like family climate, parenting practices, and a caregiver's own self-regulation. These mediating variables are in turn influenced by child characteristics. Supporting evidence for this multi-level approach has been provided recently (e.g. Gunzenhauser et al. 2014; Meyer et al. 2014; Otterpohl et al. 2012).

Interactive models also raise the important question of stability in the dynamics of the relation between co- and self-regulation. Children's needs and abilities change with age. Hence, one would expect parents to adjust their co-regulative strategies to the developmental status of their child (e.g. Bernier et al. 2010; Holodynski et al. 2013). Studies highlighting the impact of child characteristics on parental co-regulation suggest some flexibility in parental

behavior. On the other hand, a long tradition of research on parenting suggests that caregivers have their individual "style" of handling children, thus suggesting some stability in co-regulative strategies over time (e.g. Baumrind 1966). This raises the interesting question whether and how co-regulation practices vary with the age of the child (Darling/Steinberg 1993). In the existing literature, parents are reported to show moderate to high stability in their parenting behaviors over time while the absolute mean-values of individual behaviors may change with the child's age (e.g. Dallaire/Weinraub 2005; Holden/Miller 1999).

1.4 Goals of the present study

As we have argued so far, parental values, goals and attitudes towards self-regulation, children's characteristics (especially when they are related to self-regulation skills), and parental co-regulation practices might jointly predict the functioning of caregiver-child interactions and the development of self-regulation in early years. At the same time, studies that take into account all these aspects are still rare, presumably because instruments that allow for a combined assessment are still missing. The present study provides a first step to fill this gap by reporting inter-correlations between the scales of a newly developed caregiver questionnaire (IMMA 1-6: IMpulse Management: Pauen et al. 2014). This questionnaire assesses (a) caregivers' expectations (beliefs and goals regarding children's self-regulation), (b) children's self-regulation in situations that require coping with frustration, and dealing with parental demands or prohibitions; as well as (c) caregivers' co-regulation practices in corresponding situations.

IMMA focuses on parent-child interactions in situations when the caregiver asks the child to show compliance (i.e. by making a request or by prohibiting a specific action). Such situations often induce a conflict and require both sides to mutually regulate their responses. In the case of a request, the child needs to follow the goal of the caregiver. This requires the ability to remember the instruction, and to shift attention away from the present activity in order to be compliant. In the case of a prohibition, the child needs to refrain from a specific action, and to inhibit a predominant response. Hence, responses to requests and prohibitions clearly require self-regulation capacities, induced by the caregiver. On the other hand, the caregiver needs to deal with the emotions, motivations, and cognitive processes induced by the child's reaction to the request or prohibition.

In addition, IMMA also refers to situations in which the child needs to deal with a personal failure when trying to achieve a goal, and parental attempts to co-regulate potential frustration. Differing from existing inventories, IMMA thus takes a closer look at how children deal with external and internal demands, thereby considering both sides (child and parent) during interactions requiring self-regulation of the child.

Using IMMA, we asked (1) how parental expectations, children's self-regulation, and parental co-regulation practices vary with the age of the child, (2) how children's self-regulation and parental co-regulation are related to each other, and (3) how parental expectations are related to their co-regulative behaviors.

(1) We predicted that caregivers' expectations (beliefs and goals) regarding children's ability to self-regulate would become more ambitious with the age of the child, as this would

reflect the natural course of development (Bernier et al. 2010; Carlson 2005; Diamond 2013; Garon et al. 2014). We also assumed that children's self-regulation skills (as reported by parents) would improve between one and six years of age. More specifically, older children should show better emotion regulation when failing to reach a personal goal and their compliance should increase when facing parental requests or prohibitions. Finally, we checked whether co-regulation practices of parents vary with the child's age. As mentioned previously, evidence regarding this relation is mixed, with some researchers referring to "parenting style" suggesting stability (Baumrind 1966), and work highlighting the adaptability of parental behavior to the age of the child suggesting otherwise (e.g. Dallaire/Weinraub 2005; Holden/Miller 1999). If parents adapt their parental strategies to the age of the child, we would expect parents of older children to score lower on co-regulation scales and to request more self-regulation than parents of younger children.

(2) Regarding potential associations between co- and self-regulation, previous work indicates that negative parental control has a negative impact on children's self-regulation skills (see Karreman et al. 2006 for a corresponding meta-analysis), and that positive co-regulation has a positive impact on children's self-regulation development (Calkins et al. 1998; Gunzenhauser et al. 2014; Hammond et al. 2012; von Suchodoletz et al. 2011). At the same time, highly self-regulated children may trigger more positive parenting behavior than children with poor self-regulation, because they are less difficult to handle (Jenkins et al. 2003; Quittner/Opipari 1994). Hence, we expected negative control strategies to correlate with increased negative affect in the child when failing to reach a personal goal, as well as with increased protest and only directed compliance in situations requiring responses to parental requests or prohibitions. In addition, we predicted high scores of positive co-regulation strategies in parents to be related to higher scores of self-regulation skills in children.

(3) Finally, we were interested in exploring how beliefs and goals influence parenting practices. Many studies seem to suggest that parental goals and practices are related (Hastings/Grusec 1998; Kuczynski 1984; Leerkes 2010; Miguel et al. 2012; Richman/Mandara 2013; Rowe/Casillas 2011), but evidence regarding the specific associations between goals regarding children's self-regulation and parental practices in co-regulation are still sparse. Different scenarios seem plausible: Parents who assume that children at the same age as their child have already developed high self-regulatory skills might score lower on scales indicating co-regulation practices, simply because they do not see any need to co-regulate their child. But they may also show increased efforts to assist their child in reaching assumed age standards, thus showing enhanced co-regulation. Similarly, parents with high goals regarding self-regulation of their child may show less co-regulation in order to leave room for the child to develop self-regulation more rapidly, or they may show increased efforts to support their child in developing corresponding skills, thus scoring higher on co-regulation scales. The present study took an explorative look at the empirical relations between parental beliefs and goals regarding self-regulation of their child, and their parental co-regulation behaviors.

It is important to note that we used a non-experimental, cross-sectional study design. Hence, we will not be able to draw any conclusions regarding the causal relations between parental and children's behavior. Rather, it was our goal to check whether the IMMA questionnaire is suitable to discover systematic relations between parental expectations, a child's self-regulation, and parental co-regulation.

2 Method

2.1 Participants

Data collection took part in two different locations: Cologne, a large town in the Midwest of Germany, and Heidelberg, a smaller town in the South of Germany. Parents in both places came from a largely academic background. They either filled out the questionnaire at home (Cologne sample), or they completed the questionnaire during a visit at the lab (Heidelberg). The entire sample consisted of $N = 267$ parent-child dyads. Because the age distribution of children was very unequal and only part of the children visited a daycare center, we used semi-randomizing procedures to create a sample with equalized age groups, showing a similar distribution of daycare conditions and a balanced gender distribution.

This final sample consisted of $N = 132$ data sets, provided by parents (87% female) with children ranging between one and seven years of age ($M = 47.81$ months, $SD = 19.90$ months, *Range* = 12-82 months), split into six different age groups, each consisting of $n = 22$ children (Group 1: < 24 months, Group 2: 24-35 months, Group 3: 36-47 months, Group 4: 48-59 months, Group 5: 60-71 months, and Group 6: 72-82 months).

2.2 Procedure

IMMA 1-6 Questionnaire (Pauen et al. 2014). To examine caregiver's expectations, children's self-regulation, and parental co-regulation practices, we developed an item pool based on theoretical considerations and existing parenting inventories (EFB, Naumann et al. 2010; PSDQ, Robinson et al. 1995). This item pool was divided into three main parts.

Part I asked caregivers about their beliefs regarding the self-regulation skills of children matching the age of their offspring. More specifically, caregivers rated how well children of the same age as their own child were able to regulate their impulses, and to respond to a caregiver's requests and prohibitions. In addition, we asked parents about their goals regarding the self-regulation development of their own child. They rated how important it was to them at the child's given age that he/she learns to deal with corresponding situations in a self-regulated way.

Part II focused on the self-regulation attempts of the child in three different situational contexts: when being (a) unable to achieve a personal goal, (b) asked to follow a parental request, and (c) asked to stop a given activity (i.e. following a prohibition).

In Part III, caregivers were asked how they typically respond to their child's behavior in corresponding situations. A broad range of parental practices was described, including positive and negative co-regulation behaviors, as well as withdrawal (for a more detailed description see Table 1 and Appendix A). All items were written in German and could be answered

on a 6-point Likert scale (Part I: 1 = applies not at all, 6 = fully applies; Parts II and III: never – rarely – rather rarely – rather frequently – frequently – always).

Scales for each part were formed based on results of a principal axis analysis: Part I (Parents' beliefs and goals concerning their children's coping with impulses) consisted of three scales: Parents' beliefs and goals concerning children's internal self-regulation, Parents' beliefs about children's coping with external demands, and Parenting goals regarding children's coping with external demands. Part II (Children's reactions to internal impulses and external demands and limitations) comprised eight scales: Ignorance, Compliance, Directed compliance (requests), Directed compliance (prohibitions), Directed compliance (physical pressure), Discussion behavior, Negative emotion expression & aggression, and Goal-orientation. Part III (Parenting practices in reaction to the child) contained seven scales: Withdrawal, Request for self-regulation, Negative co-regulation, Positive co-regulation, Democratic parenting behaviors, Appreciation, and Use of rewards (for more details see Appendix A).

Table 1: Scale structure and internal consistencies.

Scale	Number of items	Internal consistency
Parents' beliefs and goals concerning their children's coping with impulses		
Parents' beliefs and goals concerning children's internal self-regulation	8	.88
Parents' beliefs about children's coping with external demands	5	.84
Parenting goals regarding children's coping with external demands	5	.89
Children's reactions to internal impulses and external demands and limitations		
Ignorance	3	.63
Compliance	5	.49
Directed compliance (requests)	4	.85
Directed compliance (prohibitions)	5	.85
Directed compliance (physical pressure)	2	$r = .60^{\Delta}$
Discussion behavior	3	.81
Negative emotion expression & aggression	5	.80
Goal-orientation	3	.78
Parenting practices in reaction to the child		
Withdrawal	3	.62
Request for self-regulation	2	$r = .30^{\Delta}$
Negative co-regulation	9	.84
Positive co-regulation	6	.72
Democratic parenting behaviors	2	$r = .33^{\Delta}$
Appreciation	2	$r = .60^{\Delta}$
Use of rewards	2	$r = .46^{\Delta}$

Note. In this table and the following ones we did not use the factor order resulting from the factor analysis, but arranged the scales mainly by levels of pressure, either shown by the child or by the parents to make their child comply.
Δ If a scale consists only of two items, Pearson's correlation is reported.

Source: Own representation.

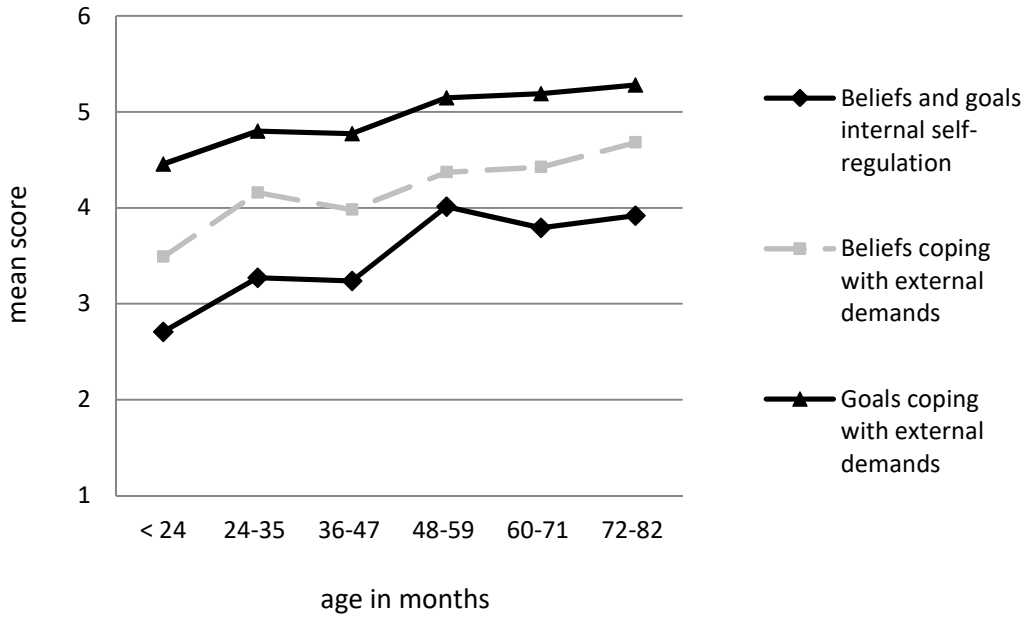
Internal consistencies for individual scales of all three parts varied from $\alpha = .49$ (Compliance) to $\alpha = .89$ (Parenting goals regarding children's coping with external demands). Thus, most scales showed acceptable to very good internal consistencies (see Table 1).

2.3 Results

All following *p*-values have been Bonferroni-corrected.

(1) Age-related differences in parental expectations, children's self-regulation, and parental co-regulation practices. Univariate tests indicated that parental beliefs and goals regarding children's internal self-regulation (i.e. dealing with the inability to achieve a personal goal) increased with age ($F(5, 118) = 9.56$ $p < .001$, $\eta^2 = .29$), with major changes occurring after the third year of life (*Tukey-T* = -0.77, $p = .04$). The same general increase with age was found for parental beliefs regarding children's capacities to cope with external demands ($F(5, 124) = 5.44$, $p < .001$, $\eta^2 = .18$). Parental goals regarding children's adaptation to external demands (requests and prohibitions) increased gradually with age, even though this trend was only marginally significant ($F(5, 124) = 2.87$, $p = .05$, $\eta^2 = .10$). Figure 1 depicts the means for each aspect over all age groups. These findings largely confirm our initial hypothesis that parental expectations regarding children's self-regulation increase with the age of the child.

Figure 1: Parents' self-regulation expectations, mean values over all age groups.



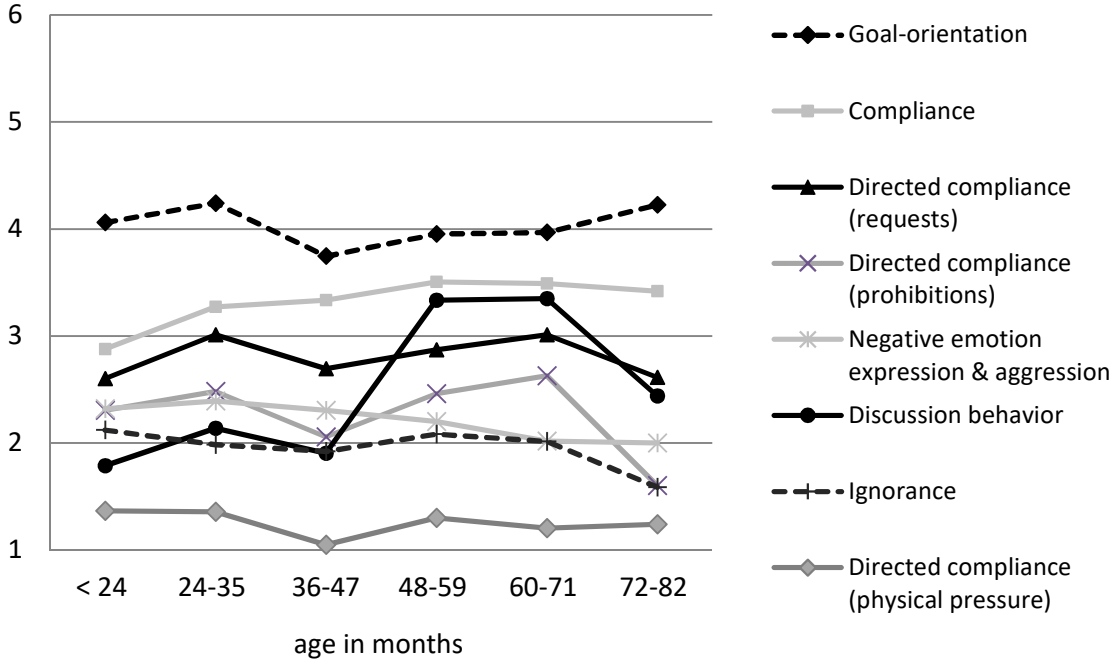
Source: Own representation.

Additional analysis revealed that parental goals regarding their child's ability to cope with external demands were significantly higher than their beliefs about the actual coping competences at a given age ($t(128) = -9.75$, $p < .001$, $d = 0.85$; goals: $M = 4.95$, $SD = 0.90$; beliefs: $M = 4.18$, $SD = 0.90$).

As expected, children's compliance tended to increase with age ($F(5, 121) = 3.34$, $p = .06$, $\eta^2 = .12$), with major changes occurring within the first two years of life (see Figure 2). Parents of older children needed less pressure to convince their child to accept a prohibition ($F(5, 122) = 4.90$, $p = .003$, $\eta^2 = .17$), showing a major decrease between five and six years when children in Germany enter their last preschool year in kindergarten (*Tukey-T* = -1.03, $p = .004$). Children's attempts to solve conflicts of interest by arguing increased ($F(5, 125) = 11.27$,

$p < .001$, $\eta^2 = .31$), especially between three and four years (*Tukey-T* = -1.43, $p < .001$), and seemed to decrease again between five and six years of age, although this effect was not statistically significant following Bonferroni correction (*Tukey-T* = -0.91, $p = .21$). We did not see an age-related decrease of negative emotions and aggressions ($F(5, 124) = 0.96$, $p = 1.00$, $\eta^2 = .04$).

Figure 2: Children's self-regulation, mean values of parents' reports over all age groups.



Source: Own representation.

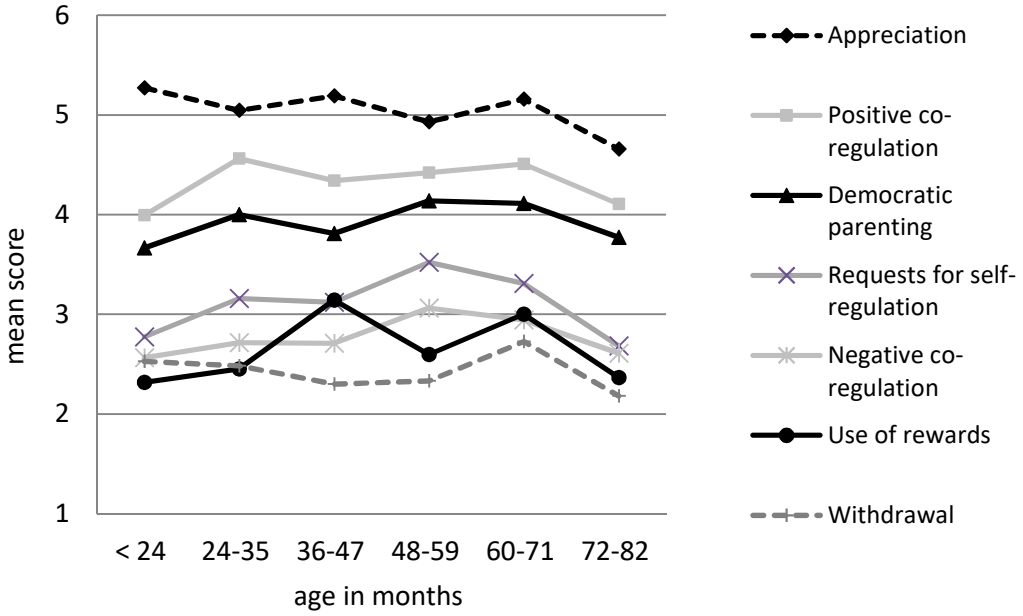
Contradicting our hypotheses, no significant age-related differences in parental co-regulation practices could be found. Only the use of rewards tended to differ with children's age ($F(5, 124) = 2.73$, $p = .10$, $\eta^2 = .10$), showing a peak for parents of three-year-olds. However, the scale "use of rewards" consists of only two items and should thus be interpreted with caution. No other age effects could be observed, suggesting that co-regulation practices are fairly similar in groups of parents with different-aged children (see Figure 3).

(2) Relations between children's self-regulation and parental co-regulation. As expected, negative control strategies correlated with increased attempts of the child to discuss parental demands ($r_{sp} = .38$, $p < .001$), as well as with directed compliance in response to parental requests ($r_{sp} = .54$, $p < .001$) and prohibitions ($r_{sp} = .44$, $p < .001$). In addition, a given child's tendency to ignore parental requests correlated with parental withdrawal in conflict situations ($r_{sp} = .38$, $p < .001$).

Furthermore, children's ignorance behavior was associated with parents' tendency to exert negative control ($r_{sp} = .40$, $p < .001$). Self-regulation requests occurred more often when children showed an increased tendency to argue about parental requests ($r_{sp} = .37$, $p < .001$) and when they tended to express their negative emotions or became aggressive ($r_{sp} = .27$,

p = .11). However, the IMMA-scale "requests for self-regulation" and its relations to other variables should be interpreted with caution, because this scale includes only two items.

Figure 3: Parents's reported co-regulation practices, mean values over all age groups.



Source: Own representation.

Contradicting our hypotheses, negative affect when failing to reach a personal goal was not associated with negative control strategies of parents (r_{sp} = .24, *p* = .39), nor did we find any significant relations between children's self-regulation in terms of compliance and positive co-regulation practices of parents (r_{sp} = .22, *p* = .90). In this context, it seems interesting to note that mean scores for scales indicating positive parenting practices (i.e. positive co-regulation, democratic parenting, and appreciation) and better self-regulation in a child (i.e. goal-orientation and compliance) were generally higher than scores for negative parenting (i.e. withdrawal, negative co-regulation), and low self-regulation (i.e. ignorance, directed compliance, debating, negative emotional expression) in the present sample: positive vs. negative parenting scales: *M* = 4.44, *SD* = 0.54 vs. *M* = 2.59, *SD* = 0.58, *t*(129) = 29.87, *p* < .001, *d* = 2.63; high vs. low self-regulation: *M* = 3.68, *SD* = 0.52 vs. *M* = 2.18, *SD* = 0.58, *t*(130) = -20.55, *p* < .001, *d* = 1.81 (see also Figures 2 and 3).

(3) Relations between parental expectations and co-regulation practices. Parents with high beliefs and goals regarding their child's internal self-regulation also requested more self-regulation (r_{sp} = .27, *p* = .04), but did report similar degrees of co-regulation practices as parents with lower expectations.

2.4 Discussion

The present study provides first data obtained with a newly developed questionnaire (IMMA: Pauen et al. 2014) designed to study empirical relations between parental expectations, children's self-regulation skills and parental co-regulation practices during early childhood. Parents of children ranging from 1 to 6 years of age were asked to fill out this inventory and

correlations between different scales were examined regarding the relations between parental expectations, child self-regulation behaviors, and parental co-regulation. Main findings refer to (1) age-related changes, (2) associations between co-regulation practices of parents and children's self-regulation, and (3) relations between parental expectations, and their co-regulation practices.

