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### Peers for better or for worse?

*Understanding susceptibility to peer influence in adolescents with mild-to-borderline intellectual disability*

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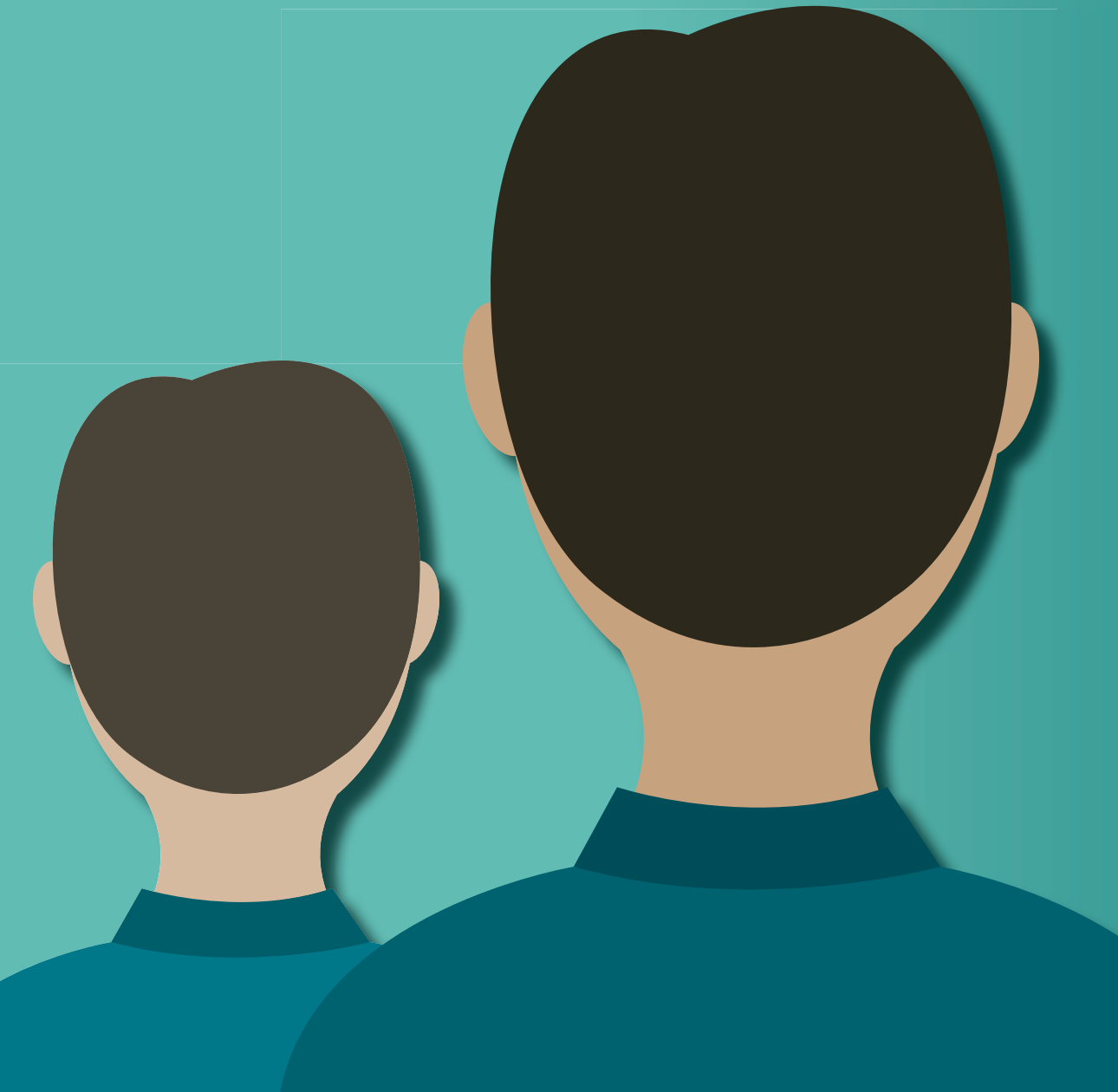
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# Chapter 7

## Development and socialization of self-regulation from infancy to adolescence: A meta-review differentiating between self- regulatory capacities, goals, and motivation

### **This chapter is based on a previous version of the publication**

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## Abstract

Self-regulation has been intensely studied across developmental science disciplines in virtue of its significance to understanding and fostering adaptive functioning throughout life. While research has predominantly focused on self-regulatory capacities, age-related changes in goals and motivation that underlie self-regulation have been largely neglected. In a systematic meta-review, we disentangle the development of self-regulatory capacities from age-related goals and motivation between infancy and adolescence. We further investigate the roles of parents, teachers, and peers in the socialization of self-regulatory capacities separately from the socialization of goals and motivation. We searched reviews and meta-analyses on self-regulation in typical development (0-18 years), identifying 1,935 records, from which 140 articles were included. Results show that self-regulation develops from being largely co-regulated in infancy to an independent yet socially calibrated process in adolescence. We further demonstrate continuity as well as age-related transitions in the capacities, goals, and motivation employed for self-regulation, and pinpoint the exact role of various social agents involved in these processes. Our meta-review yields a detailed description of self-regulation development between infancy and adolescence, providing a starting point for future developmental and intervention work regarding key processes and social agents to be considered when targeting self-regulation in a particular age group.

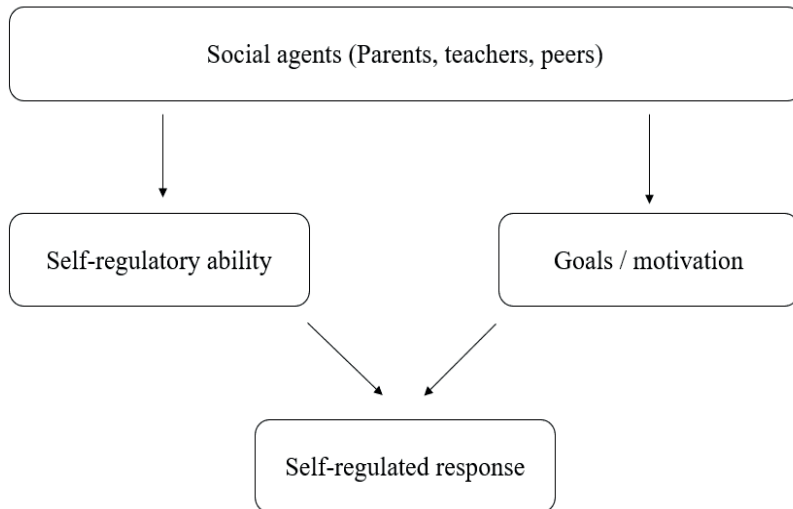
**Keywords:** Self-regulation; Goals; Motivation; Development; Socialization; Meta-Review

## Introduction

*At primary school, Sophie was known as a smart kid who obtained high grades—she was considered to be good at self-regulation. In middle school, however, her grades dropped. What caused this change? It is not likely that her self-regulatory capacities decreased, but rather increased because her parents and teachers taught her strategies to self-regulate more effectively by planning ahead and counting to ten if she felt agitated. However, her goals changed, from performing well at school to performing well in Minecraft, a goal she adopted from her peers. Her motivation to pursue this goal was continuously reinforced by excelling at the game and receiving positive feedback from peers. Thus, her self-regulatory capacities were used in gaming instead of schoolwork, and her grades dropped.*

Traditionally, developmental research has focused on the capacities that underlie self-regulation, such as executive functions and reappraisal (e.g., Diamond, 2013; Garon et al., 2008, 2014; Gestsdottir & Lerner, 2008). In Sophie's case, her capacities are sufficient to obtain high grades, and albeit rather simplistic – the example makes clear that more factors determine the extent to which these capacities are used in the service of self-regulation. Instead of learning for school, Sophie prioritizes gaming, demonstrating that her personal goals and motivation influence whether and how she will use her capacities to self-regulate in different contexts (e.g., Gestsdottir & Lerner, 2008; Murray et al., 2019). Sophie's goals, in turn, are geared towards gaining positive feedback from peers (rather than from parents and teachers), highlighting the important role of social agents in affecting self-regulation (e.g., Carlson, 2009; Johansson et al., 2015; Kidd et al., 2013; King et al., 2017; Pino-Pasternak & Whitebread, 2010; Yu & Smith, 2016).

While research has focused on the role of social agents in influencing self-regulation development in general, socialization processes involved in developing self-regulatory capacities have not been systematically differentiated from those on goals and motivation. The current meta-review integrates these perspectives into a framework in which self-regulation can be viewed as a developmental process along two pathways: 1) via the *capacity pathway* through which social agents influence improvements in the cognitive and emotional skills children employ to self-regulate, and 2) via the *goals and motivation pathway* through which social agents are involved in shaping the motivation for enacting self-regulation (see Figure 1).



**Figure 1. Conceptual framework of socialization pathways of self-regulation studied in this meta-review**

Note: proximal social agents influence self-regulation development via two pathways: 1) via self-regulatory capacities, and 2) via goals and motivation.

Self-regulation is not only relevant for academic achievement (Dent & Koenka, 2016), as shown in the example of Sophie. A large body of research demonstrates that individual differences in self-regulation predict social skills, risky behaviors (e.g., substance use and criminal behavior), physical health, internalizing and externalizing problems, and unemployment (Allan et al., 2014; Blair & Raver, 2015; Eisenberg, Valiente, et al., 2010; Hails et al., 2019; Moffitt et al., 2011; Robson et al., 2020). Given the large number of review work highlighting the relevance of self-regulation for well-being over the entire lifespan, a *meta-review* (also known as a *review of reviews*: Cooper & Koenka, 2012) appears necessary and timely to provide a broader but condensed picture of the factors involved in self-regulation development. Such a detailed description is essential to inform future research and intervention practices regarding key processes and social agents to be considered when targeting self-regulation in a particular age group. Therefore, the current meta-review summarizes existing knowledge on the development and socialization of self-regulatory capacities, goals, and motivation from infancy to adolescence (0–18 years). In the following, we provide the conceptual definitions of the studied constructs.

## Constructs studied in the current meta-review

### *What is self-regulation?*

Broadly, self-regulation can be defined as “the ability to flexibly activate, monitor, inhibit, persevere and/or adapt one’s behavior, attention, emotions and cognitive strategies in response to direction from internal cues, environmental stimuli and feedback from others, in an attempt to attain personally-relevant goals” (Moilanen, 2007, p 835; for similar definitions, see for example Blair, 2016; Nigg, 2017; Petersen et al., 2016;

Pintrich, 1999; Posner & Rothbart, 2000; Zhou et al., 2012). Various constructs have been studied under the umbrella term “self-regulation”, with substantial terminological variations emerging from different research traditions (Merritt et al., 2022; Nigg, 2017). While many definitions operationalize self-regulation as cognitive capacities such as executive functions (Merritt et al., 2022; Zhou et al., 2012), here we emphasize the role of self-regulatory capacities, goals, and motivation in order to study self-regulation as a multi-faceted developmental process.