(1) Age-related differences in parental expectations, children's self-regulation, and parental co-regulation practices

Age-related changes in parental expectations. As expected, parental beliefs and goals regarding children's ability to show self-regulation gradually increased with age. With respect to parental beliefs and goals regarding children's ability to deal with personal limitations we found a substantial increase between three and four years. During this time, German children usually enter kindergarten and thus need to deal with situations on their own – without the help of their primary caregiver. It is well possible that parental expectations regarding their child's ability to cope with personal limitations or failed attempts to reach a goal increase as this behavior gains relevance in daily life.

Adapting to external demands was valued as an important educational goal by parents of all age groups. Even parents of children younger than 24 months often stated that they wanted their child to learn how to cope with requests and prohibitions at their proper age. When educational goals slightly exceed actual capacities, this can promote the development of any skill, as long as the corresponding discrepancy is not too large (Vygotsky 1978). Parents in the present sample seemed to do so intuitively, as mean scores for goals regarding children's self-regulation were significantly higher than expectations about children's self-regulation capacities in each age group. Whether this finding only applies to parents of a rather high educational and socio-economic background characterizing our sample or to parents in general cannot be answered based on the reported data. Which factors influence parental goal setting and how discrepancies between educational goals and actual competences of the child influence children's self-regulation development provide further interesting questions that could be explored in future studies using the IMMA questionnaire.

Age-related changes in children's self-regulation. As expected, parents of older children reported more compliance in response to caregiver requests than parents of younger children, with major changes occurring during the first two years. Furthermore, children seem to accept prohibitions better with age. Especially between five and six years, less parental pressure was needed in corresponding situations. This may result from major progress in children's basic executive functions during the first years of life (Bernier et al. 2010; Garon et al. 2008; Holodynski et al. 2013).

In addition, social learning processes might play a crucial role. All children of the present sample were in day-care facilities where they experience social interactions with other children and caregivers on a daily basis. In this setting, children often need to adapt to social demands. They learn to obey rules and prohibitions. Especially during preschool years (i.e. between four and six years), day-care facilities try to enhance children's self-regulation skills to promote school readiness (e.g. Blair/Raver 2015). This could have positive effects on children's compliance behavior.

As self-regulation skills are known to improve with age we also expected to see a decrease in emotion expression and aggression. This was not the case. Since scores for showing negative emotions and aggressive behaviors were rather low in all sub-groups of our sample, this may reflect a bottom effect. In addition, problems related to social desirability may have prevented parents from admitting that their offspring shows behaviors clearly regarded as negative in our society. It would be interesting to get data on the same child from parents and daycare personal in parallel, and to compare results obtained from different caregivers filling out the IMMA questionnaire. Future studies may address this issue.

Another interesting observation concerns children's tendency to discuss requests and prohibition of parents rather than to follow instructions immediately. Between three and four years of age, this tendency increased, presumably because children's language skills improve. Pretend play activities also increase during this period (Weisberg 2015), and are associated with higher-level verbal negotiations (Howe et al. 1998). Four- to five-year-olds discuss about the goals and contents in play and seem to spent 20-50% of their play time negotiating with their play partners (Doyle/Connolly 1989). This behavior is probably also shown in interactions with caregivers.

As children approach school age (i.e. between five and six years) this way of responding to parental requests and prohibitions seemed to decrease again, presumably because self-regulation skills improve and rule understanding increases. Questioning and discussing external requests and prohibitions by authorities may be relevant to achieve this kind of rule understanding, but should become less frequent once the rules are clear to the child and it becomes more capable and willing to show compliance. In sum, our findings are in accord with knowledge about general development in early childhood.

Age-related changes in parental co-regulation strategies. Parents' co-regulation strategies did not differ significantly between age groups. We only observed marginal age-related changes in toddlerhood for the use of rewards. The fact that parents of toddlers reported to use more rewards to co-regulate their three-year-olds than either parents of younger or older children may have to do with the fact that three-year-olds are old enough to understand the relation between behavior and consequences. Hence, they can guide their behavior consciously based on this understanding. At the same time, they may still be a little too young to understand verbal explanations for why parents make a request or express a prohibition. Parents may adapt to this situation by using rewards to achieve compliance.

As mentioned previously, existing data suggests moderate to high stability in parenting behaviors (e.g. Dallaire/Weinraub 2005; Holden/Miller 1999). A study explicitly asking how stable parental discipline practices are during toddlerhood (i.e. between 16- and 37-months) found mixed results, showing stability in absolute values at least for punitive discipline (Huang et al. 2009). Considering the fact that we did not test the same parents repeatedly, our findings are not directly comparable to those of longitudinal studies. Nonetheless, it seems interesting to speculate why no group differences could be observed.

One possible explanation may be that parents interpret items of IMMA differently at different ages of their child. More specifically, they may adapt their reading of a given item to

the age of their child: for example, showing compassion, helping the child to achieve a personal goal, trying to calm a child down, or threatening with consequences in case of non-compliance may be realized in different ways when dealing with a one- or a six-year-old. More in-depth analyses are needed to describe the specific patterns of parenting if the study goal is to assess changes related to the age of the child. In general, we conclude that more longitudinal studies are needed to explore stability in co-regulation practices. In such studies, parental practices should be described precisely in order to reveal age-related changes.

(2) Relations between children's self-regulation and parental co-regulation

In line with studies that point to a negative impact on parental negative control (Karreman et al. 2006), negative co-regulation behavior correlated with indicators of lower self-regulation. Parents who describe their child as showing passive or active resistance when being asked to follow parental requests or to accept prohibitions also reported more negative co-regulation strategies and more withdrawal than parents who describe their child as being compliant. This might indicate the usefulness of the IMMA questionnaire to identify maladaptive interactive patterns in the caregiver-child dyad. Furthermore, corresponding observations provide some support for the idea that negative co-regulation and a lack of self-regulation stabilize each other (see introduction). However, no such correlation could be found with respect to negative emotion expression and aggression. As already mentioned previously, this may be due to bottom effects regarding the corresponding self-regulation scales in the present sample. Future studies should thus clarify whether the same effects can be found in families at high risk for child maltreatment.

Also pointing to the potential usefulness of IMMA in clinical contexts, we found that withdrawal behavior in parents correlated significantly with reported ignorance in children. If a parent avoids trouble by giving in easily, a child may learn to ignore prohibitions by running away or pretending to not have heard the parent. But parents may also get discouraged if their child often ignores their requests and prohibitions, and thus give in more easily. To better understand the nature of the observed correlation, longitudinal studies are needed.

Finally, parents of children who express their anger and aggression more often requested more self-regulation of their child. This may be due to emotion display rules. Negative emotions like anger are not appreciated in our society. It is possible that less regulated children induce more parental requests to show self-regulation, or that parental requests for self-regulation induce more negative feelings and active resistance in the child. Again, longitudinal studies are needed to determine the causal direction of this relation.

Contradicting our initial hypotheses, we did not find significant correlations between higher self-regulation skills in terms of a child's compliance and positive parental practices, as reported in the literature. This means that parents who show positive practices may or may not have children with good self-regulation skills. How can we explain this unexpected finding? It seems important to note that self-regulation skills in children ranging between one and six years of age vary largely due to maturation and developmental progress rather than inter-individual difference. If parental practices remain largely stable across different age groups whereas self-regulation skills change, this clearly works against finding significant correlations

for the entire sample. Larger samples of children of the same age would be needed to fully evaluate this hypothesis.

(3) Relations between parental expectations and co-regulation practices

Not unexpectedly, parents with higher beliefs and goals regarding their child's self-regulation also request more self-regulation. Interestingly though, parents with high expectations did not show less co-regulation behaviors (e.g. less negative control, less positive co-regulation, or less use of rewards). Maybe parents with high expectations first request self-regulation, but respond with co-regulative strategies if their requests fail to elicit the expected response in the child. It is also possible that there are different groups of parents with high expectations: One group may try to foster their child's self-regulation by co-regulating more than parents with lower expectations, while others may reduce the amount of co-regulation to leave room for self-regulation of their child. The specific combination may also vary with the child's age and temperament. Alternatively, parents may have referred to their beliefs about children's capacity to self-regulate in general, rather than focusing only on their own child or other children of the same age. This would reduce covariation between beliefs and behaviors (see Miller 1988 for a review on relations between parental beliefs and behaviors).

We also found no association between parental goals regarding their child's self-regulation and co-regulative behaviors. This contradicts our initial hypothesis and other studies showing substantial associations of this kind (e.g. Hastings/Grusec 1998; Rowe/Casillas 2011). At the same time, it confirms findings from social psychology indicating that intentions explain less than 30% of the variance in behavior of adults, and that the relation between intentions and behavior also varies substantially with the situational context (e.g. Armitage/Conner 2001; Sheeran 2002). Yet another reason for the given lack of relations between parental goals and applied strategies may be that parents who share goals may still have different ideas about how to best achieve them. While some parents may try to support self-regulation in their child by providing more co-regulation, others may assume that it is better to show less co-regulation. Asking parents more details about how they are planning to implement their goals could help to shed more light on the absence of goal-behavior correlations in this context. In any case, we conclude that there is no simple answer to the question how parental expectations are related to parental practices. More information about specific expectations, parenting attitudes, goals, and strategies is needed to better understand the relation between both aspects.

3 Conclusions, limitations and future prospects

Caregivers' expectations regarding children's self-regulation have been found to show age-related changes that are largely consistent with the existing literature. Furthermore, we observed significant correlations between negative forms of children's self-regulation and negative parental co-regulation, suggesting that the IMMA questionnaire (Pauen et al. 2014) might be useful for identifying maladaptive parent-child interactive patterns.

It should be noted, though, that the present sample consisted almost exclusively of German women with academic background. Thus, we still do not know whether the reported

findings are generalizable to fathers or to other populations. Previous studies comparing parenting in mothers and fathers have shown that they vary significantly with respect to their parenting goals (Hastings/Grusec 1998), which may also affect their parenting behaviors. It is possible that self-regulation beliefs and parenting goals correlate with co-regulation behaviors in fathers, but not in mothers. Hence, it will be important to compare both sexes and to investigate their level of congruence and its effects on a child's self-regulation and mental health (Chen/Johnston 2012; Lindsey/Caldera 2005).

Of course, socio-economic background may be equally important in this context, as parenting style is known to be influenced by educational background of parents (Azad et al. 2014; Carr/Pike 2012) as well as by the economic situation of the family (Azad et al. 2014). Furthermore, cultural comparisons seem necessary before any conclusions about universal or culture-specific relations between self- and co-regulation can be drawn.

In the present study, only questionnaire data was used to assess self-regulation and parenting. To increase the reliability and validity of the measures used, future studies should also collect behavioral and/or observational data to assess a child's self-regulation and parents' co-regulation strategies. This is also necessary to probe the validity of the IMMA questionnaire for diagnostic use in clinical or counseling settings.

The IMMA seems to be a promising instrument for studying the dynamics of caregiver-child interactions in self-regulation contexts. For that purpose, it should be extended and modified. Some scales consist of only few items and could be expanded to increase reliability. In addition, the factor structure of each IMMA part still needs to be evaluated using a new sample and confirmatory analyses. (We already completed work on a revised version that will be published soon.)

More aspects mentioned in the model by Morris et al. (2007) should be considered simultaneously to receive a broader picture of the co-regulation development in the caregiver-child dyad. A child's and parents' temperament could be of special interest in this context and might help to gain a deeper understanding of the correlational patterns found. Maybe assessing temperament could also help us to distinguish between a child's "willingness to be socialized" (Darling/Steinberg 1993) and its individual self-regulation capacities in situation requiring compliance.

Research on self-regulation development has already come a long way. Although parental influences have been discussed for a long time, there is still a lot of work to be done to catch the dynamic interplay between children and their parents. The fundamental importance of self-regulation for nearly all aspects of life implicates the need to take a close look at the dynamics of self- and co-regulation in the caregiver-child dyad during early childhood. Longitudinal studies would be most helpful in this regard.

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5 Appendix

5.1 Scale construction of IMMA 1-6

To explore the factor structure of each IMMA part (I-III), principal axis analyses (oblimin oblique rotation) were used. To determine the number of factors for each part Kaiser criterion (Kaiser 1960), as well as Cattell's scree plot (Cattell 1966) were used. Items not clearly associated with any factor (i.e. loadings <.30) were eliminated and a second analysis with the remaining items was conducted.

The following Tables A1-A3 show all item-factor loadings.

Table A1: Item-factor loadings for part one of the questionnaire
(Parents' beliefs and goals concerning their children's coping with impulses).[3]

Item	Factor		
	1	**2**	**3**
Children of the same age as my child are able to.....			
… regulate feelings	**.666**	.057	-.040
… control own needs	**.626**	.165	-.058
… control their will	**.465**	.147	-.012
… delay own interests as needed	**.653**	.275	-.242
It is important for me that my child learns....			
… to regulate feelings	**.724**	-.232	.226
… to control own needs	**.752**	-.162	.233
… to control one's own will	**.587**	-.147	.444
… to delay one's own interests as needed	**.574**	-.056	.308
Children of the same age as my child are able to....			
… to comply with requests	.026	**.679**	.102
… accept limits and prohibitions	-.032	**.795**	.162
… follow rules	.082	**.654**	.129
… behave thoughtfully towards others	.469	**.420**□	-.025
… be polite towards others	.455	**.412**□	.095
It is important to me that my child learns to.....			
… to comply with requests	-.016	.123	**.784**
… accept limits and prohibitions	-.062	.131	**.794**
… follow rules	-.021	.120	**.854**
… behave thoughtfully towards others	.283	.092	**.558**
… be polite towards others	.358	-.018	**.563**

Note: These items showed double loadings. Based on theoretical considerations, we decided to add them to Factor 2.

Source: Own representation.

3 Please note that this is a preliminary version of the IMMA, as well as preliminary translation into English. We currently prepare another publication reporting a revised version.

Table A2: Item factor loadings for part two of the questionnaire (Children's reactions to internal impulses and external demands and limitations)

Item	Factor							
	1	2	3	4	5	6	7	8
My child complies with my demand only after…								
… repeated request.	**.528**	.057	.133	-.032	-.058	.216	.149	.083
… I've given him/her a strict look.	**.674**	-.016	.284	.242	-.127	.030	.055	.204
… I've raised my voice and/or ranted.	**.687**	-.139	-.003	-.081	-.041	.121	.107	-.053
… I've threatened him/her with consequences.	**.833**	-.190	.005	-.185	.007	-.109	-.131	-.005
When my child is facing problems to reach a goal s/he…								
… starts to cry.	.041	**-.467**	.054	.129	-.241	-.133	.116	.033
… gets angry and loud.	-.007	**-.856**	-.099	-.133	.094	.016	-.040	-.035
… gets aggressive against objects.	-.015	**-.773**	-.006	.062	-.052	.183	-.031	-.012
… gets aggressive against other people.[1]	.038	**-.761**	.091	.140	-.032	-.072	-.027	.058
When my child has been requested for sth. s/he…								
… fights and rages without complying.[1]	.085	**-.342**	.126	-.133	-.084	.121	.166	.090
When my child has been requested for sth. s/he…								
… complies immediately, without protest.	-.466	-.075	**.309**	-.024	.025	-.076	-.190	-.056
… shows displeasure, but complies immediately.	.028	-.089	**.519**	-.075	-.010	-.232	.195	-.078
… complies only after having finished his/her ongoing activity.	.208	-.077	**.378**	-.062	.066	.111	-.045	.091
When I've prohibited sth. s/he…								
… accepts the prohibition without protest.	.057	.037	**.372**	.066	.022	-.068	-.028	-.373
… accepts the prohibition upon protest.	-.074	.056	**.510**	-.330	.022	.015	.027	.120
When my child has been requested for sth. s/he…								
… starts discussing without complying.	.343	-.060	.017	**-.561**	.111	.021	.219	-.163
When I've prohibited sth. s/he…								
… starts whining/begging to make me withdraw the prohibition.	-.058	.029	.040	**-.707**	-.097	-.085	-.036	.141
… starts discussing to make me withdraw the prohibition.	.026	.058	.119	**-.901**	-.054	.002	-.041	.016
When facing problems to reach a goal s/he…								
… keeps trying and wants to make it on his/her own.	-.030	.052	.054	-.050	**.645**	.095	.047	.004
… is giving in after a short time. (reversed)	.049	.002	-.129	.004	**.923**	-.052	.014	.072
… is turning to something else. (reversed)	-.049	-.029	.097	.154	**.682**	-.063	-.020	.003
When being requested for sth. s/he…								
… complies only after I've physically forced him/her to.[1]	.115	-.084	.052	.069	.050	**.818**	.076	-.167
When I've prohibited sth. s/he…								
… complies only after I've physically forced him/her to.[1]	-.073	-.009	-.063	.008	-.046	**.738**	-.081	.173
When being requested for sth. s/he…								
… pretends not to have heard me.	.243	.095	-.002	-.196	-.048	.108	**.304**	.174
… eludes me (e.g. is hiding, or running away).[1]	.013	.005	.120	.026	.006	-.020	**.804**	-.058
When I've prohibited sth. s/he…								
… ignores it and pretends not to have heard me.[1]	-.052	-.080	-.265	.072	.028	.025	**.454**	.387
When I've prohibited sth. s/he accepts the prohibition only after…								
… repeated warning.	-.037	.020	.099	-.127	.005	.129	.057	**.758**
… I've given him/her a strict look.	.037	-.036	.085	.064	.015	-.036	-.024	**.896**
… I've raised my voice and/or ranted.	.209	-.048	-.056	-.044	.041	.030	.023	**.725**
… I've threatened him/her with consequences.	.425	-.003	.010	-.322	.106	-.188	-.072	**.471**[¤]
When I've prohibited sth. s/he…								
… fights and rages without complying.	-.060	-.201	-.133	-.133	-.010	.087	.259	**.367**

Note. 1 = Directed compliance (requests), 2 = Negative emotion expression & aggression, 3 = Compliance, 4 = Discussion behavior, 5 = Goal-orientation, 6 = Directed compliance (physical pressure), 7 = Ignorance, 8 = Directed compliance (prohibitions); [1] = extremely high item difficulty (i.e., < .20)
[¤] This item showed double loadings. Based on theoretical considerations, we decided to add it to Factor 8.

Source: Own representation.

Table A3: Item factor loadings for part three of the questionnaire (Parenting practices in reaction to the child)

Item	Factor						
	1	2	3	4	5	6	7
If my child does not accept my request…							
… I repeat my request forcefully.	**.409**▫	-.084	-.033	-.438	.098	-.139	.016
… I give him/her a very strict look.	**.559**	.006	-.053	-.190	.138	-.081	-.049
… I raise my voice and/or rant.	**.704**	-.038	-.126	-.010	-.086	-.135	-.088
… I threaten him with consequences.	**.722**	-.044	.002	.006	-.151	-.193	-.040
… I force my child to comply.	**.810**	.130	-.047	.096	.087	-.052	.030
… I give him/her the cold shoulder.[1]	**.446**	-.092	-.353	.027	-.063	.121	-.058
… I deny him/her something s/he wants to have/do.	**.686**	-.048	-.090	.018	-.066	.202	.136
If my child gets exasperated about my request…							
… I ask him/her to stop making a scene.	**.322**	-.024	.109	-.217	-.070	.013	-.229
… I insist on getting his/her compliance.	**.563**	-.022	.284	-.007	-.114	-.019	-.006
If my child is frustrated when trying to reach a goal…							
… I show compassion.	-.048	**.615**	-.046	-.032	-.154	.010	.037
… I try to calm him/her down.	.051	**.530**	.053	.102	-.140	.064	-.283
… I encourage him/her to keep trying.	.058	**.457**	.090	-.005	-.042	.133	.209
… I help him/her to reach his/her goal.	.138	**.508**	.034	-.239	.061	.244	-.011
If my child gets exasperated about my request…							
… I show compassion.	-.084	**.709**	-.177	.041	.052	-.222	-.084
… I try to calm him/her down.	-.094	**.323**	-.064	-.158	.094	.023	-.243
If my child does not comply with my request, I give in.[1]	.083	.046	**-.453**	.208	-.065	.015	-.169
If my child gets exasperated about my request…							
… I defer my request.	.020	.093	**-.500**	-.314	-.021	.084	.020
… I give up on my request.[1]	.038	.019	**-.855**	-.010	.048	.042	.041
If my child does not accept my request …							
… I offer a compromise.	-.163	-.039	-.217	**-.320**▫	-.373	-.069	-.239
… I explain my request in more detail.	.003	.137	.019	**-.809**	-.081	.032	.017
If my child is frustrated when trying to reach a goal …							
… I ask him/her to calm down.	.144	-.012	.064	-.042	**-.381**	-.129	-.096
… I encourage him/her to vent his/her frustration.	-.032	.161	-.019	.036	**-.753**	.135	.109
If my child complies							
… I thank him/her for it.[2]	-.042	-.078	-.121	.036	-.121	**.717**	.016
… I praise him/her explicitly for it.	-.093	.103	.018	-.053	.149	**.724**	-.194
If my child complies, I give him/her a small reward.	-.083	.223	-.038	.328	-.001	.223	**-.604**
If my child does not accept my request, I promise a reward for compliance.	.181	-.091	-.164	-.150	-.145	.083	**-.742**

Note. 1 = Negative co-regulation, 2 = Positive co-regulation, 3 = Withdrawal , 4 = Democratic parenting behavior, 5 = Request for self-regulation, 6 = Appreciation, 7 = Use of rewards; [1] = extremely high item difficulty (i.e., < .20), [2] = extremely low item difficulty (i.e., >.80). ▫These items showed double loadings. Based on theoretical considerations, we decided to add them to Factor 1 and Factor 4, respectively.

Source: Own representation.

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A Review of Hot Executive Function in Preschoolers

Nancy Garon[1]

1 Introduction

Defined as a set of abilities involved in the regulation of thoughts, emotions, and behaviors (Diamond 2013), the construct of executive functions (EF) has gained increasing prominence in the last two decades, due in part to its association with important outcome measures such as early school success (Blair/Dennis 2010; Morrison et al. 2010) and social success with peers (Eisenberg et al. 2003, 2004; Eisenberg et al. 2009). Researchers distinguish hot and cool EF abilities; hot EFs are primarily associated with affective challenges, and cool EF with abstract problem solving (Zelazo/Mueller 2002, 2011). In addition, the two have been linked to different neurological substrates, both prefrontal areas: hot EF with ventromedial prefrontal (VMPFC) areas, and cool EF with lateral prefrontal (DLPFC) areas (i.b.). Although a significant amount of work has been done on cool EF in childhood (Best/Miller 2010; Garon et al. 2008 for reviews), research on hot EF in children has been comparatively scant.

The primary goal of the current paper is to review the literature on early hot EF, focusing mainly on two popular hot EF tasks, both designed to assess individual choices in order to maximize personal benefit: (a) the Iowa Gambling Task (IGT), and (b) the Delay of Gratification Task (DoGT). Each of these tasks exists in different versions, leading to diverging sets of results. Before analyzing potential reasons for this phenomenon in more detail, research exploring the general distinction between hot and cool EF abilities will be presented. A third section explores how measures of hot EF fit within the wider context of EF and self-regulation. Finally, issues for future research are discussed.

1.1 Regulation and Executive Functions

Given how closely the constructs of self-regulation and EF overlap, there has been confusion in the literature about how these differ. Self-regulation tends to be defined as a broader concept that encompasses EF (Blair 2016; Blair/Dennis 2010), and usually refers to any type of regulation that is adaptive for the individual, including bottom-up mechanisms such activation and arousal (Tucker et al. 1995). Most theories of EF have considered primarily the top-down aspects of self-regulation. For instance, Miyake and Friedman (2012) have argued that EF is composed of partially dissociable components that share an underlying process. They focused on three core cool EF components that involve primarily top-down regulation: working memory, response inhibition, and shifting.

In contrast, EF models that have incorporated hot EF processes, such as the Iterative Reprocessing (IR) theory (Zelazo/Cummings 2007), highlight the importance of bottom-

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up regulation. The IR theory emphasizes reflective thought as central to EF, but also includes the idea of iterative reprocessing, whereby lower level representations are reprocessed into more abtract representations. This suggests that higher levels of processing are dependent on the lower level, bottom-up processes. Proponents of cybernetic theories of self-regulation have also considered bottom-up processes and their relation with EF (Blair 2016; Lewis/Todd 2007; Tucker et al. 2015). For instance, Blair (2016) distinguished between bottom-up regulatory processes and top-down effortful regulatory processes, arguing for the importance of these bottom-up processes in regulating top-down processes. In addition, Blair (2016) argued that self-regulation includes both types of processes whereas EF includes only top-down regulatory processes. In this paper, self-regulation is considered to be a process involving bottom-up and top-down regulation while EF is considered to involve primarily top-down regulation, most consistent with Blair's conceptualization.

1.2 Distinguishing between Hot and Cool EF

Whereas there is general agreement in the literature about the distinction between self-regulation and EF, there is relatively less clarity in distinguishing between the constructs of hot versus cool EF (Peterson/Welsh 2014, for a review). Zelazo and Mueller (2002) distinguished between hot and cool EF in terms of the type of problem solving, with hot EF involved in motivational contexts, and cool EF involved in abstract, decontextualized contexts. Allan and Lonigan (2014) directly tested this idea by manipulating response inhibition tasks either to be hot -- by increasing the motivational context (providing rewards and losses for performance), or cool -- by administering the task in the standard manner. They used a confirmatory factor analysis (CFA), testing a model whereby all tasks loaded on one factor and another model where the tasks loaded on two factors. While the two-factor model provided a good fit, the one-factor model also provided a good fit, leading the researchers to accept the more parsimonious, one-factor model. The findings suggest that just increasing motivational aspects of a task does not necessarily engage different processes.

Studies that have succeeded in finding a distinction between hot and cool EF measures have used variations of the Delay of Gratification task (see Table 1). These tasks have long been accepted as hot EF tasks. One variation of DoGT involves delaying or choosing to delay a gratifying response with a goal of getting a larger reward. A second variation of DoGT also involves delaying gratification, but upon the request of an adult; therefore the goal involves social reward rather than a larger reward. Note that both types of task, however, involve conflicting motivations. In contrast, giving or taking away rewards following correct response inhibition does not involve such motivational conflict. Although failing DoGT will provide some gratification (i.e. get a reward immediately), failure to inhibit a prepotent response (e.g. saying "day" when you see a moon in the cool EF Day-Night task, Gerstadt et al. 1994) is not gratifying. As can be seen in Table 1, most studies have used temptation tasks to assess hot EF in preschoolers. While some findings have been inconsistent, the majority of studies have found evidence of a distinction between hot and cool EF measures (see Table 1), indicating that hot and cool EF tasks assess different abilities, as early as the preschool period.

Table 1: Studies Exploring Distinction of Hot and Cool EF Tasks

		Hot EF Tasks				Cool EF Tasks			CFA/	Hot	
Study	Age years	delay	DoG choice	tempt	CGT	WM	INB	SHIFT	EFA	Cool Distinct	Hot and Cool EF Associations
Brock et al. (2009)	5 y			√			√		CFA	√	Cool EF predicted behaviour in class & math outcomes in kindergarten
Allan & Lonigan (2011)	3-6		√	√			√		CFA	X	Single EF predicted academic outcomes & behavioural problems
Sulik et al. (2010)	4			√			√		CFA	X	N/A
Willoughby et al. (2011)	3-5			√			√		CFA	√	Hot EF predicted behavioural problems; Cool EF predicted academic outcomes
Bassett et al. (2012)	3-5			√			√		CFA	√	Hot EF predicted classroom adjustment, sensitivity and co-operation, and aggressive behaviour; Cool EF predicted academic outcomes
Denham, Warren-Knot et al. (2012)	3-4			√			√		CFA	√	Higher-order EF factor (with hot and cool factors) predicted teacher rated behavior and learning
Masten et al. (2012)	4-6			√			√	√	CFA	X	Single EF predicted academic outcomes, prosocial behaviour, peer acceptance, attention and conduct problems
Caughy et al. (2013)	2			√		√	√	√	CFA	√	N/A
Kim et al. (2013)	3-4			√			√		CFA	√	Hot EF predicted later behavioural problems Cool EF predicted later academic problems
Allan & Lonigan (2014)	3-6						√		CFA	X	3 Cool EF tasks were modified to be "hot" by giving rewards for correct response; Single EF predicted academic outcomes and behavioral problems
Denham, Bassett, Zinsser & Wyatt. et al. (2014)	3-4			√			√		CFA	√	Hot & Cool predict social cognition Hot EF predicted behavior problems; Cool EF predicted classroom readiness and adjustment
Mulder et al. (2014)	2			√		√	√		CFA	√	Cool EF predicted academic outcomes and behavioral problems 1 year later; Hot EF predicted behavioral problems 1 year later
Pauli-Pott et al. (2014)	3-6			√			√		EFA	√	Cool EF predicted by conduct problems and ADHD symptoms; Hot EF predicted by ADHD symptoms

EF = Executive Function, WM = Working Memory, INB = Response Inhibition, SHIFT = Shifting/Flexibility, CFA=Confirmatory Factor Analysis, CGT = Child's Gambling task, EFA=Exploratory Factor Analysis; SPS = Social Problem Solving

Source: Own representation.

2 Hot Executive Function Tasks

2.1 Delay of Gratification

DoGT in adults. In the adult literature, the standard DoGT, called temporal discounting, involves having participants make a choice between a small, immediate reward and a delayed, larger reward. Adults associate a smaller *subjective* value to a reward when it is delayed (Green/Myerson 2004). Furthermore, a variety of factors affect the subjective value of the delayed reward, with the most important being the objective value and the delay involved (Kable 2015). For instance, the subjective value of a delayed reward increases as its objective value increases and the time delayed is reduced.

CAPs Model. To explain the findings from the DoGT literature, Mischel and his colleagues (Metcalfe/Mischel 1999; Mischel/Ayduk 2011) proposed the Cognitive-Affective Processing system (CAPs), which argues that choice is the result of an interactive process between a hot, motivational system and a cool, effortful, abstract representation system. Poor choice can result from an overactivation of the hot system or an underactivation of the cool system. As a result of the faster development of the hot system in comparison to the cool system, the CAPs model suggests that preschoolers make poor choices because of an overactive hot system that is not modulated by an immature cool system (Mischel/Ayduk 2011).

In agreement with the CAPs model, most researchers have acknowledged that choice is the result of at least two interactive processes involving motivation and cognition. What has been disputed is the role of hot versus cool EF processes (Kable 2015). For instance, some neuroimaging research supports an antagonist interaction between the brain network underlying hot EF and the brain network underlying cool EF, with choices to delay involving activation of the cool EF network and choices for

immediate gratification involving higher activation of the hot EF network (McClure et al. 2004). These findings have been taken to indicate that choices to delay involve the cool EF network downregulating the hot EF network (i.b.). However, other neuroimaging research support a more co-operative interaction between the two brain networks. For instance, Hare, Hakimi and Rangel (2014) found that increased activity of both hot and cool EF networks was associated with increased choices to delay. Hare et al. (2014) have argued that both networks play a role in delayed choice, with the hot EF network being critical for representing the subjective value of both choices and the cool EF network providing updated, relevant information on goals. Furthermore, an important consideration in evaluating the preschool literature is the findings that the hot EF brain network plays a direct role in regulating bottom up hot motivational processes through its ability to integrate motivation with more abstract concepts and representations (Kable 2015).

DoGT in preschoolers. The preschool literature contains three main variations of DoGT. The tasks most similar to the adult temporal discounting task involve having preschooler make simple repeated choices between a small immediate and a larger delayed reward, with the number of 'choices to delay' used as the dependent measure. In the remaining two tasks, children do not choose whether they want to delay. Rather they are placed in a waiting situation and the delay they are able to endure serves as the dependent measure. In one of these tasks, children are placed in front of a reward and told that if they wait until the examiner returns, they will receive a larger reward. In the other task, children are asked to delay or suppress a response to a tempting stimulus. For clarity in the discussion to follow, the first type will be called 'DoGTchoice'; the second, 'DoGTwait', and the third, 'DoGTtemptation'.

DoGTchoice. The standard DoGTchoice used involves having children choose between an immediate reward now and a larger delayed reward after a specified period of time (Mischel/Metzner 1962). Rewards typically include treats, money, and small toys; time can vary from a few minutes to weeks. More recently, the task has been adapted further, particularly for preschoolers. For instance, Thompson, Barresi and Moore (1997) used stickers as rewards and the end of the game as the delay period. In this variant, children were asked to make several choices between 1 sticker now or 2 stickers at the end of the game.

Age improvements during preschool have been found on the DoGTchoice task (Lemmon/Moore 2001, 2007; Moore et al. 1998; Prencipe/Zelazo 2005; Rozek et al. 1977; Thompson et al. 1997), but are inconsistent (e.g. Garon et al. 2012; Moore/Macgillivray 2004). For instance, Garon et al. (2012) found U-shaped performance on the choice DoGTtask in children aged 2 to 4 years when children made choices between 1 sticker now and 1, 2 and 4 stickers later. Whereas 4-year-olds showed a trend to choose more 'delay' as quantity increased, 3-year-olds did not show evidence of choices being moderated by the quantity of the delayed choice. Surprisingly, the youngest group seemingly performed best, showing a linear increase in choices as the delayed reward increased. To explain the findings, Garon et al. noted that lacking a representation of their future selves, 2-year-olds chose based on quantity alone. In contrast, 3-year-olds may have chosen more immediate options because their choices incorporated time as well as quantity. However, because they were unable to resolve the conflict between the future and current self's desires, they chose in accordance with the desire of the immediate self. Psychological distance from the current self's desire

may play a critical role in 3-year-olds' difficulty with resolving the conflict (Prencipe/Zelazo 2005). By 4 years of age, children can resolve this conflict, perhaps in part due to the ability to shift between attention sets (a cool EF ability), which develops during this period (Zelazo et al. 2002).

Findings from preschoolers are consistent with an interaction of hot and cool EF processes in optimal DoGTchoice. First, research indicates that factors such as length of delay and objective size of the reward influence choice. Whereas some research suggests that sensitivity to length of delay is not present until middle childhood (Mischel/Metzner 1962; Reynolds/Schiffbauer 2005), simpler tasks reveal sensitivity to both delay and reward magnitude in preschoolers. Studies using such tasks have found that even preschoolers show some sensitivity to length of delay (Garon et al. 2011; Schwarz et al. 1983). For instance, Schwarz et al. (1983) gave children aged 3 to 5 years delays of 7 hours versus 1 day and found that preschoolers were more likely to delay when told that they would receive their delayed reward in the afternoon rather than the next day. Similarly, sensitivity to the magnitude of the delayed reward (Garon et al. 2012; Inouye et al. 1979; Ito et al. 2009; Lemmon/Moore 2007) has also been found in preschoolers. Lemmon and Moore (2007) for instance, gave 3- to 4-year-olds a choice between 1 sticker now and a larger number of stickers later (varying from 2 to 5). They found that only 4-year-olds chose to delay more in accordance to the size of the delayed reward, supporting the idea that these older children considered the desires of their future selves in making their choices.

The preceding findings fit with the idea that choice is a result of the competition between the subjective value of the present reward and the future reward. Choice, therefore, can be biased toward the future by reducing the subjective value of the immediate reward, as suggested by the CAPs model, or by increasing the subjective value of the future reward. The findings support the idea that increasing the subjective value of the delayed reward will increase choice for the delayed reward, particularly in older preschoolers. Another way to increase the subjective value of the delayed choice is by having children engage in prospection, which involves simulating the self in the future. Having adults imagine their future self has been found to increase choice of the delayed reward in adults (Daniel et al. 2013). Furthermore, there is evidence that engaging in prospection may increase delayed choice in part through its activation of the hot EF network (Sellitto et al. 2011). A recent study found a significant increase of delayed choices in preschoolers when they engaged in prospection as opposed to a control condition (Garon et al. 2014). Furthermore, children who did well on another hot EF task, the Preschool Gambling task (PGT), showed higher self-control for trials in which the immediate and delayed rewards were closer in value, in comparison to children who did poorly on the PGT (Garon et al. 2014). This suggests that hot EF may be particularly important for adjusting the subjective value of delayed rewards.

Other evidence points to a role of cool EF ability in the DoGTchoice. Imuta et al. (2014) created versions that encouraged use of a cool EF strategy by highlighting the numerical difference between the immediate and delayed choice. This led to significant improvements in the younger preschoolers' choice of delayed reward. The association of performance on DoGTchoice and response inhibition tasks in preschoolers (Moore et al. 1998; Yu et al. 2016), also supports the importance of cool EF in the early development of DoG ability.

DoGTwait. The 'marshmallow task' (Mischel 2014, for review) is the classic DoGTwait. In this task, children are seated in front of a marshmallow and a bell. They are told that if they wait until the experimenter returns, they can have 2 marshmallows; however, if they no longer want to wait, they can ring the bell and consume the marshmallow. This paradigm, therefore, more specifically assesses the ability to tolerate frustration since the presence of the reward throughout the delay increases temptation. Although an association is generally found between measures of DoGTchoice and DoGTwait, it is weak to moderate (Duckworth/Kern 2011), suggesting that the processes involved overlap, but also differ.

Age-related improvements in the ability to wait have been consistently found using this task (Atance/Jackson 2009; Mischel 2014; Steelandt et al. 2012; Yates et al. 1981). In contrast to the DoGTchoice, age effects have been found from 2 to 4 years, with 2-year-olds delaying for significantly shorter periods than 3-year-olds (Steelandt et al. 2012). Moreover, whereas 3- and 4-year-olds were able to delay for longer periods when the delayed reward was increased in size, 2-year-olds did not demonstrate this effect. This is interesting given 3-year-olds' failure to take delayed reward size into consideration in the DoGTchoice (Lemmon/Moore 2007), and suggests that 3-year-olds can increase waiting time, but making the choice to wait is difficult for this age group.

As with the DoGTchoice, findings from the DoGTwait indicate roles of both hot and cool EF processes. In particular, the role of attention has been consistently implicated in the 'wait' variation. The ability to direct attention away from the hot, affective properties of the reward seems to be the variable most strongly associated with children's success (Mischel 2014). Moreover, the control of attention as early as the first two years predicts preschoolers' performance on the DoGTwait (Sethi et al. 2000). While the importance of attention is indisputable, the mechanism by which it improves wait time is not as clear. The bulk of the evidence indicates that control of attention seems to improve performance through its reduction in the salience of the immediate reward (Mischel et al. 1989). Findings have consistently supported this idea, with children waiting longer in conditions that reduce the salience of the immediate reward through self-verbalization (Steelandt et al. 2011; Toner/Smith 1977), imagery (Mischel/Baker 1975), or pictures (Mischel/Moore 1973). Other findings suggest that distraction is also helpful in improving waiting times (Mischel/Ebbesen 1970; Mischel et al. 1972; Yates et al. 1981). Finally, Mischel et al. (1989) argued that another important mechanism underlying the ability to wait is knowledge about which strategies are effective. Interestingly, while preschoolers are able to benefit from, and may even spontaneously use, attentional strategies (e.g. Steelandt et al. 2014), explicit knowledge about strategies does not develop until children are in elementary school (Mischel/Mischel 1983).

DoGTtemptation. All of the several variations of the DoGTtemptation include two components: an attractive toy or activity and prohibition to use or engage in the activity. For instance, Kochanska et al. (1996) gave children aged 25 to 45 months a snack delay task, in which they put a treat under a clear plastic cup and asked children to wait until the experimenter rang a bell to get the snack. Another example, gift bow, involves requiring the child to wait before touching a bag containing a gift while the researcher retrieves a bow. Notably, a critical distinction between this task and the DoGTwait is that children do not receive a larger reward for waiting. Rather than a conflict between a smaller immediate reward and delayed, larger reward, the conflict in the

DoGTtemptation is between an immediate reward accompanied by social sanctions and a delayed reward with social approval. As a result, the ability to integrate rewards and losses in making a choice may be an important factor. In fact, there is evidence that avoiding negative outcome plays a role in preschoolers' ability to resist (Jensen/Buhanan 1974).

In other respects, however, findings from the DoGTtemptation parallel those of DoGTwait. For instance, a gradually increasing ability to resist temptation is seen from the second year of life onward throughout the preschool period (Hartig/Kanfer 1973; Kochanska et al. 1996; Pecora et al. 2014). Also, reduction in the salience of the immediate reward through self-verbalization (Abe 1980; Hartig/Kanfer 1973; Manfra et al. 2014), distraction strategies (Ebbesen et al. 1975; Mitsutomi 1991), and even encouraging negative evaluations of the toy (Mitsutomi 1991) will increase children's ability to wait.

Summary of DoGT in preschoolers. Research on the three variations of DoGT indicates age differences during the preschool period and beyond. However, this developmental pattern is less consistent for the DoGTchoice. In part, this may reflect how 2-year-olds, as opposed to older children, approach the task. Rather than representing the two choices in a temporal fashion (self now versus self later), 2-year-olds may consider only quantity (Garon et al. 2012), making it appear as though they are choosing advantageously. A similar paradoxical pattern has been found in animal research (e.g. Paglieri et al. 2013). At least a minimal ability to imagine future states, which is beginning to emerge at 3-year-olds (Atance 2008), may be required to perform this task.

The findings suggest involvement of hot and cool regulatory process in all of the DoGT. In particular, reducing the salience of the immediate reward through strategies such as self-verbalization and distraction appears to be helpful for DoGTwait and DoGTtemptation. For the DoGTchoice, increasing the subjective value of the delayed reward by increasing its objective value (i.e. increasing quantity) or reducing time improves performance, particularly in older preschoolers. As well, having older preschoolers imagine their future selves with the reward improves performance.

Iowa Gambling Task

The Iowa Gambling task (IGT; Bechara et al. 1994), was originally designed to provide a more sensitive assessment of adults with lesions to the VMPFC, the critical brain area of the hot EF network. The task involves choosing among four decks of cards, two of which are advantageous (lead to more wins over 10 cards) and two of which are disadvantageous (yield net losses). In the original version given by Bechara et al. (1994), the participants were not told anything about the deck contingencies, but instead were instructed to accumulate as much money as possible by choosing from the decks. Two of the decks (A and B) were actually disadvantageous in the long run – although they led to a win of $100 on every card turn, they also led to large unpredictable losses, totaling $1250 over ten card turns. In effect, choosing from these two decks led to a net loss $250 over ten card choices. The remaining two decks (C and D) were advantageous, leading to a win of $50 on every card turn and smaller losses of $250 over ten card choices that resulted in a net win of $250 over ten chard choices. Another important distinction among the decks, which will be addressed later, was frequency of loss. Two of the decks had losses occurring over 50% of the trials (A and C) while two of the decks had losses occurring over 10% of the trials (B and D). As hypothesized, patients with

VMPFC did not learn to avoid the two disadvantageous decks over 100 card choices, whereas control participants learned to choose advantageously.

Somatic marker hypothesis. In contrast to the CAPs model, the somatic marker hypothesis (Damasio et al. 1991; Damasio 1994), created to explain the difficulties encountered by the VMPFC patients, involves more in depth consideration of bottom-up processes in making good decisions. Damasio hypothesized that the VMPFC functioned as a convergence zone in the brain where cognition and emotion information were integrated. These somatic markers were described as a summary of affective response associated with a category of stimuli and assimilated over multiple repeated experiences. As such, somatic markers enabled quick decision making, guiding the decision maker to important aspects of the situation and reducing the amount of information to consider. This hypothesis emphasizes the importance of bottom-up motivational processes (e.g. calculating rewards and losses over time) in the success of top-down regulation (e.g. making an adaptive decision). In fact, there is evidence that an inability to engage in this bottom-up regulatory processes as occur with damage to limbic areas such as the amygdala, also leads to top-down regulatory failure (Bechara et al. 1999). Finally, while proponents of the somatic marker hypothesis, acknowledge that cool EF processes such as working memory are involved in decision making, they argue that cool EF processes are dependent on the hot EF brain network (Reimann/Bechara 2010). In fact, there is evidence that individuals who have explicit knowledge without having implicit value representations perform poorly on the IGT (Bechara et al. 1997; Cui et al. 2015).

In sum, the nature of the interaction between the hot and cool EF network may be a critical distinction between the IGT and DoGT. While all DoGT variants involve explicit instructions and provide information on the value of each choice and the delay involved, the IGT does not provide information on losses and wins for each choice. Rather, the participant is required to learn the value of each choice through feedback (win and loss) from each trial. As a result, during the learning phase, bottom-up and top-down processes have to interact to a larger extent (Damasio 1994). In addition, participants have to then use this newly constructed value representation (somatic markers) to make choices in the second stage of the game. Finally, another distinction is in translating this value representation into explicit knowledge (Wood/Bechara 2014), a process thought to involve the body's introceptive system (Craig 2009). As shall be discussed, this ability to become aware of the IGT task appears to be particularly helpful for augmenting the number of advantageous choices in preschoolers.

IGT variants in children. To assess affective decision making in preschoolers, Kerr and Zelazo (2004) developed the Child's Gambling task (CGT). Previous research had indicated rapid improvement on another hot EF task, object reversal, between the ages of 13 months and 54 months (Overman et al. 1996). The object reversal involves a switch in contingencies once children consistently choose one of two rewarded stimuli. The CGT was designed to be a child-friendly version of the IGT, with the number of decks reduced from four to two and children receiving candy rather than money as rewards. Wins were indicated by happy faces and losses by sad faces, and the number of choices was reduced from 100 to 50 cards. In support of expectations, four-year-olds chose significantly more from the advantageous deck, whereas three-year-olds showed a tendency to choose more from the disadvantageous deck. Furthermore, there was a marginal male advantage among three-year-olds, consistent with previous findings of

male advantage on the reversal learning task in younger preschoolers (Overman et al. 1996).