### **What are self-regulatory capacities?**

We define self-regulatory capacities as the subset of cognitive and emotional-affective processes that children employ in order to exercise *deliberate, effortful* control over their own behaviors, emotions, and cognitions (Hendry et al., 2016; Johansson et al., 2015). Self-regulatory capacities are functionally specialized processes such as response inhibition, meta-cognition, and reappraisal, among others. Table 1 provides a glossary with an extensive overview of the capacities (marked by \*) studied in relation to the construct of self-regulation. Although self-regulation involves the recursive interaction between top-down/deliberate and bottom-up/automatic processes (Blair & Raver, 2015; Botvinick & Cohen, 2014; Bridgett et al., 2015; Gross, 2015; Nigg, 2017; Wagner et al., 2021), we specifically focus on the top-down/deliberate aspects of self-regulation because these are the primary processes that enable individuals to engage with the environment in adaptive ways (Nigg, 2017; Tomlin & Axelrod, 2005). As earlier research has shown that different sets of self-regulatory capacities may become activated depending on the affective value of the context (Carlson, 2005; Zelazo et al., 2010; Zelazo & Carlson, 2012; Zelazo & Müller, 2002), we describe the development of capacities employed for the regulation of behavior in affectively more neutral contexts (e.g., planning) separately from the development of capacities for the regulation of emotion (Bridgett et al., 2015; Murray et al., 2019; Nigg, 2017; Zelazo & Carlson, 2012). Age-related changes in self-regulatory capacities are further examined in relation to socialization processes.

### **What are goals and motivation?**

Goals are defined as the ‘outcome’ someone is striving for (e.g., internal or external states and events; Elliot & Fryer, 2008). Self-regulation is often aimed at pursuing a personally relevant goal or at reducing discrepancies between the current and the desired situation. When conflicting goals are encountered, self-regulation serves to select an appropriate course of action in order to prioritize and achieve the more personally relevant and rewarding outcome (Shenhav et al., 2013). Specifically, self-regulation can be achieved by taking reasoned and reflective actions while overcoming habitual responses (Mischel et al., 2006). Because of changing priorities, different types of goals are pursued across different developmental stages (Hennecke & Freund, 2017). Hence, this meta-review focuses on how age-specific goals influence self-regulation, and how social agents influence goal setting and goal-pursuit.

Motivation relates to someone's 'drive' to obtain a certain outcome (Eccles & Wigfield, 2002; Woolfolk, 2016), which can be defined as an internal state that arouses, directs, and maintains behavior toward a certain goal (Woolfolk, 2016). Self-determination theory (Ryan & Deci, 2000) proposes that different types of motivation can be distinguished based on the degree to which the individual's goals originate from extrinsic, social influences versus intrinsic sources. Extrinsic motivation can be driven by compliance, rewards, and punishment (external), by avoiding guilt or shame, or by enhancing one's self-worth (introjected), by the utility of that behavior for personally valued goals (identified), or by the perception that the behavior is consistent with endorsed values and aspects of the self (integrated). In contrast, intrinsic motivation refers to the engagement with an activity for the inherent satisfaction derived from the activity itself or the congruence with one's current needs for competence, relatedness, and autonomy (Ryan & Deci, 2000). Motivation is further influenced by self-efficacy beliefs—the individual's beliefs and knowledge about their competence and efficacy, expectancies for success or failure, and the sense of control over outcomes (e.g., Bandura, 1997; Crandall et al., 1965; Eccles & Wigfield, 2002). In this meta-review, we discuss age-related changes in the motivation to self-regulate, and the influence of different social agents on motivation.

### ***What is the role of proximal social agents in influencing self-regulatory capacities, goals, and motivation?***

Early theories construed self-regulation as an inherently social phenomenon, which develops through the continuous transactions with various social agents (Bandura, 1991; Cairns, 1979; Piaget, 1932; Vygotsky, 1986). An extensive literature body has established that proximal social agents such as parents not only impact the development of self-regulatory capacities, but also create opportunities and encouragement to set specific goals and build motivation to self-regulate. While social agents can shape the development of self-regulation through these pathways, no systematic distinction has been made between the socialization processes involved in the development of self-regulatory capacities and those involved in the development of goals and motivation. In this meta-review, we focus on the role of proximal social agents who interact directly with the child—parents, teachers, and peers—to disentangle the socialization processes that influence the developmental course of self-regulatory capacities from those of goals and motivation. Although distal contextual factors such as poverty, neighborhood violence, household chaos, urbanization, and cultural background have also been acknowledged as important factors in shaping self-regulation (Andrews et al., 2021; Blair & Raver, 2015; Hails et al., 2019; Li-Grining, 2012; Marsh et al., 2020; Palacios-Barrios & Hanson, 2019; Raver, 2004; Sylva, 2014; Weeland et al., 2019), these are beyond the scope of this review (see Box A for an overview).



**[BOX A] Distal contextual factors**

Although this review focuses on influences from the proximal social environment, broader contextual factors have also been implied in the development of self-regulation following (bio)-ecological frameworks (e.g., Bronfenbrenner, 1986). Distal contextual factors likely influence the child's self-regulation development by affecting the behavior of proximal social agents. For instance, normative cultural and ethnic values shape parents' socializing processes, which in turn influence children's self-regulation (LeCuyer & Zhang, 2015; Li-Grining, 2012). A similar pathway has been suggested for the effects of environmental adversities on children's self-regulation. Poverty, for instance, can undermine the quality of parental caregiving practices, which may explain its association with lower self-regulation in children (Blair & Raver, 2015; Li-Grining, 2012). Another explanation for the effects of poverty may be that the frequent experiences of adversities cause chronic stress for a family. Studies on stress physiology have demonstrated that children from disadvantaged families show dysregulated functioning of the hypothalamic-pituitary-adrenal stress-response system (Wesarg et al., 2020). In early childhood, alterations in stress hormones may in turn affect the development of brain regions that support self-regulation functioning (Merz et al., 2019). Both hypotheses may also partly explain why adversities such as experiencing interparental and neighborhood violence are associated with lower levels of children's emotional self-regulation (Raver, 2004).