Other studies using the CGT have provided support for this age effect in decision making during the preschool period (Bunch et al. 2007; Gao et al. 2009; Heilman et al. 2009; Mata et al. 2013; Mata et al. 2013). However, the male advantage has only been found a few times (Heilman et al. 2009; Gao et al. 2009), with most studies finding no gender difference and some even finding a female advantage (Bunch et al. 2007). Hence, the role of gender is still unclear.

Another preschool IGT variant, the Preschool Gambling Task (PGT; Garon/Moore 2004), modelled closely on the CGT, has found similar results to the CGT (Garon/Longard 2015; Garon et al. 2015; Garon/Moore 2007a, 2007b), with 4-year-olds passing the 2-deck, but not the 4-deck variant (Garon/Moore 2004). Studies done on PGT variants, however, have indicated that even older preschoolers' ability to choose advantageously is highly dependent on task structure. In support of this view, the task structure for variants given to older children and adolescents is considerably different from those given to preschoolers, leading to different developmental findings. While most preschool studies suggest that by four, children have developed affective decision making, results of IGT and IGT variants given to children and adolescents suggest that the ability to make advantageous decisions does not develop until adolescence (Overman 2004; Crone/van der Molen 2004).

Task structure*.* Table 2 provides a summary of the structure of the standard IGT and a reversed version (frequency of losses and gains are reversed; Bechara/Damasio 2002). The structure of the child-friendly Hungry Donkey task (Crone et al. 2003) is shown for comparison. In this task, participants are presented with 4 doors (representing the 4 decks) and a hungry donkey on a computer screen. Participants are told that the goal is to get as many apples as possible to feed the donkey. As seen in Table 2, the contingencies of the standard Hungry Donkey task closely parallel the contingencies of the original IGT, with 4 options/decks: two advantageous and two disadvantageous options. Similar to the IGT, doors A and B are disadvantageous; each choice leads to a win of 4 apples with large losses resulting in a net loss of 10 apples after 10 choices. Doors C and D are advantageous; each choice leads to a win of 2 apples and smaller losses resulting in a net win of 10 apples over 10 choices. In comparison, the vast majority of preschool variants, with the exception of that of Garon and Moore (2004), have used only two decks. Furthermore, using a 4-deck variant, Garon and Moore failed to find advantageous decision making in preschoolers, suggesting that number of options/decks may contribute to differences in task complexity that affect age-related performance.

Game variables. Table 2 displays two main ways that IGT task structures vary: between games (game-varying) and between decks within a game (deck-varying). Figure 1 illustrates these differences. For instance, Game A differs from Game B in terms of frequency across trials. In Game A, the two options have 5 losses occurring over 10 trials, whereas Game B has two options with 1 loss occurring over 10 trials. Game C has options that vary in terms of frequency of loss. The literature reviewed in the next section indicates that frequency of loss/win serves two functions. First, higher frequency of loss leads to more feedback (as in Game A) and more opportunity to form a representation (regardless of whether it is conscious) of the decks. Second, frequency of loss when it

varies between the two options (as in Game C) also increases avoidance of a particular deck.

Table 2: Summary of Preschool IGT Variants

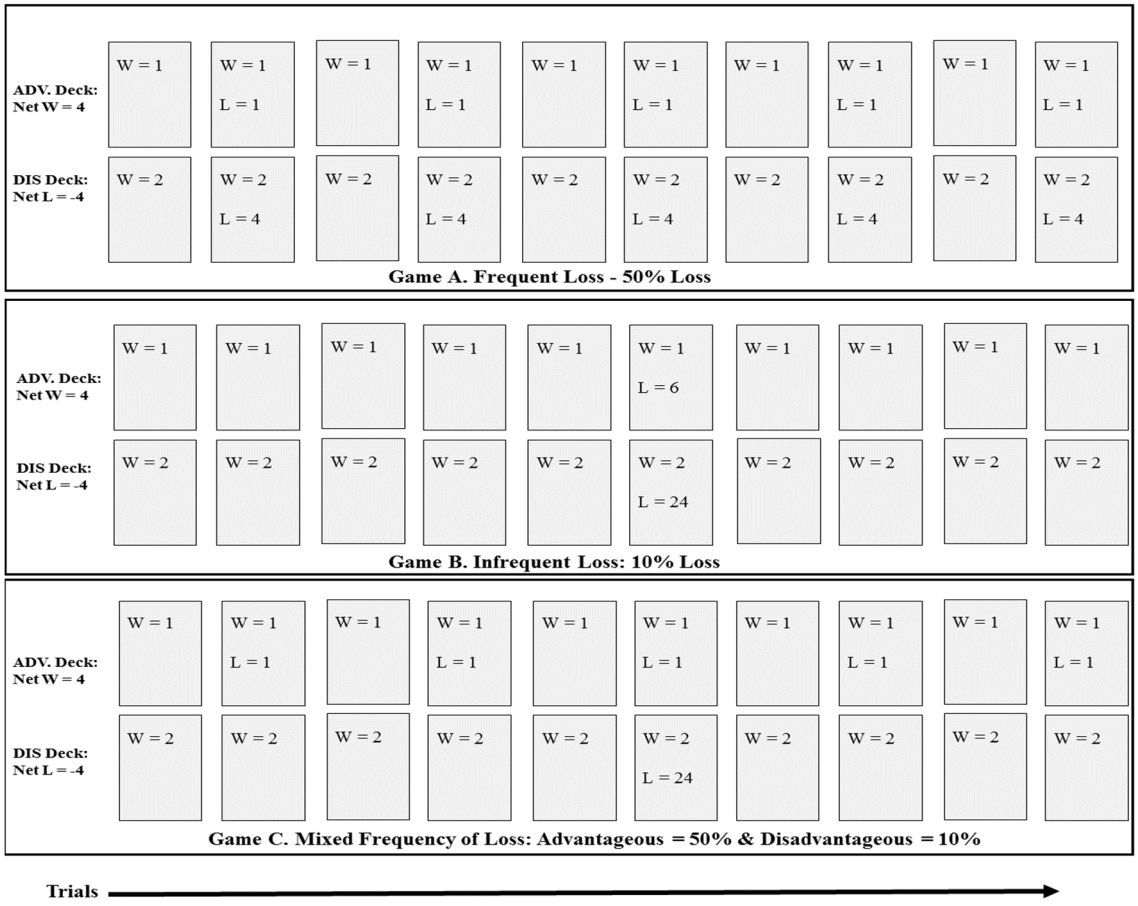
	Game-Varying		Deck-Varying (Differences between advantageous versus disadvantageous decks) v=varies between decks							
	Frequency		Magnitude		Frequency		# decks		Net Win	Age of Adv Ch.
Studies	Loss	Win	Win	Loss	Win	Loss	2	4		
Standard IGT										
Bechara et al. (1994)	10% & 50%	100%	v	v	X	v	X	v	v	Controls (Adults)
Reversed IGT										
Bechara & Damasio (2002)	100%	10% & 50%	v	v	v	X	X	v	v	Controls (Adults)
Standard Hungry Donkey Game										
Crone & van der Molen (2004)	10% & 50%	100%	v	v	X	v	X	v	v	> 12 years
Modified Hungry Donkey Game										
Crone et al. (2005)										
• 4-deck frequent	50%	100%	v	v	X	v	X	v	v	7 years to adult
• 2-deck frequent	50%	100%	v	v	X	v	v	X	v	7 years to adult
• 2-deck infrequent	10%	100%	v	v	X	v	v	X	v	> 12 years
Child's Gambling Task (CGT)										
Kerr & Zelazo (2004)	50%	100%	v	v	X	X	v	X	v	4 years
All studies using standard CGT except Hongwanishkul et al.	50%	100%	v	v	X	X	v	X	v	4 years
Modified CGT										
Gao et al. (2009) E2	50% & 70%	100%	v	v	X	v	v	X	v	4 years
Bunch et al. (2007)										
• Binary loss version	50%	100%	X	v	X	X	v	X	v	3 years
• Binary gain version	50%	100%	v	X	X	X	v	X	v	3 years
Preschool Gambling Task (PGT)										
Garon & Moore (2004)	20% & 50%	100%	v	v	X	v	X	v	v	6 years
Garon & Moore (2007a)	20%	100%	v	v	X	X	v	X	v	4 years
Garon & Moore (2007b)	30%	100%	v	v	X	X	v	X	v	4.5 years
Garon et al. (2013)										
• Infrequent loss version	10%	100%	v	v	X	X	v	X	v	None
• Frequent loss version	50%	100%	v	v	X	X	v	X	v	4 years
Garon & Longard (2015)	50%	100%	v	v	X	v	v	X	v	4 years for low conflict

Note: IGT = Iowa Gambling task; Adv Ch= Advantageous Choice

Source: Own representation.

With the exception of the Reversed IGT shown in Table 2, wins within decks do not vary across trials in all IGT and IGT-variants. That is, the same magnitude of win occurs for every trial within a deck/option. Given this non-varying aspect across all trials, participants can quickly learn that the disadvantageous decks always give a larger win on individual trials (Dunn et al. 2006). However, a more difficult aspect of the task to learn is the frequency of loss, as this does vary from trial to trial, with only some trials leading to losses. In the standard IGT and Hungry Donkey task, two decks (1 advantageous and 1 disadvantageous) have losses on 50% of trials and the other two decks have losses on 10% of trials. The decks with 50% losses provide an obvious learning advantage over the decks with 10% losses. Furthermore, in most preschool variants, a loss frequency of 50% is used, pointing to this aspect as a possible reason for different patterns of findings for the preschool versus child/adolescent IGT variants. In fact, research comparing games with 10% versus 50% losses suggest that both preschoolers (Garon et al. 2015) and older children (Crone et al. 2005) make significantly more adaptive choices on games with 50% as opposed to 10% losses.

Figure 1: Examples of IGT-variant games varying according to frequency of loss between and within games



Note: In Game A and B, frequency of loss is the same for the advantageous and disadvantageous deck, allowing children to focus on difference in magnitude of loss. Children would be expected to make more adaptive choices on Game A in comparison to Game B. In Game C, decks differ in frequency of loss. Children would be expected to choose according to frequency of loss and choose the deck with less frequent loss, even though in this case it leads to disadvantageous choices. DIS = Disadvantageous; ADV = Advantageous

Source: Own representation.

Deck variables. As seen in Table 2, advantageous and disadvantageous decks within a game can vary in several ways. First, the net win (overall payoff) determines whether a deck is classified as advantageous or disadvantageous, and is therefore consistent across all variants of the IGT, i.e. net wins are larger for advantageous decks. Second, decks can differ in frequency of wins/ losses and magnitude of wins/losses. Note that in this section, frequency of loss is discussed in reference to differences between decks *within* a game (see Game C, Figure 1). Furthermore, the 4 decks/options in the standard IGT differ in terms of frequency of loss, but not in frequency of wins (i.e. wins occur in 100% of trials). When facing options varying in frequency of loss, even adult participants tend to prefer decks with a lower frequency of loss (e.g. Lin et al. 2009). In fact, frequency of loss seems to be a particularly salient characteristic, more important than magnitude of loss (Huizenga et al. 2007). In a sample aged 6 to 25, Huizenga et al. (2007) found a

developmental shift in strategy from an early guessing strategy in the youngest particpants, to a unidimensional strategy whereby participants focus on frequency of loss (tending to choose from decks with lower frequency of loss), and finally, to the oldest participants using a strategy that considers both frequency and amount of loss.

This conclusion is consistent with findings in the preschool literature. Although the IGT and standard Hungry Donkey task present participants with options varying in frequency and magnitude of loss, the vast majority of preschool variants use decks that do not vary in frequency of loss. Rather, the options vary in magnitude of loss, with the disadvantageous decks having higher magnitude losses. This suggests that, with advantageous and disadvantageous decks not differing in frequency of loss, young children can focus on magnitude of loss and make advantageous decisions. Their problem may occur when both frequency and magnitude of losses vary across decks within a game, and both must be considered when making a choice. Supporting this idea, a recent study found that older preschoolers' performance deteriorated significantly when they had to consider both magnitude and frequency of loss to make an adaptive choices (Garon/Longard 2015). As in Piaget's conservation tasks, preschoolers have difficulty considering more than one dimension at a time (e.g. Houdé 1997).

Number of differences between decks*.* Another potentially important variable that affects preschoolers' performance on IGT variants is the total number of features that differ between the advantageous and disadvantageous decks. Bunch et al. (2007) created two new versions of the CGT to explore this. They reasoned that the two decks in the CGT differ in terms of the magnitude of immediate gains, the magnitude of losses, and net payoff. According to Bunch et al., three features, may be too complex for the younger preschoolers; varying only two features might help 3-year-olds to choose advantageously. In the binary-relational gain version, the advantageous and disadvantageous decks differed on win magnitude (10 versus 20 candies) and net payoff (see Table 2). In the binary-relational loss version, the two decks differed on loss magnitude (5 versus 25 candies) and net payoff. Bunch et al. found that even 3-year-olds could chose advantageously in these simplified versions of the task.

Awareness in decision making. As has been found in the adult literature (e.g. Brand et al. 2006), there is evidence that awareness of the game plays a role in preschoolers' decisions. Garon and Moore (2007a) found that the majority of 4-year-olds had some knowledge of the game at the first awareness test (after 40 choices), that this awareness improved by the end of the game, and that awareness was associated with performance. Garon and Moore suggested that asking children awareness question may even help them consolidate their implicit and explicit knowledge and lead to improved choices. In a second experiment, children who were asked the awareness questions showed a significant improvement in performance. These findings indicate that not only is higher awareness associated with better performance, but just having children reflect on the game may provide "scaffolding", leading them to integrate and use knowledge of the game more systematically. This corresponds well with research indicating that metacognitive processes are still immature at this age (Sodian et al. 2012). Encouraging preschoolers' awareness of their knowledge may thus be especially helpful.

Two recent studies conducted in the preschool population further suggest that simplifying task structure will improve children's awareness and performance. Garon et al. (2015) found that children in the frequent loss (50%) condition had significantly

higher awareness levels compared to children in the infrequent loss (10%) condition. They further found that the effect of loss frequency on card choice was partially mediated by awareness performance, suggesting again that explicit knowledge improves performance. Finally, Andrews and Moussaumai (2015) assigned preschool children to three conditions. In the first condition, children played the standard CGT. In the binary experience condition, they played a simpler binary versions of the CGT (see Table 1) and then completed the CGT. Finally, in the binary experience + awareness condition, children played the simpler versions followed by awareness questions about these versions. Results indicated that for younger preschoolers, playing a simpler game first improved awareness of the standard game and this was associated with increased choices from the advantageous deck. These findings show a pattern of increasing integration of implicit learning and explicit knowledge influencing choices from early to later preschool.

Summary of IGT variants in preschoolers. In sum, the findings from IGT variants during preschool indicate that, in parallel to adult findings, the IGT entails two main stages. Furthermore, each stage appears to show distinct patterns of age differences. The first stage of integrating conflicting rewards and losses over multiple trials appears to be the most challenging for both preschoolers and older children. Reducing feedback (i.e. frequency of loss) and varying both frequency and magnitude of loss appears to be too taxing even for older preschoolers. This stage may be particularly difficult due to its reliance on bottom-up (forming a value-based representation) and top-down (quickly updating and activating these representation) regulatory processes. The findings also suggest that preschoolers have difficulty transitioning to an explicit stage of decision making, particularly when the task structure is more complicated. For instance, older preschoolers can use explicit knowledge of a game to improve decisions, but may need adults to help them to integrate this knowledge (Garon/Moore 2007a). Perhaps integration of hot and cool EF abilities is just beginning to develop.

3 Hot and Cool EF Interaction

At present, few theories consider both hot and cool EF processes and their associations. Most theories consider primarily cool EF processes (e.g. Miyake/Friedman 2012) or hot EF processes (e.g. Wood/Bechara 2015). Notably, hot EF theories put a stronger emphasis on bottom-up regulatory processes (e.g. Metcalfe/Mischel 1999). Some recent theories including the Iterative Reprocessing theory (Zelazo/Cummings 2007) and cybernetic theories of self-regulation (Blair 2016; Lewis/Todd 2007; Tucker et al. 2015) have argued for the importance of bottom-up regulatory influences in regulating top-down EF processes. As previously discussed, this may be an important distinction between hot and cool EF processes.

Figure 2 illustrates some similarities and distinctions of hot and cool regulatory processes. Hot and cool EF show parallels in at least three ways. First, hot and cool regulation involve both top-down and bottom-up processes. The abilities listed as hot in Figure 2 include DoG and advantageous decision making, and those listed in cool top-down regulation include working memory, set shifting and response inhibition, all of which have beeen considered to be EF abilities in the literature. In contrast, abilities such as ‘formation of a stimulus-value set’ (listed in bottom-up hot regulation), and ‘forming an attention set’ (listed in bottom-up cool regulation) have not typically been considered

EF abilities. A second similarity between the two types of EF involves conflict regulation. Hot EF tasks involve the resolution of conflicts involving motivation, whereas cool EF tasks entail the resolution of conflicts involving cognition, behavioral response or both (see Garon et al. 2008, for a review). A third similarity involves the reliance of both types of EF on representations held in long-term memory, as shown on Figure 2. Each, however, relies on a different kind of representation.

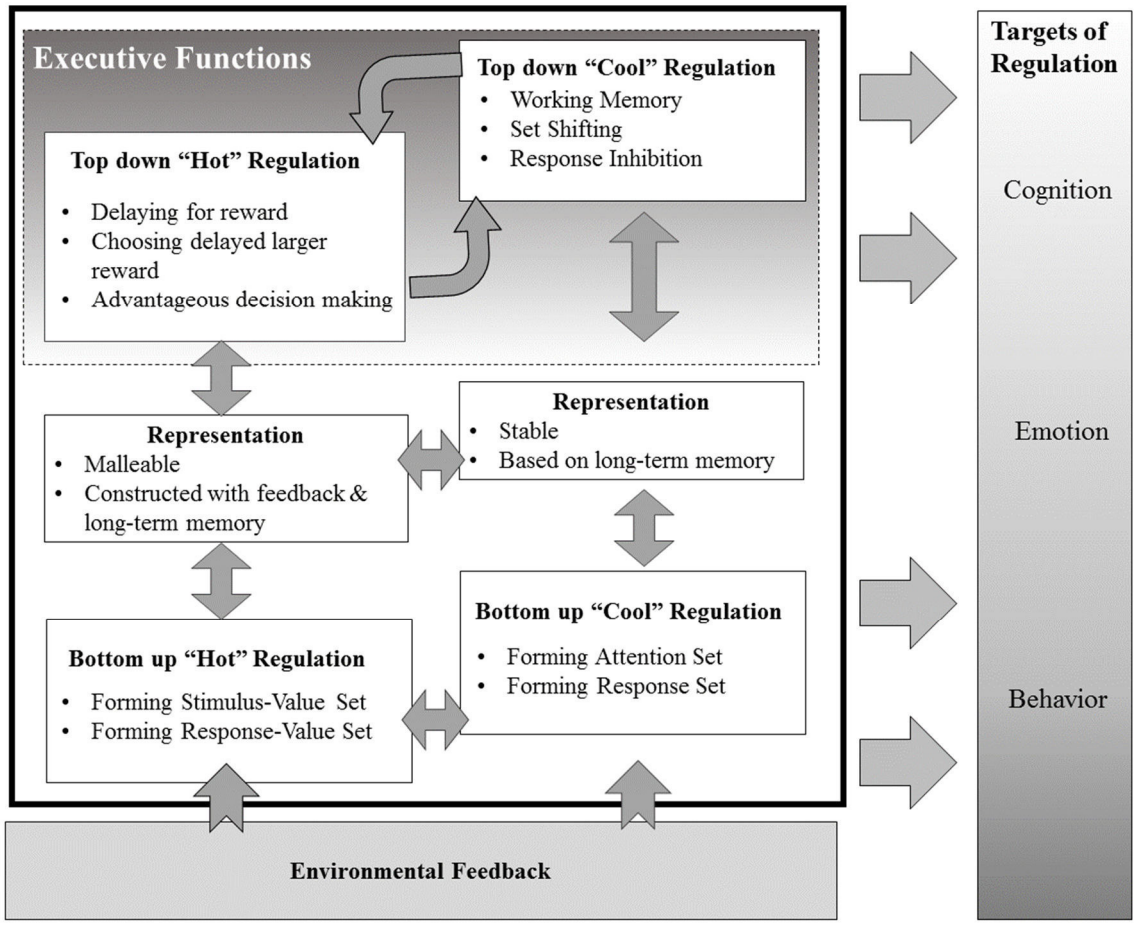
In spite of these similarities, there are essential differences between hot and cool EF. First, an important distinction is the type of representation each relies upon. Cool EF tend to rely on stable long-term memories, but although cool EF such as working memory may be involved in activating and strengthening of associations in long term memory (Blumenfeld/Ranganath 2007 for review), they do not change these long-term representations. In contrast, the representations utilized by hot EF tend be more malleable (Damasio 1994). In fact, the hot EF brain network appears to be actively involved in learning and forming new value-based representations (Murray et al. 2015; Pujara et al. 2016). For instance, research indicates that patients with VMPFC lesions have difficulty integrating new information into long-term memory representations (Ghosh et al. 2014). Spalding, Jones et al. (2015) argued that that these patients' difficulty with integrating new experiences into memory parallel young children's difficulty with assimilation (Piaget 1952). Use of this type of malleable representation no doubt allows for quicker responses to environmental change, but also makes behavioral response more variable.

A second important distinction between hot and cool EF is their positions in the EF processing hierarchy (Lewis/Todd 2007; Zelazo 2015). Figure 2 shows cool EF placed at a higher level than hot EF. As a result of this arrangement, hot and cool EF networks may participate in the resolution of hot EF problems. The involvement of both EFs and the nature of their interaction has caused much difficulty in the literature. For instance, some researchers have argued that hot EF brain networks are essential for hot EF tasks such as temporal discounting (Motzkin et al. 2014; Sellitto et al. 2010), whereas others have argued that the brain networks associated with cool EF (e.g. DLPFC) are critical for making choices on DoGT (McClure et al. 2004). Finally, others have argued that it is the interaction between these two systems that is important for performance on hot EF tasks such as IGT and DoGT (Hare et al. 2009; Hare et al. 2014; Peters/Buchel 2010; Reyna/Huettel 2014).

The evidence reviewed in the current paper suggests two possible mechanisms for making an advantageous choice: one involving just the hot EF network, and the other, both hot and cool EF networks. When only the hot EF network is involved, the choice would depend on the hot EF network's ability to integrate value information across time, activate the value-based information in response to cues, and adjust the delayed option's value. In a situation in which both hot and cool EF networks operate, choice would rely on the cool EF network's ability to augment the functioning of the hot EF network by providing information about goals and context to update values. As reviewed earlier regarding IGT and DoG, both mechanisms can operate in decision making. Furthermore, these two types of hot tasks likely differ in the extent to which they activate both hot and cool EF processes. For instance, it is possible that DoGT activate both processes moe strongly as the task structure is more explicit than in IGT and its variants. Similarly, it is likely that the second stage of the IGT depends more on

both processes than the first stage, due the participant's increasing knowledge of the game.

Figure 2: A model of hot and cool self-regulation.



Note: The diagram shows a simplified model of hot and cool EF and their association with bottom-up regulatory processes and long-term representations. While all the processes would be considered self-regulation, only the top-down regulatory processes would be defined as executive functions.

Source: Own representation.

4 Summary and Suggestions for Future Directions

The research reviewed in this paper permits some tentative conclusions about early cool and hot EF. First, the evidence thus far largely supports a distinction between hot and cool EF measures during early childhood. Second, in spite of this distinction, evidence suggests that performance on hot EF tasks depends on both hot and cool EF processes. Third, considerable development of hot EF appears to occur during the preschool years. Each of these points is discussed in turn below.

Several lines of evidence indicate that hot and cool EF are distinct in preschoolers. First, the majority of studies using EFA or CFA distinguish between hot from cool EF tasks. Furthermore, the association between the hot and cool EF factors in such studies is usually moderate, rather than the strong associations typically among cool EF factors (Willoughby et al. 2012). This result contrasts with a failure to find a consistent distinction between cool EF components such as working memory and inhibition in

preschoolers using CFA (e.g. Wiebe et al. 2008; Wiebe et al. 2011). Another line of research reveals different patterns of associations between preschoolers' performance on hot and cool EF tasks and other behavioral characteristics (e.g. Bassett et al. 2012). Future research should therefore investigate more systematically what types of outcomes are predicted by cool versus hot EF abilities.

There is also evidence that hot EF tasks rely on both hot and cool EF processes. For the IGT, cool EF processes may be more important in the second stage of decision making, when the magnitude and probabilities of values associated with each option have become explicit. For preschoolers, encouraging cool reflective processes (by asking which option is best) significantly improves performance (Garon/Moore 2007a). For DoGTchoice, supporting cool processes such as emphasing differences in reward magnitudes for the delayed choice, also improves performance in 3-year-olds, who typically struggle with this task (Imuta et al. 2014). For DoGTwait, encouraging children to focus on abstract qualities of the reward improves their ability to delay (Mischel et al. 1989). Future research should further explore the dependence of each of these tasks on hot and cool EF processes by manipulating the use of hot- versus cool-based EF strategies.

On the whole, evidence implicates cool EF processes in the two main types of hot EF tasks. What is lacking, however, is evidence that these tasks measure a similar construct. Whereas some correlations are seen between performance on different types of DoG tasks, little association is found between IGT variants and any DoG tasks. Part of the problem is that relatively little research has been done using IGT and DoG tasks in parallel. Another difficulty may be the complexity of the various tasks and their dependence on cool EF as well as pure hot EF abilities. Hot EF tasks that load on a single factor are almost exclusively DoG variants. Future research needs to include hot EF tasks that incorporate IGT-type learning and different DoG paradigms. The use of other tasks to assess hot EF would also be helpful to further deconstruct hot EF. For instance, Fellows (2011) reviewed evidence that patients with VMPFC lesions have difficulty maintaining consistency in their preference judgments, a task that could easily be adapted for preschoolers.

This review indicates gradual improvement in four abilities associated with hot EF tasks during the preschool period. First, the ability to integrate frequency and magnitudes of contingencies over time is present in a very basic form as early as 3 years old. What seems to develop after this age is an ability to integrate multiple features over time (i.e. frequencies, conflicting wins and losses). Note that this ability may be more reflective of "pure" hot EF development, as integrating magnitude and probability across time has been most strongly associated with the VMPFC rather than the DLPFC (Venkatraman et al. 2009). Second, there is evidence of development from age 3 to 4 in the ability to translate implicit value-based representations to more explicit knowledge. Third, evidence from the second stage of IGT variants and from the DoG choice task indicates improvemed ability to activate and use value-based representations (e.g. imagining the future self) to make good decisions. Fourth, research on the DoG wait and temptation tasks indicates an improvement in the ability to inhibit or suppress a rewarding activity for longer periods. The ability to increase waiting time may reflect increasing integration of cool and hot EF processes, as findings consistently suggest the critical role of attention control in reducing the salience of the immediate reward (Mischel 2014).

In conclusion, this review showcases the remarkable body of work to date in early EF and its possible underlying mechanisms. Although our understanding of EF has improved significantly in recent decades, a number of unresolved issues remain to be addressed in order for the field to move forward. In particular, the area of early hot EF is only just emerging, being partly hampered by definitional issues regarding what processes constitute self-regulation versus EF, and what constitutes hot versus cool EF measures. Another difficulty is the hierarchical relation between hot and cool EF processes. As a result, whereas a cool EF task may engage primarily cool EF processes, a hot EF task may engage both hot and cool EF processes to different degrees. The nature of the interaction between hot and cool EF processes during hot EF tasks is unresolved. Some theorists have argued for an antagonistic relation, but others have proposed a co-operative relation. It is likely that the nature of this interaction will vary for different hot EF tasks, and perhaps even for different phases of a task. Finally, the issue of how hot and cool EF work together to yield adaptive behavior still remains an unexplored and potentially important area. Rather than being determined by hot or cool EF abilities, adaptive functioning may be more strongly determined by an intricate interplay between these two critical abilities.

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Impact of Instructional Modality and Emotional Valence on the Reflective Emotion Regulation of Expression in Preschool Children

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1 Introduction

One of the major challenges as well as progresses in the socio-emotional development of preschool children are their first steps towards the acquisition of a reflective mode of emotion regulation (Campos et al. 2004: 386–388; Holodynski et al. 2013: 34–38). According to Holodynski et al. (2013), the reflective mode of emotion regulation is the ability "to volitionally inhibit or modify an elicited emotion so that the dominant action readiness linked to the emotion is not enacted but replaced by a subdominant one" (ib.: 35). Thus, this competence enables children to voluntarily inhibit or modify their emotional expressions (Holodynski et al. 2013: 35–37; Liebermann et al. 2007) and is an example of "hot" executive functions (cf. Zelazo et al. 2010). Empirical studies demonstrate the importance of reflective emotion regulation, relating it to social competence (Cole et al. 1994; McDowell et al. 2000; Miller et al. 2006) and early academic achievements (Herndon et al. 2013; Howse et al. 2003). As this ability is relevant to various crucial competences later on, this study further examines the reflective emotion regulation, focusing on the masking of emotional expression (Holodynski et al. 2013: 40–41).

So far, most of the studies on preschool children aimed at the masking of negative emotions (Cole 1986; Davis 1995; Garrett-Peters/Fox 2007; Hudson/Jacques 2014; Josephs 1994; Kieras et al. 2005; Kromm et al. 2015; Simonds et al. 2007; Tobin/Graziano 2011) by means of the disappointing gift paradigm of Saarni (1984), rather neglecting the masking of positive emotions such as pride (Reissland/Harris 1991) or schadenfreude (Baaken 2005). Thus, it is not yet clear to what extent preschool children can volitionally regulate the expression of positive emotions. In addition, previous studies on the reflective emotion regulation of expression were based only on verbal instructions. However, it is yet unclear to what extent the modality of instruction has an impact on the regulation of emotional expression. Thus, iconic and verbal instructions are contrasted in the present study.

1.1 The Reflective Emotion Regulation of Expression

Saarni et al. (1998) describe different causes for the reflective regulation of emotional expression in the sense that it might be necessary to volitionally inhibit or mask the impulse of showing the expression of an elicited emotion in order to satisfy one's motives and concerns in the long run (ib.: 278–280). These causes are: (1) *display rules,* either *cultural* (determining which emotion is appropriate and which is inappropriate in a certain situation based on a cultural consensus) or *personal* ones (referring to an individual feeling of adequate coping in an emotional situation), and (2) *direct deception* (the deliberate expression of a dissimulated emotional expression in order to mislead another

person and gain certain advantages or avoid certain disadvantages). Furthermore, according to Ekman/Friesen (1975), there are several expression management techniques that can be applied to regulate one's emotional expression: *qualification* (the element of a "nonfelt" emotion is added to the expression), *modulation* (the intensity of the expression is increased or decreased) and *falsification* (ib.: 140–143). The latter is in turn subdivided into three forms: (1) *simulation* (an expression is shown although no emotion is felt), (2) *neutralization* (no expression is shown although an emotion is felt) and (3) *masking* (a felt emotion is masked by the expression of a nonfelt one) (ib.: 141–143). Like previous studies on the regulation of emotional expression, the present study focuses on the masking technique.

1.2 Development of the Emotion Regulation of Expression

The ability to control one's emotional expression has already been reported for 4-year-olds (Carlson/Wang 2007; Cole 1986; Josephs 1994). However, there is no consensus if there is an age-correlated development during preschool. While some authors did not find an age effect (e.g. Cole 1986; Kieras et al. 2005; Tobin/Graziano 2011), others reported an improvement with increasing age in preschool age and beyond (Carlson/Wang 2007; Garrett-Peters/Fox 2007; Hudson/Jacques 2014; Kromm et al. 2015; Saarni 1984; Simonds et al. 2007). Most studies up to now have focused on the *spontaneous* control of emotional expression (i.e. without an explicit instruction to control an expression) based on the disappointing gift paradigm by Saarni (1984) and assessed the degree of regulation by means of an objective, standardized analysis of expression, for example the *Facial Action Coding System* (*FACS*) by Ekman/Friesen (1978), or by means of self-developed, simplified coding systems (e.g. Carlson/Wang 2007; Cole 1986; Saarni 1984). In other studies, however, participants were instructed to volitionally mislead a real or imagined counterpart in an interaction about their felt emotion, followed by analyses of the impression that the child's emotional expression induced in naïve observers (e.g. Feldman et al. 1979; Kromm et al. 2015; Visser et al. 2015). Feldman et al. (1979), for example, asked 6-, 13-, and 19-year-olds to deceive an interviewer by acting as if they had tasted a delicious drink, regardless of the actual taste. Naïve observers then rated how much the participants really liked their beverage, detecting the deception in 6-year-olds, but not in older participants, corroborating the assumption of an age effect beyond preschool age. However, the age differences between the three groups were very large and do not allow detailed conclusions concerning the development of reflective emotion regulation of expression in early to middle childhood. Kromm et al. (2015) adopted this method of subjective impression analysis in their study of 4- to 8-year-old children and found that, while 4-year-olds were not able to mislead naïve observers, 6- and 8-year-olds were able to create a convincing impression of joy. Following this study, reflective emotion regulation of expression appears to develop especially between the ages of 4 and 6 (ib.).

1.3 Modality of Instruction in Tasks on the Emotion Regulation of Expression

In previous studies on the reflective emotion regulation of expression (e.g. Davis 1995; Kromm et al. 2015), children were verbally instructed to display a (false) smile. However, the modality of instruction might influence children's regulation of emotional expres-

sion, as may be concluded from studies on the simulation of expression[1]. Some simulation studies applied verbal instructions, too, asking children to "make a face" of a certain emotion (Buck 1975; Gosselin et al. 2011; Lewis et al. 1987). Other simulation studies, in contrast, used iconic instructions, presenting photographed or videotaped emotional expressions and asking the children to produce emotional expressions on this basis (Ekman et al. 1980; Field/Walden 1982; Hamilton 1973; Odom/Lemond 1972). Some of these included supplementary conditions, e.g. using visual aids such as mirrors (Ekman et al. 1980; Field/Walden 1982; Hamilton 1973), additionally presenting verbal descriptions of the iconic material (Ekman et al. 1980), or verbally encouraging children to imitate the depicted target expression (ib.). Field/Walden (1982) compared the simulation of emotional expression of 3- to 5-yearold children in different instructional conditions, containing either only a verbal label of the target emotion, only a photograph of the respective emotional expression, or a combination of these two. Adult raters then categorized children's videotaped behavior, attributing the simulated emotion to children's expressions less often when children were solely given verbal labels (ib.). Thus, children were able to produce emotional expressions more precisely when they had corresponding photographs at their disposal (ib.). But what makes the difference between an iconic and a verbal instruction? First, according to Peirce's *sign theory* (Peirce 1903), while *icons* (i.e. pictures) directly denote an object, *symbols* (i.e. verbal labels) first have to be interpreted. Thus, the decoding of a verbal emotion label might represent a cognitive demand on its own, given that it has to be referred to a concept of the corresponding prototypical expression of this emotion by the child before he or she can actually show the respective expression (Holodynski 2006: 63–64; Peirce 1903). Second, according to the concept of *emotional contagion* and spontaneous motor mimicry of expression (Hatfield et al. 1994; Lundqvist/Dimberg 1995), individuals tend to automatically mimic facial expressions of others to "converge emotionally" (Hatfield et al. 1994: 154), resulting in a corresponding emotional experience. This spontaneous motor mimicry may also function in an emotional masking task when a child is provided with an iconic instruction in the form of a picture of the target expression, leading to a more accurate production of the target emotion as well as eliciting the corresponding emotion. In addition, according to Field/Walden (1982: 1309), when children are provided with verbal instructions about the target expression in an expression management task, they have to transform the verbal input into an associated expression stored in memory at first. These individual memories might elicit more idiosyncratic displays of the target expression than a photographed prototypical one, thus resulting in more miscategorizations in an impression analysis of naïve observers (ib.: 1309).

In summary, the concept of a spontaneous motor mimicry of observed expressions and the presented empirical results lead to the conclusion that the modality of instruction influences the masking of an emotional expression in a way that the iconic presentation of the target expression facilitates its display in comparison to a verbal instruction.

1 In contrast to studies on the emotion regulation of expression, simulation studies focus on the mere production of an expression corresponding to a specific emotion and do not include a requirement to mask another emotion.

1.4 Emotional Valence in Tasks on the Emotion Regulation of Expression

While studies on emotion understanding and display rule knowledge often included tasks on the masking of negative as well as that of positive emotions (Holodynski 2004; Hudson/Jacques 2014; Josephs 1994; Kromm et al. 2015), studies on the emotion regulation of expression in preschool children generally applied the disappointing gift paradigm (Saarni 1984), thus focusing on the masking of negative emotions and disregarding that of positive ones (Baaken 2005; Cole 1986; Davis 1995; Garrett-Peters/Fox 2007; Hudson/Jacques 2014; Josephs 1994; Kieras et al. 2005; Simonds et al. 2007; Tobin/Graziano 2011). One exception is the study of Carlson/Wang (2007), who included a task on the reflective emotion regulation of a positive emotion, asking 4- to 6-year-old children to keep exciting news a secret. Results showed that the suppression of a positive emotion did not correlate significantly with neither age nor expressive behavior in a disappointing gift task. However, their operationalization of a successful reflective emotion regulation of a positive emotion was based on children's actual behavior (i.e. whether they gave away the secret or not), not on their emotional expression (ib.).

In contrast, studies on the development of pride examined the spontaneous control of emotional expression in pride-eliciting situations. Reissland/Harris (1991), for example, reported that by the age of 5, children spontaneously tried to neutralize or mask their pride after winning a competitive interaction in the presence of younger siblings. However, since their study did not include a condition triggering disappointment, no conclusions can be drawn with regard to the comparison of the two emotional valences (ib.). Studies on the simulation of emotional expression, on the other hand, detected that the positive expression of joy is produced more easily than other, negative emotional expressions (Buck 1975; Field/Walden 1982; Odom/Lemond 1972). Sadness, most of all, seems to be difficult to produce even for school children and adults (Ekman et al. 1980; Lewis et al. 1987). Gosselin et al. (2011) compared the simulation of joy to that of sadness and found that preschool as well as school children were more successful in producing a full expression of joy than that of sadness, concluding that positive expressions seem to be easier to simulate.

However, masking does not only include the simulation of a certain emotional expression but also a simultaneous inhibition of the expression corresponding to the emotion actually felt. Therefore, although the simulation of joy is more easily managed by preschool children than that of disappointment, it remains unclear how effectively children can inhibit their expression of felt joy in comparison to that of felt disappointment and, thus, whether these results are transferable to the reflective emotion regulation of expression where both, simulation and inhibition are required at the same time. In addition, the abovementioned studies on positive expressions were all based on an objective, standardized analysis of expression. Therefore, it is not yet clear whether children's positive expressions indeed would convince naïve observers as being genuine.

1.5 Aims and Hypotheses

The present study examines whether the quality of reflective emotion regulation of expression in 3- to 5-year-old children is influenced by the modality in which the experimenter instructs the child to mask his or her emotion (verbal vs. iconic), by the valence of the emotion that the child is supposed to mask (joy vs. disappointment), and by chil-

dren's age. For this purpose, children were instructed to display a predetermined emotional expression while opening a box that either contains a gift (gift trials) or not (no-gift trials). Assuming that gift trials elicit joy and that no-gift trials elicit disappointment, children's task was to mask their actually felt emotion.

(1) With regard to the impact of instructional modality, we expected children to mask their actually felt emotions more successfully after an iconic than after a verbal instruction following previous studies on the simulation of emotional expression. (2) As to a potential effect of emotional valence, no distinct hypothesis could be drawn from previous literature. Therefore, the corresponding analyses were accomplished in an explorative way. (3) Furthermore, we expected an improvement in the masking of emotional expression in the course of preschool age, reflected in a successful deceit of naïve observers of one's felt emotion by convincingly showing an opposed expression.

Congruent trials requiring no masking and no reflective emotion regulation of expression were implemented as control conditions where children could authentically display their felt emotions that should be recognized successfully by the naïve observers. (4) Thus, we expected naïve observers to attribute joy to the children in congruent gift trials and disappointment in congruent no-gift trials above the chance level of 33% (one hit out of three alternative qualities of emotion that the child may feel: disappointed, neutral, happy).

2 Methods

2.1 Participants

Twenty-three children (16 girls, 7 boys) participated in the study, of which 13 were 3;5 to 4;8 years old (*M* = 49.08 months, *SD* = 5.07 months) and 10 were 5;5 to 5;11 years old (*M* = 68.10 months, *SD* = 1.85 months). The children came from two urban preschools which can be described as middle class districts with single and multiple family houses in Münster, Germany. The main language spoken at home was German for all children (100%). Two children were from bilingual families (8.7%), additionally speaking Arabic respectively Russian.

2.2 Materials and Procedure

The present cross-sectional study consisted of the dice game of expression "Masquerade" and the subsequent subjective impression analysis of children's expressive behavior with adult naïve observers. Children's examinations took place in a separate room specifically equipped for the study at the respective preschool. The described procedures were part of a widespread data assessment, consisting of two experimental blocks.

2.2.1 Assessment of children's gift preferences

In order to ensure that the gift in the box did indeed elicit joy, each child was presented two different, colorful toys (a dinosaur and a teddy) and asked which one he or she liked best.

2.2.2 Dice game of expression "Masquerade"

Based on the modified disappointing gift paradigm by Kromm et al. (2015), we developed a social dice game to assess reflective emotion regulation of expression. As children seem to be equally disappointed by an unattractive gift and by no gift when they expect an attractive gift (Kromm et al. 2015: 592), we confined the experimental paradigm to empty boxes to elicit disappointment and boxes containing toys to elicit joy.

The experimenter outlined the course of the experiment, making sure that the child understood what he or she had to do by means of queries. She told each child that the two of them would now play the game "Masquerade" on a tablet computer that would work like a dice, at first deciding who would be allowed to open a gift box and then which emotion one should express when opening the box: *joy* or *sadness* (as an alternative, more usual label than *disappointment* for children). Thus, the task consisted of showing the expression of the emotion presented by the tablet computer, regardless of what the box actually contained. In order to increase children's motivation to show the intended expression, they were told that the boxes could contain toys that they were allowed to keep. In addition, the task was embedded in a guessing game to motivate the children to show the target expression which differed from the elicited emotion on four of six trials. If the target emotion was displayed so that the fellow player guessed it right, one could choose a candy out of a candy bowl.

Children were familiarized with the experimental procedure by means of two test trials (one for each emotional valence) that were not included in further analyses. These trials allowed the experimenter to check whether the child was able to simulate the two target expressions to a sufficient degree. If he or she was not able to do so, the experimenter told him or her to pout (i.e. to purse his or her lips) as an additional aid to display sadness respectively to smile to display joy. That served to ensure children's understanding of how the labels *sad* respectively *happy* looked like as a facial expression.

The instruction which emotion was to be expressed was presented iconically in one experimental block and verbally in the other experimental block. Children were randomly assigned to a specific order of experimental blocks, balanced for both age groups. Fourteen children (61%) were first instructed iconically and then verbally, while the other nine (39%) were instructed in reverse order. Since joy is more easily displayed than disappointment, the two emotional valences were arranged in a predetermined order so as to enable shy children to get involved in the task, thus always starting with the expression of joy.

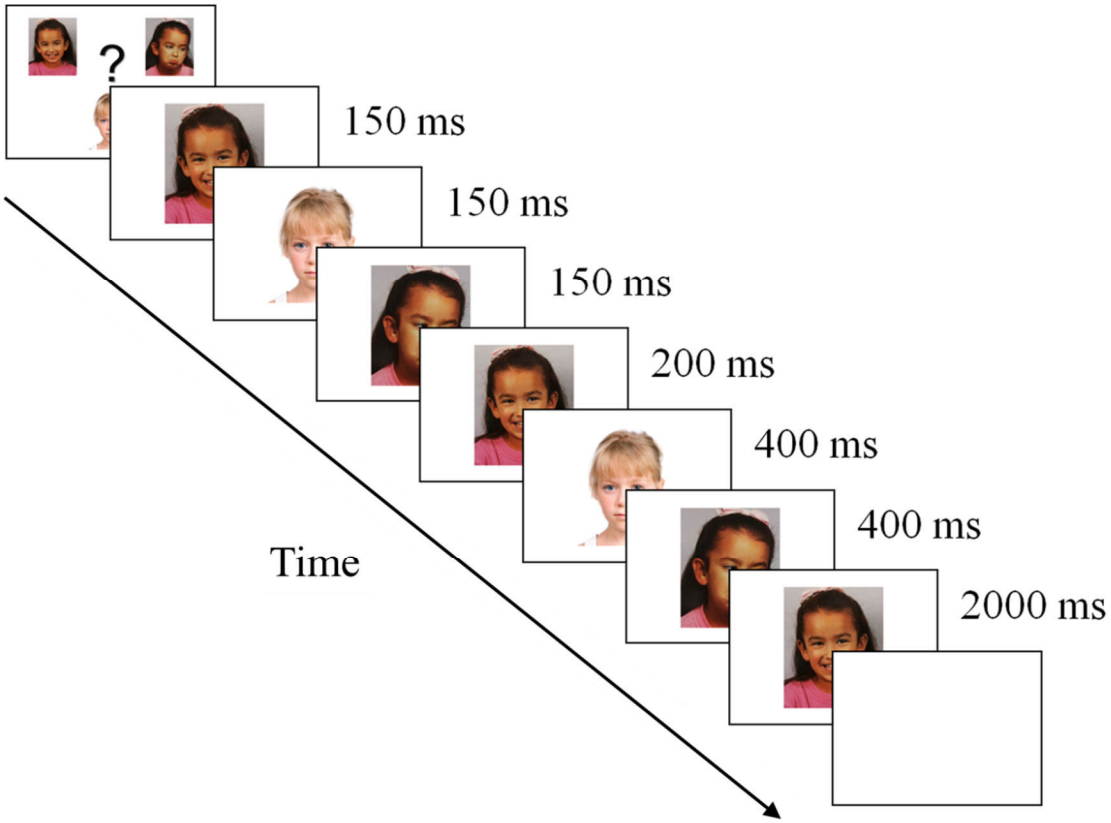
Masking trials. To assess the ability to reflectively regulate an emotional expression for each of the two modalities of instruction, elicited emotion and target expression were opposed in four trials. Thus, children were to express disappointment when receiving a gift (*masked joy*) and joy when receiving no gift (*masked disappointment*), previously instructed iconically or verbally for each emotion.