***The current meta-review***

The goals of the current work were to (1) summarize existing review literature on the development of self-regulatory capacities, goals, and motivation from infancy to adolescence; and to (2) synthesize current knowledge on how the development of self-regulatory capacities, goals, and motivation is influenced by parents, teachers, and peers. In order to highlight topics that were considered central enough to be reviewed in the current heterogeneous self-regulation literature, as well as to identify underrepresented topics that warrant further research, we used a meta-review approach. To this end, we performed a systematic search of peer-reviewed reviews and meta-analyses on self-regulation in typically developing youth between 0 to 18 years of age. We mapped out the review literature according to commonly used developmental periods to study self-regulation: infancy (< 1 year), toddlerhood and preschool period (1–5 years), childhood (6–11 years), and adolescence (12–18 years).

## Methods

### Literature search

#### *Eligibility criteria and information sources*

We searched for peer-reviewed narrative, systematic and meta-analytic reviews on self-regulation and related constructs in typically developing children between 0 and 18 years of age. We used four major databases in Psychology and Educational Sciences: PsycINFO, ERIC, Web of Science, and Medline, searching all possibly eligible reviews published prior to September 2022.

#### *Search strategy*

The search strategy and syntax used in this study are available on the project's Open Science Framework [OSF] Repository. The database searches yielded a total of 3,904 records, and 1,924 records following deduplication using the citation management tool Zotero (see Table S1 for an overview of the records per database, per developmental period). We complemented our findings with specific non-systematic searches following Staaks (2022) (e.g., relevancy search in Google Scholar, from personal knowledge, bibliography of papers from our results, suggestions from peer-researchers). The number of records included per search method can be found in the PRISMA 2020 flowchart (Figure 2).

#### *Selection process*

After removing duplicates, titles and abstracts were screened by the five first authors using the systematic review web application Rayyan (Ouzzani et al., 2016). Fleiss kappa, a measure of agreement suitable for categorical outcomes that corrects for chance-level among more than two raters, was calculated on a randomly drawn subset of 65 records using the R-package "irr" (v.0.84.1, Gamer & Lemon, 2019). Decisions of inclusion and exclusion among the five raters showed near-perfect agreement ( $k = .93$ ,  $p < .001$ ). To maintain the reliability of our judgments during the screening process, a decision tree specifying the labelling system, key term synonyms, and criteria for labelling an article to be "included" or "excluded" was applied during the screening (available on OSF). Papers were excluded in a hierarchical manner, due to 1) non-English language, 2) non-target population (i.e., > 18 years of age, animals, atypical populations, etc.), 3) non-target publication type (e.g., unpublished work, dissertations), 4) non-target topic. Following full-text screening, 372 papers were retained for data extraction (see Figure 2).

#### *Data extraction*

Results were extracted according to a qualitative coding scheme available on OSF. Book chapters that were eligible for inclusion were consulted in case there were no reviews or meta-analyses available on the same topic.

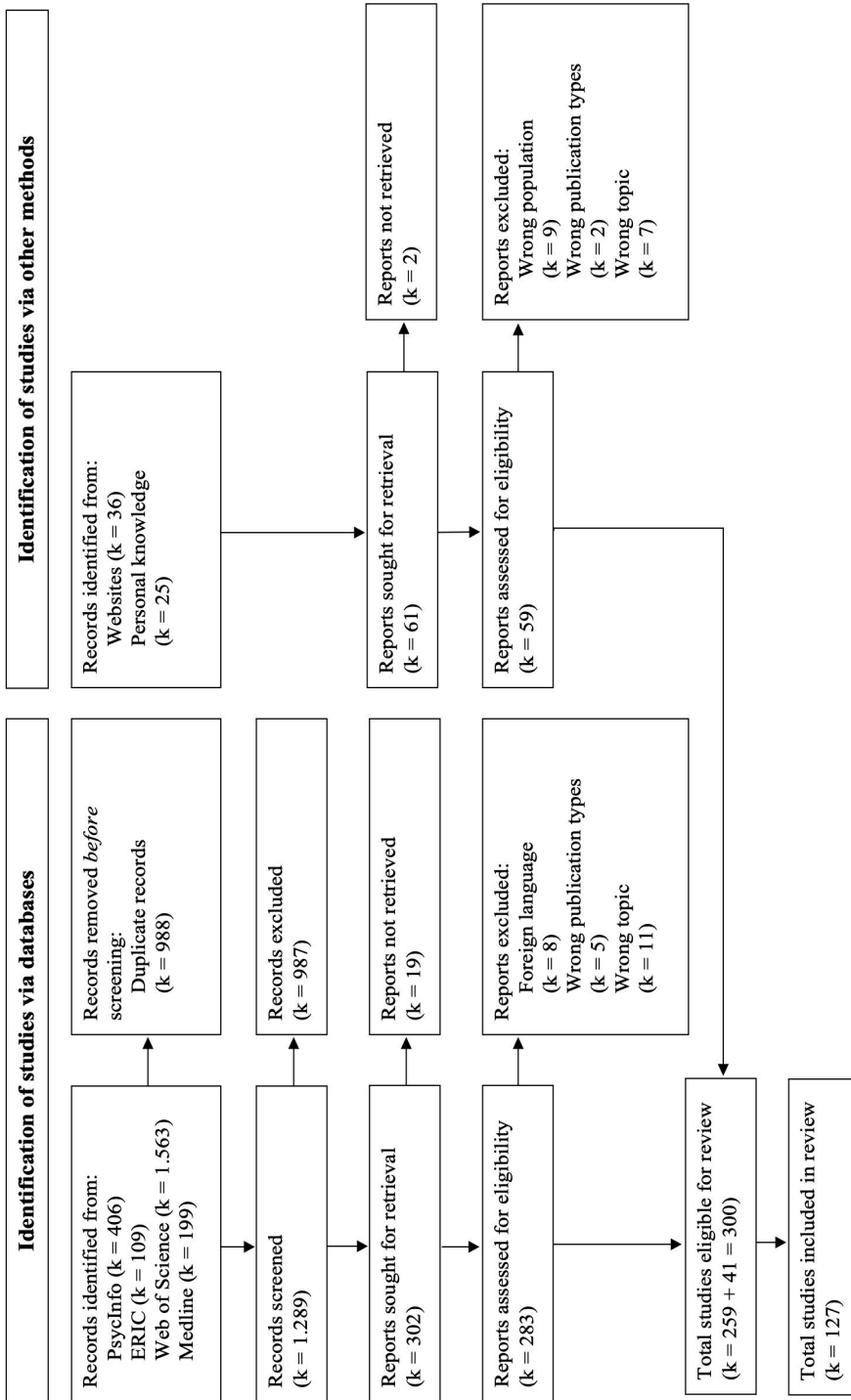
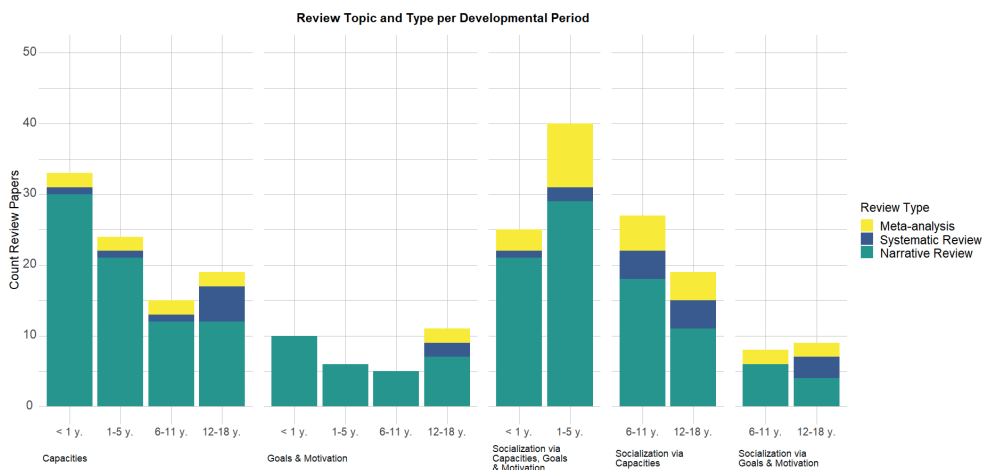


Figure 2. Systematic search of the literature: PRISMA 2020 flow-chart

### Data items

The extracted data can be found on OSF. The main outcome variables were 1) a working definition of self-regulation (and whether it was provided in the first place), 2) the aspect of self-regulation that was discussed (e.g., self-regulatory capacities, social agents), 3) the main study goals, 4) a summary of the most relevant findings, and 5) the publication type (i.e., meta-analysis, systematic review, narrative review). The publication type of the papers cited in our results section is indicated by superscript <sup>N</sup> for narrative reviews or book chapters, <sup>S</sup> for systematic reviews, and <sup>M</sup> for meta-analyses. Figure 3 and Table S2 provide an overview of the number of reviews included in the results section per publication type and developmental period. Data were further extracted on the measurement methods of self-regulation, study limitations, future recommendations, and practical implications as mentioned in the review papers, as well as those identified by our team.



**Figure 3. Review type and review topic per developmental period**

Note: our search yielded disproportionately few systematic reviews and meta-analyses relative to narrative reviews on the topic of self-regulation. Furthermore, much less review work was available on (the socialization of) goals and motivation.

### Results synthesis

The eligible papers were grouped per developmental period and ranked based on relevancy to the primary research questions. Papers were marked as relevant if they specifically addressed: 1) how capacities, or goals and motivation influence self-regulated responses, 2) how capacities, goals, or motivation are manifested in specific developmental periods, 3) the influences of social agents on capacity, goals, or motivation. Findings from the set of 'relevant' papers ( $N = 140$ ) are reported in the Results section. Because we want our results section to reflect the reviews that we identified through our search only, we did not refer to original sources in case we discussed previous theoretical work that was discussed in these reviews.

## Results

The definitions for all underlined terms throughout our results section are provided in the glossary in Table 1.

### Infancy (< 1 year)

#### *Self-regulatory capacities*

During the first year of life, the self-regulatory system is primarily concerned with the regulation of affective, arousal, and attention states (Foley, 2017<sup>N</sup>; Hendry et al., 2016<sup>N</sup>; Murray et al., 2019<sup>N</sup>; Samdan et al., 2020<sup>S</sup>). In infancy, the self-regulatory system transitions from being largely involuntary and contingent on the parents' co-regulation to becoming more effortful and endogenous (Eisenberg & Sulik, 2012<sup>N</sup>). This developmental progression is supported by marked improvements in attention control (Hendry et al., 2016<sup>N</sup>; Posner & Rothbart, 2000<sup>N</sup>), information processing speed, simple inhibition, and working memory capacity (Hendry et al., 2016<sup>N</sup>), as well as the rising ability to articulate intentions to others using non-verbal communication (Foley, 2017<sup>N</sup>; Kuvalja et al., 2013<sup>N</sup>; Prizant & Wetherby, 1990<sup>N</sup>; Santa-Cruz & Rosas, 2017<sup>N</sup>).