Iconic instructions. In these trials, target emotions were presented in form of photographs of happy, neutral[2], or sad facial expressions (ca. 10 x 13 cm) of boys or girls (depending on the sex of the participating child). Photographs had been taken from *Bigstock* (Shutterstock, Inc d/b/a Bigstock 2004–2016a, 2004–2016b), an online market-

2 In the interaction with the child, the neutral facial expression was labeled as *normal* for both instruction modalities as an alternative, more common term than *neutral* for children.

place for stock images, and the "Feelings and Faces Games" (Lakeshore Learning Materials 1994). Each trial included the presentation of several photographs to elicit the impression that the game respectively the target expression was indeed decided by chance. However, the distractor photographs changed rather rapidly so that the child knew that this was only the "dicing procedure". Lastly, the target emotion appeared for 2 seconds, followed by a blank screen (to run parallel to the verbal instruction). The "dicing procedure" lasted for about 7 to 8 seconds and is illustrated for the target emotion joy in Figure 1.

Figure 1: Schematic illustration of a trial with an iconic instruction of the target emotion joy for girls



Source: Own representation.

Verbal instructions. In these trials, target emotions were presented by means of an audio recording of a female voice speaking different emotional labels aloud and in an emotionally neutral mode for about the same length as the iconic instructions, e.g. "*happy – normal – sad – happy*" for the target emotion of joy. Again, distractors were used to elicit the impression that the target expression was decided by chance. Analogous to trials with iconic instructions, children's task was to show the expression corresponding to the last-named emotion when opening the next box.

Congruent trials. In two additional trials, elicited emotion and target expression were congruent, aiming at authentic expressions. Thus, children were to express joy when receiving a gift (*congruent joy*) and disappointment when receiving no gift (*congruent disappointment*). Since we did not assume that the modality of instruction had an impact on these trials, they were only instructed in either an iconic or a verbal way,

balanced for both age groups. Two-sample, two-tailed t-tests indeed yielded no significant differences between iconic and verbal instructions for neither joy nor disappointment ($t(16.22) = -0.09$, $p = .993$ resp. $t(21) = 0.40$, $p = .696$). Thus, further analyses of congruent trials based on the means of iconically and verbally instructed trials for each emotional valence.

2.2.3 Impression analysis

In order to examine how successful children are in volitionally masking their felt joy respectively disappointment, an impression analysis was carried out with adult naïve observers. This method can be regarded as a strong and ecologically valid test method, assessing to what extent a person is able to mislead naïve observers about his or her felt emotion by displaying an opposed expression. For that purpose, children's emotional expressions were videotaped during the experiment by using a hidden, remotely controlled video camera, angled so that a child's face and upper body were always seen frontally, whereas the content of the boxes could not be seen.

Preparation of the video material for the impression analysis. The 138 individual video episodes of the children's expressions during the dice game (6 trials x 23 children) were arranged in a pseudorandomized order, balanced with respect to condition, age, and sex (no more than five episodes of the same type in succession). No child appeared in two successive episodes. The duration of an episode was usually about 3 to 6 seconds. Each video episode started as soon as the child lifted the lid of a gift box and ended when the child closed the lid or when the emotional expression receded.

Sample of observers. 12 adults (six male, six female), undergraduate psychology students at the university of Münster aged between 22 and 33 years ($M = 26.50$, $SD = 3.12$), took part in the impression analysis. Afterwards, participants completed the "Emotional Competence Questionnaire" (*EKF*, Rindermann 2009), which is a self-report inventory of one's ability to recognize, express and regulate emotions that can be considered reliable (Cronbach's alpha coefficients of .88 to .92 for the four subscales; ib.: 42–43) and valid (ib.: 44–51). The subscale "recognition of emotion in others" was of particular interest, assessing the ability to recognize and understand feelings of others by means of verbal and nonverbal signals. Observers' mean standard score was 107.27 ($SD = 8.84$), indicating no deviation from the average of the normal population of the same age and sex. No observer had a standard score below average, and four observers (33%) had standard scores above average. Thus, all observers can be assumed as being able to recognize emotions in others on an average or above-average level. Participation in the study was voluntary and each participant received € 20.00.

Conducting the judgments. For each video episode in each block, the 12 naïve observers judged the quality of emotion the child seemed to experience (*disappointment [-1], neutral [0], joy [+1])*. Interrater-reliability was estimated by means of internal consistency analyses (with observers as items) for each of the six experimental conditions, indicating good to excellent consistency (Cronbach's alpha coefficients of .89 to .96, $Mdn = .94$).

For masking trials, the measures of interest were (a) the percentage of observers who categorized children's expression as disappointed when he or she had received a gift and the target emotion was disappointment, and (b) the percentage of observers who categorized children's expression as happy when he or she had received no gift and

the target emotion was joy. Thus, a successful reflective emotion regulation of expression was characterized by misleading naïve observers in such a way that they did not attribute the actually felt, but the target emotion to the respective video episode.

For congruent trials, the measures of interest were (a) the percentage of observers who categorized children's expression as happy when he or she had received a gift and the target emotion was joy, and (b) the percentage of observers who categorized children's expression as disappointed when he or she had received no gift and the target emotion was disappointment.

2.2.4 Manipulation check: self-report of felt emotion

In order to ensure that the intended emotion was elicited and that the present experimental paradigm did indeed require the masking of joy respectively disappointment, children were asked to state their actually felt emotion and its intensity after each opened box on a bipolar 5-point Likert-type emotion scale. The scale was introduced as an "emotion thermometer" and ranged from *very sad* (–2), *slightly sad* (–1), *neutral* (0) and *slightly happy* (+1) to *very happy* (+2). The measure of interest was the quality and the intensity of emotion that the child indicated.

3 Results

3.1 Impact of Instructional Modality, Emotional Valence and Age on the Reflective Emotion Regulation of Expression in Masking Trials

The means and standard deviations of attribution rates of gift trials to disappointment and of no-gift trials to joy are shown in Table 1.

Table 1: Attribution Rates (in %) of Gift Trials to Disappointment and of No-Gift Trials to Joy by 12 Naïve Observers for Masking Trials, Depending on Children's Age and Modality of Instruction

			Masked emotion			
			Joy[a]		Disappointment[b]	
Modality of instruction	Age	*n*	*M*	*SD*	*M*	*SD*
Iconic	3 to 4 years	13	41.03	42.00	30.77	32.70
	5 years	10	78.33***	29.44	40.83	32.02
Verbal	3 to 4 years	13	16.67	24.30	26.92	36.03
	5 years	10	62.50*	42.36	35.00	38.25

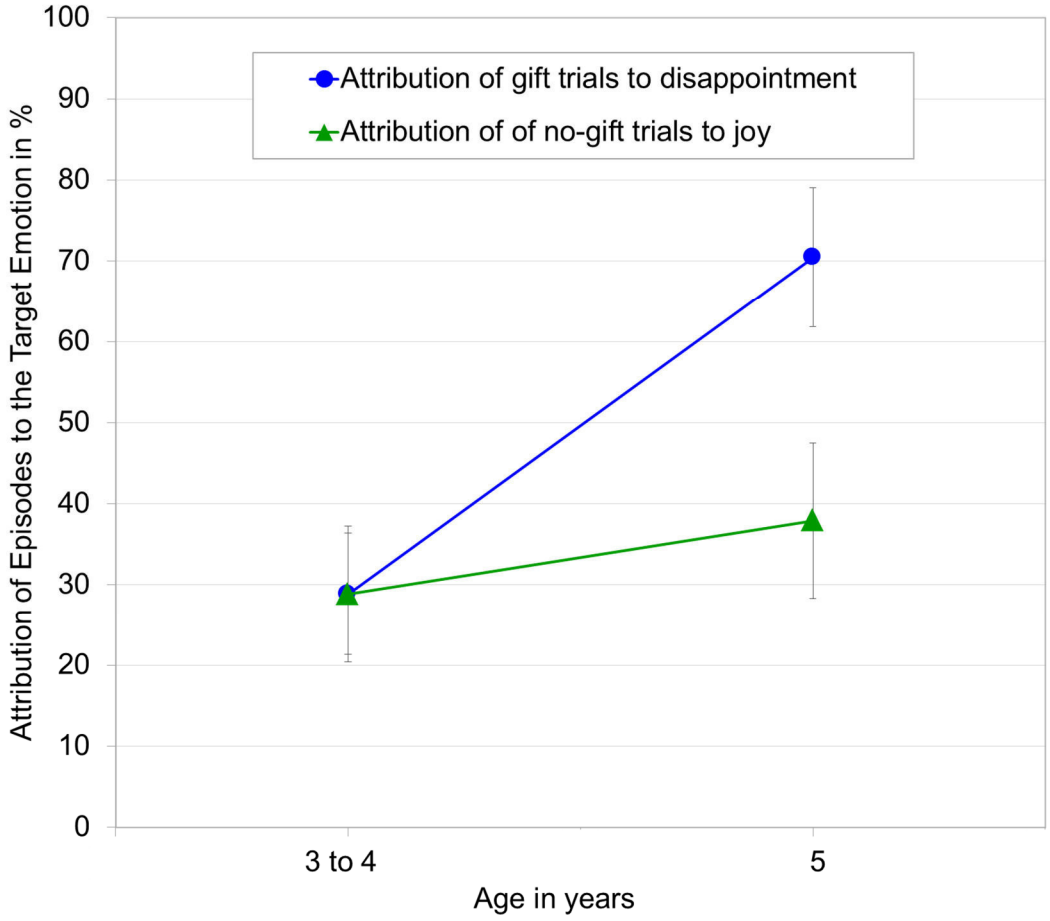
Note. p-values are based on one-sample one-tailed *t*-tests examining whether the mean attributions are significantly higher than the chance level of 33% (one hit out of three alternatives: disappointed, neutral, happy). * $p < .05$. ** $p < .01$. *** $p < .001$.
[a]Attribution rate of disappointment. [b]Attribution rate of joy.

Source: Own representation.

A 2 x 2 x 2 (Age [3- to 4-year-olds, 5-year-olds] x Modality of Instruction [iconic, verbal] x Emotional Valence [joy, disappointment]) repeated measurement ANOVA revealed a significant main effect of instructional modality in the expected direction ($F(1, 21) = 6.24$,

p = .021, η^2 = .23), with higher attribution rates to the respective target emotion in iconically instructed trials. This main effect did not interact neither with age (F(1, 21) = 0.11, p = .747, η^2 = .01) nor with valence (F(1, 21) = 1.29, p = .269, η^2 = .06). No second order interaction was found, F(1, 21) = 0.15, p = .699, η^2 = .01. In addition, a significant interaction effect of age and valence was revealed (F(1, 21) = 5.84, p = .025, η^2 = .22), as illustrated in Figure 2. Therefore, the significant main effects of age (F(1, 21) = 6.30, p = .020, η^2 = .23) and valence (F(1, 21) = 5.84, p = .025, η^2 = .22) cannot be interpreted independently. In order to examine the interaction effect between emotional valence and age, simple effect analyses were conducted. Comparing the two age groups, attribution rates of gift trials to disappointment were significantly higher for 5-year-olds compared to 3- to 4-year-olds (p = .002, Bonferroni-corrected). In contrast, no age-related difference was found for attribution rates of no-gift trials to joy (p = .486). Comparing the two emotional valences, a significant difference of attribution rates of trials to the respective target emotion was found for 5-year-olds (p = .004, Bonferroni-corrected), but not for 3- to 4-year-olds (p = 1.000).

Figure 2. Attribution of gift trials to disappointment and of no-gift trials to joy, depending on children's age



Source: Own representation.

In order to indicate a successful reflective emotion regulation of expression, one-sample one-tailed t-tests were conducted for each combination of instructional modality, emotional valence, and age group as to whether observer attribution rates to the respective target emotion were significantly higher than a hit rate that would be expected by chance (33% at one hit out of three alternatives: disappointed, neutral, happy). This analysis showed that, as expected, 3- to 4-year-olds were not able to mask neither their felt joy nor their felt disappointment since naïve observers attributed the respective target emotion to all four trials only below chance level (see Table 1 for *p*-value levels). In contrast, 5-year-olds successfully masked their joy by displaying a convincing expression of disappointment in gift-trials, leading to attribution rates to disappointment above chance level. In no-gift trials, however, even 5-year-olds were not able to successfully mask their disappointment, as naïve observers categorized their expression as happy only on chance level.

3.2 Authentic Emotional Expressions in Congruent Trials

As revealed by one-sample one-tailed t-tests, observers' attribution rates of gift trials to joy and of no-gift trials to disappointment in congruent trials were significantly higher than the hit rate of 33% that would be expected by chance (gift trials: $M = 61.96\%$, $SD = 33.69$, $t(22) = 4.12$, $p < .001$; no-gift trials: $M = 72.83\%$, $SD = 32.20$, $t(22) = 5.93$, $p < .001$). Thus, the children authentically expressed joy and disappointment in congruent trials that required no masking.

3.3 Manipulation Check

In masking trials, 82 % of the children reported having felt slightly or very happy at the sight of a gift when instructed iconically and 87 % when instructed verbally. In contrast, only 57 % of the children reported having felt slightly or very sad at the sight of no gift when instructed iconically and 70% when instructed verbally. In congruent trials, 91% of the children reported having felt slightly or very happy at the sight of a gift and 78% reported having felt slightly or very sad at the sight of no gift. Thus, almost all children stated to feel the emotion which was intended to be elicited (i.e. joy in the gift trials and disappointment in the no-gift trials).

One-sample one-tailed t-tests were conducted as to whether children's reported emotions significantly differed from a neutral emotional state (i.e. the scale mean zero). In masking trials, children's self-reports of emotions were significantly higher than zero in both gift trials, but they were significantly lower than zero in both no-gift trials only for 5-year-olds (for means, standard deviations and *p*-value levels, see Table 2). In congruent trials, children's self-reports of emotions were significantly higher than zero in the gift trial ($M = +1.83$, $SD = 0.58$, $t(22) = 15.20$, $p < .001$) and significantly lower than zero in the no-gift trial ($M = –1.38$, $SD = 1.02$, $t(20) = –6.18$, $p < .001$).

Table 2: Children's Self-Report of Felt Emotion for Masking Trials, Depending on Children's Age, Modality of Instruction and Valence of Masked Emotion

Modality of instruction	Age	*n*	Masked emotion[a]			
			Joy		Disappointment	
			M	*SD*	*M*	*SD*
Iconic	3 to 4 years	13	1.38***	1.04	0.00	1.64
	5 years	9	1.67***	0.71	–1.22***	0.83
Verbal	3 to 4 years	13	1.62***	1.12	–0.62	1.56
	5 years	9	1.78***	0.67	–1.00**	0.87

Note. p-values are based on one-sample *t*-tests examining whether the mean self-reports are significantly different from 0 (*neutral*). * $p < .05$. ** $p < .01$. *** $p < .001$.
[a]The scale ranged from –2 (*very sad*) to 0 (*neutral*) to +2 (*very happy*).

Source: Own representation.

4 Discussion

The applied experimental and analytical design revealed an impact of instructional modality on children's reflective emotion regulation of expression, confirming hypothesis 1 (more successful masking after an iconic than after a verbal instruction). In addition, an interaction between emotional valence and age was found, suggesting a differential effect of emotional valence depending on children's age and thus corroborating hypothesis 2 (effect of emotional valence) and, in parts, hypothesis 3 (continuous improvement in the reflective emotion regulation of expression). Hypothesis 4, concerning children's authentic emotional expressions (attribution rates of gift-trials to joy and of no-gift trials to disappointment above the chance level of 33%), was confirmed by the analysis of congruent trials.

4.1 Impact of Instructional Modality in Masking Trials

As predicted by hypothesis 1, an iconic instruction improved children's ability to mask their felt emotion in comparison to a verbal instruction. When instructed iconically by means of photographed emotional expressions, children were more successful in misleading naïve observers about their actually felt emotion by convincingly showing an opposed expression than when instructed verbally by means of an emotional label. These findings are consistent with the study of Field/Walden (1982) on the simulation of emotional expression and confirm the benefits of an iconic instruction for the reflective emotion regulation of expression. With regard to the underlying mechanisms, two alternative explanations are possible. On the one hand, following Peirce's *sign theory* (1903), an iconic instruction provides children with a picture of the target facial expression with which they can immediately match their own expression, while a verbal instruction requires a mental translation from a symbolic code into an iconic code of expression (Holodynski 2006: 63–64). On the other hand, according to the concept of emotional contagion and spontaneous motor mimicry of expression (Hatfield et al. 1994; Lundqvist/Dimberg 1995), it may be assumed that the presented photographed emo-

tional expressions elicited an emotional contagion to a greater extent than the presented audio recording of a female voice speaking verbal labels of emotions, resulting in an emotional experience corresponding to the presented target emotion. In consequence, previous studies on the reflective emotion regulation of expression (e.g. Davis 1995; Kromm et al. 2015) might have underestimated children's ability to mask their emotion with an opposed emotional expression, using verbal instructions only. However, bearing in mind the rather small sample size of the present study, this finding should be further examined in future studies.

4.2 Impact of Emotional Valence in Masking Trials

With regard to an impact of emotional valence (hypothesis 2), an interaction of age and valence was revealed. Five-year-olds were able to mask their felt joy by showing an expression of disappointment more successfully than their felt disappointment by an expression of joy. However, this was not the case for 3- to 4-year-olds, who were not able to mask neither their joy nor their disappointment successfully. This seems to contradict the findings of previous literature on the simulation of emotional expression (Buck 1975; Field/Walden 1982; Gosselin et al. 2011; Odom/Lemond 1972) that positive expressions seem to be easier to simulate for preschool children than negative ones. However, as described above, the reflective regulation of emotional expression requires a simultaneous inhibition of the expression corresponding to the actually felt emotion, so that results on the simulation of emotional expression cannot be directly transferred to masking processes. According to the findings of the present study, the masking of disappointment by joy seems to be more difficult than the masking of joy by disappointment for 5-year-olds, while 3- to 4-year-olds are equally unsuccessful in masking both emotional valences. Beyond the difficulty of masking, the results of the 5-year-olds alternatively might be due to the analysis design applied in the present study, namely the impression analysis of naïve observers. Judging children's emotional expression, naïve adults might have an implicit attribution bias by taking young children's expressions of disappointment, namely a pout (that most of the 5-year-olds displayed), more seriously and authentically than expressions of joy, namely a smile. Therefore, when confronted with mixed expression signs of joy and disappointment in gift trials, the naïve observers might have trusted the signs of disappointment more than the signs of joy, thus being misleaded by the 5-year-olds. In no-gift trials, in contrast, that bias resulted in a successful detection of the felt disappointment. Three- to 4-year-olds, on the other hand, apparently were not able to display a requested target emotion at will, resulting in a quite unequivocal authentic expression of their felt emotion independent of the actual emotional valence. This bias may be beneficial in a psychological sense, making sure that children's negative expressions have a strong appeal on adults who feel obliged to take care of the "sad" child to protect him or her against potential threats. However, whether the revealed interaction of age and emotional valence should be ascribed to the children or to the naïve observers remains unclear. Further analyses of children's expressions by means of objective coding systems, such as the FACS (Ekman/Friesen 1978) as well as detailed interviews of the raters concerning the basis of their judgements, could shed further light on this matter.

4.3 Impact of Age in Masking Trials

Hypothesis 3, suggesting an improvement in the masking of emotional expression in the course of preschool age, was corroborated only in parts. Five-year-olds were indeed able to mask their felt joy by showing an expression of disappointment more successfully than 3- to 4-year-olds. However, whether this is due to an improvement in the simulation of disappointment or to that in the inhibition of joy, or even to a bias in naïve observers' perception of disappointment, cannot be answered with the present experimental and analytical design. There was no age effect for the masking of disappointment, with attribution rates of no-gift trials to the target emotion joy not differing significantly from chance level for both age groups. Thus, even older preschool children seem to experience difficulties when it comes to mask their disappointment and the respective development seems to take place at an older age. At first glance, this finding is not consistent with previous studies on the reflective emotion regulation of expression that applied the disappointing gift paradigm of Saarni (1984) or modified versions thereof and reported age-related trends for the masking of disappointment in the course of preschool (e.g. Carlson/Wang 2007; Kromm et al. 2015). However, while Carlson/Wang (2007) based their analysis of expression on the FACS by Ekman/Friesen (1978), the children in the study of Kromm et al. (2015) were older than those included in the present study, so that results are not directly comparable.

4.4 Authentic Emotional Expressions in Congruent Trials

As predicted by hypothesis 4, naïve observers attributed gift trials to joy and no-gift trials to disappointment above chance level when felt and target emotion were congruent. This indicates that, for one thing, children were able to express joy respectively disappointment to a sufficient degree in order to be recognized as such. For another, that implicates that naïve observers were able to recognize children's joy respectively disappointment successfully as such when displayed authentically in congruent trials of the dice game "Masquerade". In consequence, results concerning children's expressions in masking trials may be assumed as being valid.

4.5 Manipulation Check

In congruent trials, children reported having felt joy at the sight of a gift and disappointment at the sight of no gift at an intensity level significantly different from neutral. In masking trials, however, while children of both age groups reported a significantly intense joy at the sight of a gift, only 5-year-olds reported a significantly intense disappointment at the sight of no gift. In consequence, it can be assumed that gift episodes of the dice game "Masquerade" validly elicited joy and that thus masking gift trials indeed required the masking of an emotion. The same assumption, however, cannot be made for no-gift masking episodes without qualification. However, as some 3- to 4-year-olds even reported having felt slightly or very happy at the sight of no gift, it seems that the self-report of felt emotion had been influenced by the presentation of the respective target emotion. This may be due to a limited differentiation between emotion and expression in 4-year-olds (Cole 1986; Gross/Harris 1988; Josephs 1994; Pons et al. 2004; Rottleuthner-Lutter 1987), who might have linked the self-report to the expression that they had just shown rather than to their actually felt emotion. This effect has been ob-

served before in studies on the *facial feedback theory* with adults (McIntosh 1996; Soussignan 2002). Displaying an expression that opposed the actually felt emotion led to a diminished self-reported intensity of the felt emotion compared to a condition where no masking was required (ib.). Additionally, a limited capacity of children's working memory might have led to the unexpected self-reports due to the *recency effect* (Purves et al. 2008: 342–343) in a way that the target emotion "overwrote" the actually felt emotion, above all in younger children.