#### **Capacities for the regulation of behavior**

##### **Attention**

As oculomotor control and visual acuity improve rapidly over the first two to three months, young infants learn to detect and orient to novel stimuli that appear in their immediate environment, often triggered exogenously by certain physical characteristics of the stimulus such as color contrast or dynamic motion (Feldman, 2004<sup>N</sup>; Hunnius, 2007<sup>N</sup>; Petersen & Posner, 2012<sup>N</sup>). The first instances of endogenous attention manifest around 3 to 4 months of age when infants begin shifting their focus between competing spatial locations, a development that has been primarily attributed to maturation in the cortical and subcortical visual systems and the orienting attention network (Hendry et al., 2016<sup>N</sup>, 2019<sup>N</sup>; Hunnius, 2007<sup>N</sup>; Petersen & Posner, 2012<sup>N</sup>; Posner & Rothbart, 2000<sup>N</sup>; Rothbart & Posner, 1985<sup>N</sup>; Rothbart et al., 2011<sup>N</sup>). This allows infants to exercise a degree of selectivity upon the inputs that get forwarded for further processing—a skill that remains key for thriving in an environment in which multiple locations are competing for attentional engagement. Improvements in the speed of attention shifts continue even into adulthood but the steepest improvements are observed in infancy between 1 and 6 months of age (Hendry et al., 2016<sup>N</sup>; Petersen & Posner, 2012<sup>N</sup>).

The development of sustained attention towards the end of the first year reflects the integration of multiple cognitive control systems, in particular the control that the early executive system begins to exert over the alerting system (Hendry et al., 2019<sup>N</sup>; Posner et al., 2016<sup>N</sup>). Although even young infants are able to achieve a steady state of alertness (Blair & Raver, 2015<sup>N</sup>), maintaining alertness through effort only becomes possible after the age of 8 to 9 months when infants begin to maintain voluntary visual engagement for the sake of information processing while suppressing input from distracting events

(Eisenberg, Spinrad, & Eggum, 2010<sup>N</sup>; Eisenberg & Sulik, 2012<sup>N</sup>; Hendry et al., 2016<sup>N</sup>; Posner & Rothbart, 2000<sup>N</sup>; Santa-Cruz & Rosas, 2017<sup>N</sup>). Importantly, between-person variation in sustained attention towards the end of the first year has been found predictive of concurrent and toddlerhood impulse control and cognitive flexibility (Posner & Rothbart, 2000<sup>N</sup>; Santa-Cruz & Rosas, 2017<sup>N</sup>). However, results are mixed regarding the stability of individual differences in sustained attention and whether the predictive relationship holds across cognitive flexibility measures (Hendry et al., 2016<sup>N</sup>).

### ***Rudimentary executive functions***

Substantial increments in information processing speed are reported between 2 and 6 months of age (Colombo & Mitchell, 2009<sup>N</sup>); moreover, working memory capacities emerge between 5 and 8 months of age (Hendry et al., 2016<sup>N</sup>; Levin & Hantén, 2005<sup>N</sup>; Santa-Cruz & Rosas, 2017<sup>N</sup>). Individual differences in information processing speed at 7 and 12 months of age were found to predict working memory and set-shifting performance at the age of 11 years (Hendry et al., 2016<sup>N</sup>), which is consistent with the relation between encoding speed as the major rate-limiting factor of working memory capacity observed across other age groups (Colombo & Mitchell, 2009<sup>N</sup>; Hendry et al., 2016<sup>N</sup>). Early forms of simple inhibition also begin to manifest as infants become capable of controlling their looking responses towards spatially competing stimuli (Posner & Rothbart, 2000<sup>N</sup>; Rothbart et al., 2007<sup>N</sup>).

### ***Non-verbal communication skills***

Two aspects of the developing language and communication skills support developmental improvements in self-regulation—the intentional pre-verbal communication with other social agents and the rise of self-directed language (Foley, 2017<sup>N</sup>; Kvalja et al., 2013<sup>N</sup>; Prizant & Wetherby, 1990<sup>N</sup>; Santa-Cruz & Rosas, 2017<sup>N</sup>; Thompson, 1991<sup>N</sup>). Between 8 and 10 months, infants become able to articulate intentions to others using non-verbal communication such as gestures and vocalizations for giving, showing, and pointing to objects (Bates, 1987<sup>N</sup>). These skills occur during periods of joint attention with the parent that become more frequent around the same age (Carpenter et al., 1998<sup>N</sup>; Colonesi et al., 2010<sup>M</sup>). In doing so, infants begin to deliberately regulate the behavior of others around them (e.g., by maintaining the parent's attention towards an object; Bretherton & Bates, 1979<sup>N</sup>; Colonesi et al., 2010<sup>M</sup>) and soon after, infants start using ostensive gestures to regulate their own behavior. Self-directed pointing gestures observed among 11- to 15-month-olds' are specifically used for problem-solving in the absence of another communicative party (Kvalja et al., 2013<sup>N</sup>). Furthermore, ostensive gestures between the ages of 8 and 24 months were found to aid attention maintenance and prospective planning towards object manipulation (Prizant & Wetherby, 1990<sup>N</sup>). Self-prohibition is another relevant phenomenon observed in preverbal infants who vocalize or gesture negation via head shakes upon engagement with a previously forbidden object or activity, which is thought of as a product of internalizing co-regulation (Prizant & Wetherby, 1990<sup>N</sup>). These observations are consistent with the idea of language as a precursor to the development of (rudimentary) executive functioning (Zelazo & Frye, 1998<sup>N</sup>; Zelazo et al., 2003<sup>N</sup>) in that (pre-)linguistic skills are thought to aid the formation of a mental goal representation of the problem or conflict to be solved (Kvalja et al., 2013<sup>N</sup>).

### Capacities for the regulation of emotion

Developing control over the orienting attention network is instrumental not only in enabling infants to steer their own learning processes but also for modulating levels of arousal and affect and for managing the natural flow of communication with the parent (Eisenberg & Sulik, 2012<sup>N</sup>; Foley, 2017<sup>N</sup>; Henderson & Wachs, 2007<sup>N</sup>; Strayhorn, 2002<sup>N</sup>). From around 4- to 5-months of age, spatial orienting begins to serve as a general behavioral strategy for multiple self-control goals, such as modulating distress levels, preventing overstimulation, and improving soothability (i.e., emotion and arousal regulation; Eisenberg, Spinrad, & Eggum, 2010<sup>N</sup>; Gennis et al., 2022<sup>M</sup>; Henderson & Wachs, 2007<sup>N</sup>; Petersen & Posner, 2012<sup>N</sup>; Raver, 2004<sup>N</sup>; Rothbart et al., 2011<sup>N</sup>; Samdan et al., 2020<sup>S</sup>; Strayhorn, 2002<sup>N</sup>). Tactile self-stimulation is another early-life strategy used to temper negative arousal (Foley, 2017<sup>N</sup>; Gennis et al., 2022<sup>M</sup>; Henderson & Wachs, 2007<sup>N</sup>; Samdan et al., 2020<sup>S</sup>; Thompson, 1991<sup>N</sup>). Similar to spatial orienting, tactile self-stimulation only provides a temporary buffer to reduce negative affect rather than resolving it via the active manipulation of the environment (Henderson & Wachs, 2007<sup>N</sup>; Taipale, 2016<sup>N</sup>). At about 8 months of age, infants become able to perform simple response inhibition tasks with minimal working memory demands, such as withholding approach under conditions of heightened reward/punishment and per request of the parent (Hendry et al., 2016<sup>N</sup>). Early forms of simple inhibition also manifest via fear responses towards novel objects and persons that become more frequent in the second half of the first year and show considerable stability through childhood up to late adolescence (Posner & Rothbart, 2000<sup>N</sup>; Rothbart et al., 2007<sup>N</sup>).

### Goals and motivation

Infants' action goals can be defined with reference to the self as well as to other social agents (Trevarthen & Aitken, 2001<sup>N</sup>). In terms of goal contents, infants have been documented to systematically pursue physiological and emotional regulation—maintaining physiological homeostasis, establishing a feeling of security, experiencing positive emotions and controlling negative emotions (Tronick, 1989<sup>N</sup>). At the same time, infants seek engagement with the social and physical world – interacting with others, maintaining proximity to parents, engaging in positive reciprocal interactions, and exploring objects (Prizant & Wetherby, 1990<sup>N</sup>). In terms of what motivates infants to exert voluntary control during the first year of life, infants demonstrate that they are independent learners who, motivated by their own curiosity, are intrinsically drawn to explore novelty around them (Bazhydai & Westermann, 2020<sup>N</sup>; Marvin et al., 2020<sup>N</sup>; Oudeyer et al., 2016<sup>N</sup>; Smith et al., 2018<sup>N</sup>). Approach and avoidance tendencies are also strongly mediated by hedonic factors (i.e., avoiding punishment, approaching reward) and by the tendency to avoid sensory overstimulation (Henderson et al., 2015<sup>N</sup>; Lipsitt, 1990<sup>N</sup>; Trevarthen & Aitken, 2001<sup>N</sup>). In fact, the neural systems for pain perception and cognitive control are closely aligned, allowing the mediation of learning in response to aversive events by pain receptor mechanisms (Tucker et al., 2005<sup>N</sup>). Viscerally significant motives such as the experience of (emotional) pain and longing can also motivate early-life social behaviors. Specifically, opiate release during periods of affection and frustration can guide the development of coping strategies in response to unrewarding experiences that are part of adaptive social functioning (Tucker et al., 2005<sup>N</sup>). Noteworthy is that in our search results, there were

no publications reviewing the developmental progression of goals and motivation during the first year of life.

### ***Socialization of self-regulatory capacities, goals, and motivation***

The impact of socialization processes on the development of infants' self-regulatory capacities, goals, and motivation was not clearly differentiated in the review literature; hence, we report on these findings together.

#### **Parents**

The development of self-regulatory capacities such as executive functioning depends heavily on early social experiences, such as the parents' co-regulation and provision of sensitive, contingent care and stable routines (Blair & Raver, 2015<sup>N</sup>; Eisenberg, Spinrad, & Eggum, 2010<sup>N</sup>; Foley, 2017<sup>N</sup>; Miller et al., 2020<sup>N</sup>; Raver & Blair, 2016<sup>N</sup>; Samdan et al., 2020<sup>S</sup>). Parents use various co-regulation strategies to assist infants with regulating their emotions, for instance, by directly modulating their exposure to stimulating events (Thompson, 1991<sup>N</sup>). Similarly, processes such as selective reinforcement of positive emotional experiences and the attenuation of negativity, modeling emotional behavior, and social referencing (i.e., when the infant seeks information from the parent's social cues to resolve ambiguity) all serve for managing the circumstances under which heightened emotional arousal states are likely to be experienced (Thompson, 1991<sup>N</sup>). Infants' distress, frustration, and fear are further co-regulated through soothing and distraction techniques (Eisenberg & Sulik, 2012<sup>N</sup>; Foley, 2017<sup>N</sup>; Henderson & Wachs, 2007<sup>N</sup>; Posner & Rothbart, 2000<sup>N</sup>; Thompson, 1991<sup>N</sup>). Through the parents' mirroring of facial expressions (i.e., affective attunement), on the other hand, infants gradually learn to track, identify, and articulate their own emotional states, which is an integral part of emotion regulation (Murray et al., 2019<sup>N</sup>; Taipale, 2016<sup>N</sup>; Thompson, 1991<sup>N</sup>). Practicing the synchronous timing with which infants and parents exchange reciprocal communicative signals during early social interactions is another important facilitator for developing communicative skills and emotion regulation (Masek et al., 2021<sup>N</sup>; MacPhee et al., 2015<sup>N</sup>), whereas dysregulated interactions contribute to adjustment problems and externalizing behaviors (MacPhee et al., 2015<sup>N</sup>).