Overall, children reported a more intense joy in gift trials than disappointment in no-gift trials. The circumstance that positive emotions are induced with more intensity than negative ones seems to be a general effect that has been reported before (e.g. Holodynski 2004; Kortas-Hartmann 2013). In addition, as Kromm et al. (2015: 592) argued, an intense disappointment would rather be unexpected since the task applied does not aim at an extremely intense disappointment for ethical reasons.

4.6 Conclusions and Outlook

The findings from the present study make several contributions to the empirical state of research on the reflective regulation of emotional expression. First, a new experimental design has been shown to validly assess the reflective regulation of emotional expression in preschool children. Second, an impact of instructional modality was revealed, with children masking their actually felt emotion more effectively when instructed iconically than when instructed verbally beforehand. Third, an interaction of emotional valence and age was found, reflecting a more difficult masking of disappointment than that of joy for older preschool children. However, this study also raises some questions that require further investigation. With regard to the impacts of instructional modality and emotional valence, the analysis of the mechanisms underlying these effects needs further investigations. In addition, as the sample size of the present study was rather small, the experiment described in this study should be replicated, bearing in mind the new-risen questions and the suggestions as to how to answer them. Furthermore, as gender effects have been reported before in some studies on the spontaneous control of emotional expression (Baaken 2005; Cole 1986; Davis 1995; Garrett-Peters/Fox 2007), the potential influence of gender on the impacts of instructional modality and emotional valence should be addressed in future studies with larger sample sizes and a balanced proportion of girls and boys.

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Self-Regulation in Preschool Children's Everyday Life: Exploring Day-to-Day Variability and the Within- and Between-Person Structure

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1 Introduction

Self-regulation is the ability to adaptively regulate one's own emotions, cognition, and behavior in order to respond effectively to internal as well as environmental demands (McClelland/Cameron 2012; Raffaelli et al. 2005). Early childhood is a sensitive stage for the development of self-regulation. In longitudinal studies, self-regulation increases substantially during infancy and the preschool years, with individual variability in growth rates (e.g. Fuhs/Day 2011; Moilanen et al. 2009; Raffaelli et al. 2005; Raikes et al. 2007). Inter-individual differences in self-regulation in early childhood are predictive of numerous outcomes across the lifespan (Fergusson et al. 2013; Moffitt et al. 2011), including school readiness (Blair/Raver 2015; Suchodoletz et al. 2013), literacy and math skills (Becker et al. 2014; Sawyer et al. 2015a), behavioral problems in the classroom (Sawyer et al. 2015b), and building as well as maintaining positive peer relationships (Holmes et al. 2016). The present study is the first investigating whether there is also *intra*-individual, day-to-day variability in preschoolers' self-regulation besides inter-individual differences, and how the factor structure of self-regulation can be described at the within-person (intra-individual) and between-person (inter-individual) level.

1.1 Within- and Between-Person Variability in Self-Regulation

So far, research on self-regulation in childhood has concentrated on inter-individual differences. However, some studies have already demonstrated intra-individual variability in related constructs: Miller and colleagues (2015) experimentally investigated the relationship between acute sleep restriction and different self-regulation strategies during an unsolvable puzzle task in a sample of two- and three-year old children. The experimental group was deprived of sleep by not having their usual afternoon nap, while the children of the control group were allowed to sleep. During the unsolvable puzzle task, the experimental group showed significantly less adaptive, self-regulatory behaviors (e.g. insistence on completing an unsolvable puzzle, self-soothing behaviors) compared to the control group. Even if these findings have to be interpreted with caution due to the small sample size (n = 12), the study provides first evidence for the influence of factors subjected to change from day to day (i.e. sleep time) on self-

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regulation in early childhood. Using an intensive longitudinal design with ambulatory-assessed (i.e. smartphone-based) working memory tasks three times a day over four consecutive weeks, Dirk and Schmiedek (2016) demonstrated substantial day-to-day fluctuations, as well as fluctuations throughout the day in elementary school children's working memory. Likewise, two studies with adolescent samples within the clinical context recently showed substantial day-to-day fluctuations in self-regulation failures (Berg et al. 2014; Schmid et al. 2016). Thus, besides the fact that some children generally show better self-regulation skills compared to other children (inter-individual differences or between-person level), day-to-day fluctuations in self-regulation should be present in younger samples as well; the individual child might also intra-individually experience days on which his or her self-regulation is better or worse compared to other days (within-person level). This dynamic nature of self-regulation was already mentioned by Thompson (1994), who concluded in his basic review about emotional self-regulation that "there is no necessary reason why individuals should exhibit deficiencies in all aspects of emotion regulation or in all situations" (p. 45) and highlighted the need for future research to focus on (emotional) self-regulation "much less globally and in a manner that is far more situationally specific" (p. 47). The present study addresses Thompson's challenge and contributes to closing this research gap by empirically investigating whether within-person variability in self-regulation is also present in the everyday life of healthy preschool children, as it was previously shown in older and clinical samples (Berg et al. 2014; Dirk/Schmiedek 2016; Schmid et al. 2016). For this purpose, the study applies an intensive longitudinal design over a measurement period of seven consecutive days, enabling us to differentiate between within- (intra-individual) and between-person (inter-individual) effects.

1.2 The Structure of Self-Regulation

Present theories about the structure of self-regulation in children are built on assumptions at the between-person level. Many researchers from multiple research fields have addressed (inter-individual) self-regulation, yet have emphasized slightly different aspects, such as effortful control (Rothbart et al. 2001), self-control (Moffitt et al. 2011), emotion regulation (Carlson/Wang 2007), or executive functioning (Miyake/Friedman 2012).

Summarizing the different approaches and perspectives on children's self-regulation by independent researchers, self-regulation integrates three processes: cognitive, behavioral, and emotional regulation. Cognitive self-regulation refers to executive functions such as updating (working memory), inhibition, and flexible attentional shifting (Garon et al. 2008; Miyake/Friedman 2012). To concentrate one's attention and to stay focused is an important self-regulation skill in children's everyday life, especially with regards to academic performance (Blair et al. 2015; McClelland/Wanless 2012). From a cognitive perspective, executive functions constitute the underlying, higher-order neurocognitive ("top down") process subserving cognitive self-regulation (Blair/Ursache 2011; Bridgett et al. 2015; Hofmann et al. 2012). Behavioral regulation refers to self-control abilities and compliance, that is, the ability to internalize rules and standards as well as to inhibit predominant behavioral responses that do not conform to those rules and standards or that do not fit the demands of the environment (Denham et al. 2012; Tangney et al. 2004). Children's behavioral self-

regulation describes behaviors such as adhering to rules, listening to others without interrupting them, or being able to wait until one's turn. Thus, behavioral self-regulation is linked to positive and desired social outcomes, such as positive peer relations (Ramani et al. 2010) and socially appropriate behavior (Eisenberg et al. 1997). Emotional regulation refers to the experience and expression of emotions (Gross 2014). Emotional regulation emerges in early childhood as the employment of regulation strategies shifts more and more from an extrinsic (i.e. parent-monitored) to an internal (i.e. self-monitored) process during the preschool years (Bridgett et al. 2015). During development, children acquire an increasing number of emotion-regulation strategies: from early strategies such as regulation of visual attention by two or three months of age or physical self-soothing behaviors (e.g. thumb sucking) between four and ten months of age (Bridges/Grolnick 1995) to more complex strategies such as cognitive reappraisal (Gross 2014; Gullone et al. 2010). From a functionalist perspective, the ability to regulate emotions is important for building and maintaining social relationships as well as meeting situational demands and social expectations (e.g. in the school context) or achieving goals (Thompson, 1994). For instance, children with good emotional self-regulation skills would not be easily frustrated when things did not work out as well as expected (i.e. starting crying, tossing toys, etc.).

However, it is still unclear whether cognitive, behavioral, and emotional self-regulation are so strongly interrelated that they form a unidimensional self-regulation factor or whether they can be empirically separated from each other despite their interrelation. Therefore, up to now there exist different, competing structural models of preschoolers' self-regulation, including three-factor, two-factor, and single-factor models. According to Bridgett and colleagues (2015), a two-factor structure of self-regulation is assumed with a conglomerate of cognitive and behavioral self-regulation on the one hand and emotional self-regulation on the other hand. A conceptually similar two-factor structure of preschoolers' self-regulation is also assumed by researchers who differentiate between "hot" versus "cool" self-regulation (e.g. Willoughby et al. 2011). While hot self-regulation describes affective and motivational processes (i.e. self-regulation in the presence of emotionally arousing and/or appetitive demands), cool self-regulation describes cognitive, emotionally neutral regulatory processes (i.e. executive functions). Besides a two-factor structure of self-regulation, past research found also evidence for the conceptualization of self-regulation as a global, single-factor construct and – in contrast – as a rather differentiated, three-factor construct. Studies supporting a three-factor model argue that the regulation of cognition, emotion, and behavior describes three related but empirically distinct constructs (Denham et al. 2012; Jahromi/Stifter 2008). Studies supporting a unidimensional, single-factor model of self-regulation argue that the factor correlations between the two or three latent factors are so high that a global self-regulation factor is most appropriate (Allan/Lonigan 2014; Raffaelli et al. 2005).

In sum, there is no consensus about whether preschoolers' self-regulation is best described by a unidimensional construct or whether self-regulation consists of related but empirically distinct subcomponents. Overall, few studies have investigated the factor structure at a between-person level in samples of preschool children, and there is no study yet investigating the factor structure of children's self-regulation at a within-person level and testing whether the factor structure differs between the within- and between-person levels.

1.3 The Present Study

The aim of the present study was twofold: a) to investigate the amount of daily fluctuations in self-regulation within individuals over the course of several days and b) to explore which factor structure best describes preschoolers' self-regulation at both the within- and between-person level. The current lack of research in this area might be mostly due to a lack of instruments assessing daily self-regulation. We therefore developed a short parental questionnaire capturing self-regulation in preschool children on a daily basis (see below). This questionnaire was then applied to a larger sample in the present study to investigate the two research aims.

Since there is no prior research investigating self-regulation in preschool children on a daily basis, our approach to examine the second research question is grounded on model assumptions obtained in past between-level studies. Therefore, three nested models were tested against each other: a global single-factor model (i.e. global self-regulation), a two-factor model (i.e. cognitive-behavioral self-regulation vs. emotional self-regulation), and a three-factor model (i.e. cognitive vs. behavioral vs. emotional self-regulation). Multilevel confirmatory factor analyses (CFA) were conducted in order to test the assumed factor structures at both the within- and between-person level.

2 Method

2.1 Participants

The present study was part of a larger research project investigating potential influences on self-regulation at the individual, family, and preschool levels. The sample consisted of 106 parents with their children aged four to six years (M_{age} = 4.83, SD_{age} = 0.72) from eight different preschools in the south of Germany. Gender was almost equally distributed (44.3% female children). On average, participants' socio-economic status was in the middle-to-upper regions as indicated by education and income: The highest maternal school qualifications were 60% who had qualified for university entrance, 31.8% middle school, and 4.7% lower secondary school (3.5% missing values). The average net family income per month was distributed as follows: 17.9% above €5,000, 15.1% between €4,000-€5,000, 18.9% between €3,000-€4,000, 12.3% between €2,000-€3,000, 4.7% between €1,000-€2,000, and 0.9% below €1000 (30.2% missing values). 73.6% of the sample spoke German as their mother tongue at home, 9.4% spoke German at home most of the time, and 12.3% spoke German at home at least part of the time (4.7% missing values). Parents and their children were recruited by flyers and information letters in different preschools; parents gave written informed consent to participation. The study was approved by the local research ethics committee.

2.2 Procedure

When completing the parental consent form to participate in the study, the parents had to indicate whether they wished to answer the daily questions about their child's self-regulation by phone or by an online questionnaire. 41.5% chose the telephone interview. For seven consecutive days, the parents were called every evening at about 7pm and were asked about their child's self-regulation on the particular day. The parents who chose the online questionnaire received an email, every evening at about

7pm, with an individualized link to the questionnaire of the particular day. Out of the persons who answered the daily questions 84.3% were mothers. Families received €50 for their participation in the complete study.

2.3 Daily Self-Regulation Measure

The child's daily self-regulation was assessed with a short parental questionnaire developed in a preliminary study within our research group. The initial questionnaire was developed in two steps. First, an initial item pool was built based on the definition of self-regulation as the ability to control or direct one's attention, thoughts, emotions, and behaviors (McClelland/Cameron 2012). According to McClelland and Cameron (2012), instruments measuring self-regulation should capture aspects of self-regulation that are relevant in the context of interest. We aimed at creating a measure that captures self-regulation on a daily basis in the everyday life of preschool children. Hence, the items of the questionnaire should imply behaviors that can be observed in children aged four to six in their natural environments. For this purpose, we selected items from preexisting, validated parental questionnaires measuring general self-regulation in normal preschool children. These were the Behavior Rating Inventory of Executive Function – Preschool Version (BRIEF-P, German version by Daseking/Petermann 2013), the effortful control scale of the Children's Behavior Questionnaire (CBQ, Rothbart et al. 2001), and the Child Behavior Rating Scale (CBRS, Bronson et al. 1990). We also created several additional items in an attempt to capture all facets (i.e. cognitive, behavioral and emotional) of self-regulation equally well. The initial item pool consisted of 22 items. Since the purpose was to measure day-to-day self-regulation, the item wording was adjusted so that the parents were asked to what extent their child showed the self-regulatory behaviors *on the particular day*. This item pool was empirically tested (administered in German) in a sample of 20 parents with children aged four to six years (M_{age} = 4.65, SD_{age} = 0.81) who took part in an unrelated study at our laboratory. In the evening after the laboratory visit, parents were contacted by phone and responded to each item using a 5-point rating scale ranging from 1 "this is not true" to 5 "this is very true". At the end there was also one open question where the parents were asked to make critical comments to the items in order to adapt the wording of the questions if necessary. Next, items with item selectivity less than .30, item difficulty less than .20 or greater than .80, and items which had been indicated as difficult to understand were excluded. This procedure resulted in 10 items selected and partially adapted for use in the main study. All items with descriptive statistics can be seen in Table 1 (see below).

2.4 Data Analyses

The data gathered for our two research questions are hierarchically structured: Repeated measurements (level 1 or L1) are nested within persons (level 2 or L2) in our study. As the children were nested in eight different preschools, we tested whether there was the need to account for dependency at a third level (i.e. the preschool). However, the design effect (i.e. a function of both the intraclass correlation coefficient (ICC) and cluster size: design effect = 1+ (average cluster size-1)*ICC) for the preschool level (L3) was smaller than 2 (Lai/Kwok 2015; Muthén/Satorra 1995), indicating that there is no data dependency on a third level.

To answer the first research question whether preschoolers' self-regulation varies from day to day, the average intra-individual standard deviation (ISD) and the ICC were calculated for each item. The ISD reflects each participant's individual standard deviation in self-regulation responses across the seven assessment days. The average ISD is the mean intra-individual standard deviation for each item across all participants. The ICC refers to the proportion of between-person variance relative to overall variance (Snijders/Bosker 2012). Thus, small values can be seen as an indicator for substantial within-person variability.

To answer the second research question concerning the within- and between-person factor structure of self-regulation in preschool children, several multilevel CFAs were conducted. We started with one global self-regulation factor at the within- and between-person level (Model 1). Next, in Model 2, two latent factors were differentiated at each level, namely emotional self-regulation (with factor loadings from items 1, 3, 5, 9) versus cognitive-behavioral self-regulation (with factor loadings from items 2, 4, 6, 7, 8, 10). Finally, a further differentiated model with three latent factors at each level (i.e. four items measuring emotional self-regulation: items 1, 3, 5, 9; four items measuring behavioral self-regulation: items 2, 7, 8, 10; and two items measuring cognitive self-regulation: items 4, 6; also see Figure 1 below) was tested (Model 3). Only two items capturing cognitive aspects of self-regulation met the criteria to be included in the final questionnaire during item development. However, these two items reflect in particular the attentional aspect of executive function (i.e. cognitive self-regulation) but not cognitive shifting and inhibition (Miyake/Friedman 2012). Therefore, in the following, we refer to this factor as *attentional* self-regulation instead of cognitive self-regulation. The factor loadings of the first indicator per factor were fixed to one; no other constraints were imposed. In order to evaluate model fit, several fit indices were used with regards to the criteria proposed by Schermelleh-Engel and colleagues (2003): the Root Mean Square Error of Approximation (RMSEA: good fit: ≤ .05, acceptable fit: ≤ .08), the Comparative Fit Index (CFI: good fit: ≥ .97, acceptable fit: ≥ .95), and the Standardized Root Mean Square Residual for the within- and between-person level ($SRMR_w$/$SRMR_b$: good fit: ≤ .05, acceptable fit: ≤ .10). However, it has to be noted that these fit indices were established for single-level factor analyses and their application to two-level models is questionable (Hsu 2009). To compare the models, χ^2-difference tests were calculated (Satorra/Bentler 2001); Akaike's Information Criterion (AIC) was additionally used as a descriptive index with lower values indicating better model fit. All models were estimated with Mplus 7 (Muthén/Muthén 1998-2012) using a maximum likelihood estimation with robust standard errors (MLR). Reliability of the final retained factor(s) was considered separately for the within- and between-person level using the reliability coefficients by Cranford and colleagues (2006) (based on variance decomposition within the framework of multilevel models) as well as two-level alpha (based on multilevel CFA) by Geldhof and colleagues (2014)[2]. While within-person estimates reflect sensitivity to change (i.e. reliability of daily fluctuations in self-regulation), between-person estimates reflect sensitivity to differences between persons across the seven measurement days.

2 An additional two-level reliability estimate (based on multilevel CFA) is McDonald's omega (Geldhof et al. 2014). However, it was not possible to calculate omega since model identification failed for the attentional self-regulation factor due to the small number of indicators.

The amount of missing observations per item was small (range: 0.07 to 1.2%). Missing data were managed with a full maximum likelihood approach (FIML) used in Mplus by default. There were no missing data at level 2 (i.e. aggregated responses per person across days). In five cases there were missings on all items. That is, five persons only answered the questions on six instead of seven days. These (complete) missings could not be managed with FIML and hence could not be included in the analyses.

Table 1: Descriptive Statistics of Self-Regulation Items

Items[b]	Original item number	Factor[c]	*M* (*SD*)[d]	*Average ISD (SD)*	*ICC*
Today, my child was frustrated when things did not work out as well as expected.[a]	1	e	3.96 (0.64)	0.91 (0.38)	.21
Today, my child was easily depressed when she/he did not accomplish a task.[a]	3	e	4.39 (0.61)	0.66 (0.47)	.30
Today, my child had strong mood swings.[a]	5	e	4.21 (0.62)	0.84 (0.50)	.21
Today, my child had difficulties shifting between tasks.[a]	9	e	4.56 (0.53)	0.50 (0.42)	.34
Today, my child was able to listen to others without interrupting them.	2	b	3.40 (0.62)	0.76 (0.33)	.29
Today, my child easily waited until his/her turn.	7	b	3.44 (0.58)	0.78 (0.39)	.23
Today, my child had difficulties following rules.[a]	8	b	3.96 (0.62)	0.85 (0.36)	.24
Today, my child blurted out answers without waiting until it was his/her turn.[a]	10	b	3.93 (0.63)	0.84 (0.40)	.25
Today, my child concentrated easily.	6	a	3.80 (0.60)	0.65 (0.33)	.35
Today, my child followed a task through.	4	a	4.00 (0.60)	0.69 (0.41)	.29

Notes. ISD = intra-individual standard deviation (within-person); *ICC* = intraclass correlation coefficient. [a]Items are recoded (higher values mean higher self-regulation). [b]For all items, the full range of scale values (1 to 5) was used. [c]e = emotional, b = behavioral, a = attentional self-regulation. [d]Standard deviation of the group-means of individuals (between-person).

Source: Own representation.

3 Results

3.1 Preliminary Analyses

Since some parents chose the phone interview and some parents the online questionnaire to answer the daily questions, we first tested for differences between these two groups with regards to demographic background. There were no differences in children's gender ($\chi^2(1) = 1.45$, $p = .243$), age ($t(104) = -0.69$, $p = .493$), and family net income ($\chi^2(5) = 6.75$, $p = .240$). However, those who chose the online questionnaire had a significantly higher maternal educational degree ($\chi^2(3) = 15.05$, $p = .002$). Descriptive statistics of the self-regulation items can be seen in Table 1. Parents mainly used the upper categories of the self-regulation ratings, with item means (L2) ranging from $M = 3.41$ to $M = 4.56$.

3.2 Variability of Daily Self-Regulation

The average ISDs and ICCs for all items are displayed in Table 1. Although parents mainly used the upper categories for rating their child's self-regulation, the ratings still varied considerably from day to day as indicated by the ISDs and ICCs. The ICCs ranged from .21 to .35, that is, between-person variance was two to four times smaller than within-person variance in all items. Values of the average ISDs ranged from .50 to .91, indicating substantial variability of self-regulation within persons from day to day; in fact, ISDs were larger than the between-person SDs for nine out of ten items.

3.3 Within- and Between-Person Factor Structure of Self-Regulation

Model fit results for the series of different models with factor combinations ranging from one to three factors at the two data levels are displayed in Table 2. Model fit was worst in Model 1, implying an undifferentiated, single-factor solution at the within- and between-person level. With greater differentiation at each level, model fit improved (see Model 2 and 3). The model with three latent factors at both the within- and between-person level (Model 3) showed best model fit compared to the other factor structures. However, the inter-factor correlation between the factors attentional self-regulation and behavioral self-regulation was relatively high at the between-person level ($r = .87$) compared to the within-person level ($r = .60$). Hence a fourth model with three factors at the within-level but two factors at the between-level was tested (Model 4). The multilevel CFA produced a quite similar but slightly worse model fit for Model 4 in comparison to Model 3 with regards to the descriptive fit indices. A χ^2-difference test (Satorra/Bentler 2001) revealed a significantly smaller deviance of Model 3 compared to Model 4 (χ^2 (2) = 6.10, $p = .047$). Hence, Model 3 was finally accepted with three latent factors that can be labeled as "attentional self-regulation", "behavioral self-regulation", and "emotional self-regulation"[3]. Factor loadings of the final model can be seen in Figure 1.

3 We thank a reviewer for suggesting Ryu and West's (2009) approach for level-specific model fit evaluation in which each level is separately evaluated by defining partially saturated models. We estimated two partially saturated theoretical models and two partially saturated baseline models for each level. Similar to the SRMRwithin and SRMRbetween provided by Mplus (Table 2), the χ^2 estimates and CFIs showed that the model fitted worse at the between-person level.

Table 2: Model fit indices for the measurement models (multilevel CFA)

Model (factors)	*χ^2 (df)*	*AIC*	*RMSEA*	*CFI*	*SRMR (within/between)*
1. 1 within-1 between	393.15 (70)	18436.63	.08	.77	.08/.24
2. 2 within-2 between	201.57 (68)	18241.99	.05	.90	.05/.13
3. 3 within-3 between	164.34 (64)	18210.03	.05	.93	.04/.12
4. 3 within-2 between	170.53 (66)	18212.87	.05	.93	.04/.13

Notes. CFA = confirmatory factor analysis; *df* = degrees of freedom; *AIC* = Akaike Information Criterion; *RMSEA* = Root Mean Square Error of Approximation; *CFI* = Comparative Fit Index; *SRMR* = Standardized Root Mean Square Residual. *Source:* Own representation.

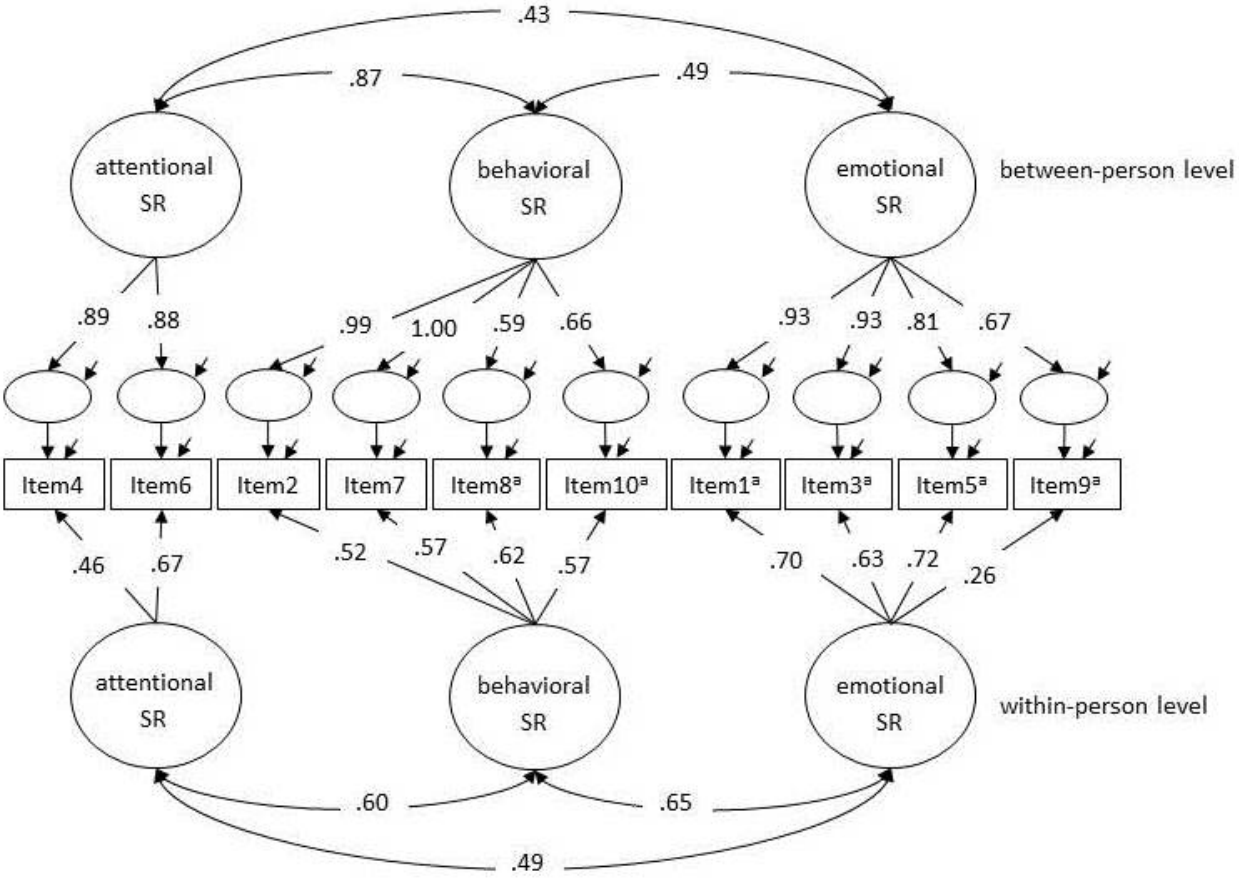
Two-level alphas (Geldhof et al. 2014) at the within-/between-person level were .66/.91 for the emotional self-regulation scale, .65/.89 for the behavioral self-regulation scale and .47/.87 for the attentional self-regulation scale. Within-/between-person reliability according to the coefficients by Cranford and colleagues (2006) were .66/.92 (emotional self-regulation), .65/.91 (behavioral self-regulation), and .46/.89 (attentional self-regulation). These values are comparable with multilevel reliability coefficients reported in previous diary studies (e.g. Schmid et al. 2016).

4 Discussion

4.1 Day-to-Day Fluctuations

For the first time we showed that self-regulation varies substantially within individuals in a sample of healthy preschool children on a daily basis. The ICCs, which indicate the proportion of between-person variance, ranged between .21 and .35. Thus, between 65% and 79% of the overall variance was due to within-person variance but not to between-person variance. For nine out of ten items of our self-regulation measure, the daily variability of self-regulation as indicated by the averaged ISDs (within-person level; range: .50 to .91) was greater than the standard deviations of the group-means (between-person level; range: .53 to .64). That is, in the present sample, self-regulation varied stronger *intra*-individually than *inter*-individually. Similar values were obtained when studying children's affect – a construct well-known for its state component (Leonhardt et al. 2016). This finding emphasizes the dynamic nature of self-regulation by empirically showing that the ability to self-regulate cognitive, behavioral, and emotional processes in preschool children fluctuates from day to day besides relatively stable differences in average self-regulation abilities between individuals.

Figure 1: Factor structure, standardized factor loadings, and inter-factor correlations of the final model (Model 3)



Note: Short arrows reflect residual variances. All factor loadings are significant (p < .001). SR = self-regulation. [a]Items are recoded. *Source:* Own representation.

The study extends findings from previous research investigating individual differences in preschool children's self-regulation at a between-person level (e.g. Jahromi/Stifter 2008; Sawyer et al. 2015b) and intra-individual variability in similar constructs and older samples (Berg et al. 2014; Dirk/Schmiedek 2016; Schmid et al. 2016). This result calls into question the results of one-time assessments of self-regulation, because one-time assessments fail to take intra-individual variability into account and in the worst case might represent one of the extreme points (best or worst performance intra-individually) rather than typical performance (cf. Toplak et al. 2013). Moreover, it is not yet clear whether there are inter-individual differences in intra-individual variability. In emotion research, there is a vivid debate how to measure such inter-individual differences in variability (Wang et al. 2012), and different methods of measuring inter-individual differences in variability are differentially related to relevant outcomes (Houben et al. 2015; Wang et al. 2012).

In addition to analyses of inter-individual differences in intra-individual variability, daily correlates of self-regulation using longitudinal study designs could be investigated as a next step. Becker and colleagues (2014) recently found first evidence for the influence of moderate to vigorous physical activity on preschool children's self-regulation skills. Although the study investigated this question at the between-person

level, physical activity seems to be a promising influencing factor on children's self-regulation on a daily basis; it varies within individuals from day-to-day (and within shorter time intervals; e.g. Ridgers et al. 2015) and is through its motivating nature a fun and relatively simple approach to positively influence children's self-regulation skills in their natural, everyday life. Another promising daily correlate of self-regulation is positive affect. Positive affect enables effective self-regulation by facilitating cognitive processes (i.e. efficient processing of information) and providing psychological resources (i.e. energy, motivation) that are essential for self-regulatory processes (Aspinwall 1998; Isen 2000; Muraven/Baumeister 2000). Since previous research already showed that positive affect varies within children on a daily basis (Leonhardt et al. 2016), the question remains whether daily variations in preschoolers' self-regulation could be explained by preceding variations in positive affect. The identification of within-person correlates and which situations are conducive to preschoolers' self-regulation in their everyday life enables the creation of more specific interventions enhancing preschool children's self-regulation skills. The focus on this young age group is hereby in particular important since an enhancement of self-regulation is advisable before the children transition into school.

4.2 Factor Structure of Self-Regulation

Multilevel CFAs revealed that the factor structure of daily self-regulation was best described by a model with three latent factors (i.e. emotional, attentional, and behavioral self-regulation) at both the within- and between-person level. With regards to the measurement of daily self-regulation in the present study, the factor "attentional self-regulation" consists of items describing cognitive self-regulation, or executive function, such as focusing the attention and staying focused for a while, or being able to concentrate. Attentional self-regulation (cf. executive function) is particularly essential for variables within the school context, such as school readiness and success in school (see for a short review Blair/Raver 2015). However, the factor "attentional self-regulation" has only two indicators, thus reducing reliability of the scale (Marsh et al. 1998). The factor "behavioral self-regulation" reflects inhibitory, compliant behaviors such as being able to wait for something (i.e. until someone finished speaking, until it is one's turn etc.) or following the rules. This part of self-regulation is a developmentally important aspect of self-regulation in particular with regards to social interactions (e.g. Eisenberg et al. 1997; Ramani et al. 2010). The factor "emotional self-regulation" describes the regulation of affect and emotions, especially in case of negative emotions (e.g. frustration) when things do not work out as expected. The development of emotional self-regulation also has important implications for social relationships. Both cross-sectional and longitudinal studies showed significant associations between children's emotional self-regulation (e.g. self-distraction during a delay task) and their popularity with peers (Raver et al. 1999; Spinrad et al. 2006; Trentacosta/Shaw 2009). With the exception of attentional self-regulation, two-level reliability estimates showed satisfactory coefficients in the present study at both the between- and within-person level for emotional and behavioral self-regulation.

Besides empirical evidence in the present study for the three-factor model in comparison to other factor structures (i.e. single-factor or two-factor models), the conceptualization of self-regulation as a differentiated construct with three distinct processes

(i.e. cognitive/attentional, behavioral, emotional) is also in accordance with findings from previous research. On the one hand, there is evidence for discriminant validity of multifaceted self-regulation in children. That is, different facets of self-regulatory processes uniquely predict different outcome variables, such as cognitive self-regulation being a dominant predictor above behavioral and emotional self-regulation in predicting false belief (Jahromi/Stifter 2008), or behavioral self-regulation mediating the association between emotional self-regulation and academic achievement (Howse et al. 2003), thus supporting the assumption that self-regulation consists of different interrelated processes. On the other hand, some of the previous factor-analytic studies investigating the latent factor structure of preschoolers' self-regulation (at a between-person level) also received best model fit for a model with three factors similar in content to the factors identified in the present study (Denham et al. 2012; Raffaelli et al. 2005). However, it has to be noted that within the study of Raffaelli and colleagues (2005), a single-factor model was yet accepted because of very high correlations among the three identified latent factors. In the present study, the inter-factor correlation between behavioral and cognitive self-regulation was quite high at the between-person level as well (r = .87). This seems to support previous studies postulating a two-factor model of self-regulation such as the segmentation of self-regulation into a "hot" (i.e. emotional) versus "cool" (i.e. cognitive-behavioral) self-regulation factor (Willoughby et al. 2011). However, previous research is only based on data at the between-person level. By disaggregating the within- and between-person level, the present study shows that a more differentiated factor structure is true for both levels while controlling for the respective data level. At the within-person level, the inter-factor correlations are much smaller compared to the between-person level, ranging from .49 to .65 in the present study. The inter-factor correlations at the between-person level range from .43 to .87, but are smaller compared to the study by Raffaelli and colleagues (2005) who also measured preschoolers' self-regulation by parent-report and obtained inter-factor correlations ranging from .74 to .95 at the between-person level. The possibility of a two-factor structure at the between-person level was empirically tested in the present study: a difference test revealed a significant better model fit of the model with three distinct factors at the within- and between-person level compared to the model with three factors at the within- but two factors at the between-person level. However, the inter-factor correlations between behavioral and attentional self-regulation were clearly greater than the respective correlations with emotional self-regulation at the between-person level, indicating that the "cool" processes of cognitive and behavioral self-regulation are more strongly related with one another than each is with the "hot" process of emotional self-regulation (cf. Bridgett et al. 2015).

In sum, the present study contributes to the understanding of self-regulation as a diverse construct whose regulatory processes (i.e. emotional, attentional, behavioral) are related but distinct. However, more research is needed to support this initial finding and provide further insights into the factor structure, for instance by investigating discriminant predictive validity of the three factors (e.g. academic and social relationship outcomes, see above).

4.3 Limitations and Future Directions

Some limitations of the present research must be acknowledged: First, daily self-regulation was assessed by parent-report (particularly mothers) rather than by self-report. Within clinical research, several studies only show limited convergence between child- and parent-reported symptoms (Achenbach et al. 1987; De Los Reyes/Kazdin 2005). However, in research with children under the age of six, parent-reports are nonetheless the method of choice, since applying self-reports is difficult within this young age group as the children have difficulties in representing complex internal experiences (Luby et al. 2007). Moreover, the problem of convergence between child and parent reports seems to be of more concern in the case of internal processes such as the investigation of children's depressive or anxious symptoms (De Los Reyes/Kazdin 2005). Although self-regulation means the self-monitored regulation of different emotional, behavioral, and attentional – and thus internal – processes, the outcome of these regulatory processes (i.e. successful or non-successful self-regulation) is visible for external observers, such as showing *no* frustration reaction when things did not work out as well as expected or being able to complete a game or keep on task. Therefore, we assume the measurement of preschool children's self-regulation by an external person as adequate. However, one could further argue whether the measurement by parent's report or rather by preschool teacher's report is more appropriate. Since the children spend a large part of their waking hours in the preschool, the preschool teacher might see more situations demanding self-regulation, especially in socially interactive situations. However, during the day, one preschool teacher has to supervise multiple children; thus, focusing on one child in order to adequately rate its self-regulation throughout the day is quite difficult in practice. Moreover, the data of the present study also included weekend days where there would be missing data in the case of preschool teacher-reports. We therefore chose parents' reports to measure preschoolers' daily self-regulation. Nevertheless, for future research it would be interesting to combine preschool teachers' reports and parents' reports to get further insights into children's self-regulation in different contexts. In addition, the present study only investigated children's intra-individual self-regulation on a daily basis. Dirk and Schmiedek (2016) already showed that children's working memory performance varies not only from day to day, but also from occasion to occasion (i.e. morning, noon, afternoon). Thus, a study design with multiple measurement bursts throughout the day is recommended to further investigate preschoolers' intra-individual self-regulation within shorter time intervals.

Second, the sample is limited in representativity, as the sample was self-selected with a middle-to-high socio-economic background. The elaborate review by Bridgett and colleagues (2015) underlines the key role that parental influence factors play for children's self-regulation. Parental (mostly maternal) and children's self-regulatory abilities are usually correlated in part because of intergenerational transmission processes such as parenting behavior (e.g. caregiving), inter-parent relations (e.g. marital conflict), and rearing context (e.g. socio-economic background) (Bridgett et al. 2015). Concerning the ceiling effects in the present study partially represented in the relatively high item means of the aggregated self-regulation scores, a more heterogeneous sample might enhance individual differences in self-regulation thus enhancing between-person variance. To what extent this might affect within-person variance is as

yet unclear. Although the children scored relatively high on the self-regulation items on average, there was still substantial variation within and between individuals. Hence, future research is needed including more diverse samples regarding family background and using longitudinal study designs to disaggregate within- and between-person level effects.

Third, it should be noted that while the $SRMR_{within}$ met Schermelleh-Engel and colleagues' (2003) criteria for good model fit, the RMSEA and CFI of the three-factor model only showed acceptable model fit according to conventional cut-off criteria (e.g. Hu/Bentler 1999; Schermelleh-Engel et al. 2003). However, it must be remarked that the use of conventional cut-off criteria such as Hu and Bentler (1999) as golden rules for evaluating model fit has been criticized (Marsh et al. 2004). Marsh and colleagues (2004) instead recommend the comparison of nested models as more adequate. In the present study, besides the comparatively better descriptive fit indices, a difference test revealed a significant smaller deviance of the three-factor model. Therefore the three-factor model was accepted. Moreover, there exist no general cut-off criteria yet for two-(or more)level model fit, and the application of current cut-off criteria for single-level models to multilevel models has to be done with caution (Hsu 2009; Wagner 2008) - simulation studies showed that global fit indices are more sensitive to the within-level than the between-level (Hsu 2009; Wagner 2008). Here, level-specific model fit evaluations revealed better model fit at the within-person level and worse model fit at the between-person level according to the $SRMR_{between}$ provided by Mplus and the partially saturated model approach by Ryu and West (2009). Future research should include more items for further exploration of the source of misfit at the between-person level and the reliability estimates of the scales (i.e. additionally calculating McDonald's omega, see Geldhof et al. 2014).

4.4 Conclusion

The present study provides evidence that preschoolers' parent-reported self-regulation skills substantially vary from day to day. Similar results have been found for related constructs in older samples. This finding emphasizes the dynamic nature of self-regulation and highlights the need for a prospective focus on intra-individual (within-person) self-regulatory processes besides common investigations at the between-person level. Here, potential antecedents and consequences of within-person variability in self-regulation should be investigated as a next step as well as variability within shorter time intervals (i.e. morning, noon, afternoon).

By disaggregating the two-level data, the study provides further insights into the factor structure at both the within- and between-person level: Best model fit was found for a three-factor model including behavioral, emotional, and attentional self-regulation. This finding further contributes to the understanding of self-regulation as a diverse construct with distinct but related processes.

5 Declaration of interests and funding

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Abstracts

Understanding early development of self-regulation and co-regulation: EDOS and PROSECO

Sabina Pauen and the EDOS group

Abstract

Keywords

Self-regulation; co-regulation

The Role of Co-Regulation for the development of social-emotional competence

Judith Silkenbeumer, Eva-Maria Schiller, Manfred Holodynski and Joscha Kärtner

Abstract

Regulating emotions volitionally requires the inhibition and modification of an elicited emotional action readiness and includes phases of reflection, planning and self-regulation. The proposed internalization model of reflective emotion regulation argues that caregivers' co-regulation of emotionally challenging events plays a constitutive role for the development of 4- to 6-year-olds' reflective emotion regulation. The model specifies the gradual shift from co- to self-regulation by focusing on two important ways how caregivers structure emotionally challenging interactions: Through emotion talk, caregivers promote the development of preschoolers' emotional awareness. Once established, they support children in establishing a repertoire of effective emotion regulation strategies and they guide preschoolers' emerging skills to generate, evaluate, and select from alternative appraisals or behavioral responses.

Keywords

emotion regulation; co-regulation; self-regulation; emotion socialization; social-emotional competence

Co- and self-regulation in the caregiver-child dyad: Parental expectations, children's compliance, and parental practices during early years

Sabrina Bechtel-Kuehne, C. Anna Strodthoff and Sabina Pauen

Abstract

Self-regulation skills develop in early childhood and seem to be highly predictive of success in different areas of adult life. The present report explores how (a) parental expectations (beliefs, goals) regarding children's self-regulation, (b) children's self-regulation and compliance, and (c) parental co-regulation practices are related to each other. To assess these aspects, a new questionnaire (IMMA: Pauen et al. 2014) has been filled out by N = 132 parents of 1- to 6-year-old children. Our data revealed that parental self-regulation expectations increased with a child's age, as did children's self-regulation and compliance, as reported by parents. However, parental co-regulative strategies did not change with the age of the child and were not correlated with parents' expectations. Nevertheless, we did find specific associations between children's self- and parental co-regulation: Parents who described their child as arguing a lot, or showing only directed compliance also reported to use negative co-regulation strategies more often than parents who experienced their child as being more compliant. Furthermore, parents who perceived their child as ignoring external requests tended to withdraw more easily in situations involving a conflict of interests than parents reporting less child ignorance. In sum, these findings suggest that parental expectations, children's self-regulation skills, and parental co-regulation strategies are related in systematic ways. Future studies using a longitudinal design should explore the causal nature of these relations in more detail.

Keywords

self-regulation; co-regulation; caregiver-child dyad; parenting

A Review of Hot Executive Functions in Preschoolers

Nancy Garon

Abstract

Executive functions (EF), a term used to refer to a large number of abilities involved in self-regulation, has become an important focus of research in early development. A distinction between cool and hot EF is often made based on whether a problem involves abstract versus motivational aspects. While research on cool EF in preschoolers is abundant, relatively little work has been done on hot EF abilities. The current paper focuses

primarily on research utilizing two hot EF tasks: the delay of gratification task (Mischel et al. 1989) and preschool variants of the Iowa Gambling task (Bechara et al. 1994). The pattern of findings clearly indicate age improvements in hot EF during the preschool period. Finally, processes involved in hot EF tasks are placed into the broader context of early EF and self-regulation and areas warranting future research are discussed.

Keywords

hot executive functions; cool executive functions; delay of gratification; Iowa Gambling task; preschool

Impact of Instructional Modality and Emotional Valence on the Reflective Emotion Regulation of Expression in Preschool Children

Helena Kromm, Vanessa Hettwer, Joscha Kärtner and Manfred Holodynski

Abstract

The current study investigates the impact of instructional modality and emotional valence on the reflective emotion regulation of expression in preschool children. Twenty-three boys and girls aged 3 to 5 years took part in a social dice game of expression where they were motivated to mask their felt emotion (joy when receiving a gift resp. disappointment when receiving no gift) with an opposed expression, presented either iconically (as a picture) or verbally (as a spoken instruction). Twelve adult naïve observers judged children's videotaped behavior according to the quality of emotion children seemed to experience. This impression analysis revealed that children masked their actually felt emotion more effectively when instructed iconically. In addition, 5-year-old children masked joy more effectively than disappointment, while no such differences were found for 3- to 4-year-old children.

Keywords

Emotion regulation; masking of expression; disappointing gift; modality of instruction; emotional valence; preschool

Self-Regulation in Preschool Children's Everyday Life: Exploring Day-to-Day Variability and the Within- and Between-Person Structure

Katja Ludwig, Amelie Haindl, Ruth Laufs and Wolfgang A. Rauch

Abstract

Objective: Self-regulation - the ability to regulate one's own behavior, emotions, and cognition - is fundamental for achieving personal goals and successful socio-emotional

adaptation. Individual differences in self-regulation and associations with correlates important in early childhood (e.g. school readiness) are well studied at a between-person level. This is the first study investigating intra-individual variation in self-regulation in the everyday life of a sample of preschool children using an intensive longitudinal design. Moreover, the study explores the dimensionality of self-regulation at both the between- and within-person level. Method: Over a period of seven consecutive days including weekend days, 106 parents (84.3% mothers) rated their preschool children's self-regulation every evening either by an online questionnaire or via a phone interview. Results: Preschoolers' self-regulation varied substantially within per-sons over the measurement period as indicated by intra-individual standard deviations and intraclass correlation coefficients. Multilevel confirmatory factor analyses re-vealed best model fit for a model with three correlated but empirically distinct factors at both the within- and between-person level that can be labeled as "emotional self-regulation", "behavioral self-regulation", and "attentional self-regulation". Conclusion: The study is the first demonstrating that self-regulation varies within, and not only between, individuals from day to day in a sample of healthy preschool children. Preschoolers' self-regulation can be described by three related but distinct factors at the within- and between-person level, supporting the conceptualization of self-regulation as a construct with multiple interrelated but separable facets.

Keywords

self-regulation; daily; preschool; intensive longitudinal design; within-person

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