Other behavioral mechanisms through which parents co-regulate the infant's behavioral and emotional responses are parental sensitivity and responsiveness, each found to be concurrently (Eisenberg, Spinrad, & Eggum, 2010<sup>N</sup>; Foley, 2017<sup>N</sup>; Samdan et al., 2020<sup>S</sup>) and longitudinally predictive of toddlerhood self-regulation skills, especially in infants with heightened reactivity to environmental inputs (Samdan et al., 2020<sup>S</sup>). The earliest positive effects of parental sensitivity on infant regulation of temperament, sleep, and sleep were observed already from birth on, whereas after 4 months of age parental sensitivity was related to infant regulation of attention and mood (Samdan et al., 2020<sup>S</sup>). Through positive parenting techniques such as scaffolding (i.e., the provision of supporting strategies through instruction and demonstration; Vygotsky, 1962), including autonomy support, and mind-mindedness (i.e., the capacity to treat the child as an agent with independent thoughts and feelings ; Aldrich et al., 2021<sup>M</sup>; Meins,



2013<sup>N</sup>), and in the context of secure attachment (Van IJzendoorn et al., 1995<sup>M</sup>), parents provide infants with the vocabulary to verbally mediate their own behavior, thereby also fostering the development of executive functioning (Aldrich et al., 2021<sup>M</sup>; L. A. Carlson, 2003<sup>N</sup>; MacPhee et al., 2015<sup>N</sup>). Furthermore, an early-life linguistic focus on verbs rather than objects has been related to an earlier onset of inhibitory and self-control processes (LeCuyer & Zhang, 2015<sup>N</sup>).

Affective maternal touch and proximity have been shown to foster the development of emotional and behavioral regulation, reciprocity during social interaction, and the formation of a secure attachment bond (Farroni et al., 2022<sup>N</sup>; Feldman, 2004<sup>N</sup>; Weller & Feldman, 2003<sup>N</sup>). The development of stable cognitive representations of attachment relationships around 9 to 10 months enables infants to use social support for regulating distress (Chen et al., 2017<sup>N</sup>) and secure attachment provides a safe context for exploration or dealing with frustration (Foley, 2017<sup>N</sup>). However, longitudinal relationships between attachment and self-regulatory outcomes such as executive functioning do not manifest robustly until toddlerhood (Pallini et al., 2018<sup>M</sup>), though this result may be partially accounted for by the methods used to measure self-regulation and attachment before the age of 3 years.

### Teachers

Interactions with other caretakers during the first year of life did not emerge as a theme in our search results, which was surprising given that infants begin attending day care as early as 3 months of age in some countries.

### Peers

Only one review focused on the socialization of self-regulation capacities, goals, and motivation via peers, nevertheless demonstrating the importance of peers already in the first year of life. Infants between 3 and 6 months of age were shown to be sensitive to distress signals from peers, responding with behavioral strategies such as tactile self-stimulation and attentional spatial orienting to regulate their own emotional distress (Pahigiannis & Glos, 2020<sup>N</sup>). Additionally, the production of gestures and shared engagement with toys during peer interactions was shown to be influenced by peer responses from previous social interactions (Pahigiannis & Glos, 2020<sup>N</sup>).

## Toddlerhood and preschool (1-5 years)

### *Self-regulatory capacities*

#### **Capacities for the regulation of behavior**

In the toddler and preschool years, a rapid development from simple to more complex self-regulation capacities occurs, enabling improvements in behavior regulation (Calkins, 2007<sup>N</sup>; Eisenberg & Sulik, 2012<sup>N</sup>; Kopp, 1982<sup>N</sup>). For instance, toddlers become able to deploy their attention more voluntarily from the second year of life on, allowing the processing of additional sources of information (Eisenberg & Sulik, 2012<sup>N</sup>; Murray et al., 2019<sup>N</sup>; Rothbart et al., 2007<sup>N</sup>; Ziv et al., 2017<sup>N</sup>). Toddlers further begin to

demonstrate compliance in response to external (e.g., parental) directives, a prototypic form of early self-regulation (Kopp, 1982<sup>N</sup>).

Marked age-related improvements in inhibitory control occur from age 3 to 6, as reflected in preschoolers' increasing ability to withhold or suppress a prepotent but no longer relevant response or stopping a response in progress (Levin & Hanten, 2005<sup>N</sup>; Miller et al., 2020<sup>N</sup>; Petersen et al., 2016<sup>M</sup>; Roebbers, 2017<sup>N</sup>; Rothbart, 2007<sup>N</sup>; Ziv et al., 2017<sup>N</sup>). For instance, whereas only half of the 3-year-olds in the "bear/dragon" test (Reed et al., 1984) manage to follow directions from the bear puppet while ignoring commands from the dragon puppet, 5-year-olds easily succeed in this task (Ziv et al., 2017<sup>N</sup>). Relatedly, toddlers and preschoolers become increasingly better at inhibitory control in motivationally salient situations (Kochanska & Aksan, 2006<sup>N</sup>; Posner & Rothbart, 2000<sup>N</sup>; Ziv et al., 2017<sup>N</sup>). For instance, the length of time children can wait for a treat increases between 2 and 4 years of age, reflecting improvements in the ability to delay gratification (Eisenberg & Sulik, 2012<sup>N</sup>).

From about age 4, preschoolers' working memory improves as they start using simple tactics for remembering, such as verbally naming an item for rehearsal (Levin & Hanten, 2005<sup>N</sup>; Ziv et al., 2017<sup>N</sup>). Preschoolers also develop cognitive flexibility: they begin to use rules more flexibly by changing and shifting between rules based on their understanding of environmental demands (Ziv et al., 2017<sup>N</sup>). Preschoolers further manage simple planning tasks (De Corte, 2019<sup>N</sup>; Levin & Hanten, 2005<sup>N</sup>), whereby they make use of meta-cognitive abilities such as private speech or self-directed language to guide their behavior (Anastopoulos & Krehbiel, 1985<sup>N</sup>; Foley, 2017<sup>N</sup>; Gholami et al., 2016<sup>N</sup>; Kvalja et al., 2013<sup>N</sup>; Levin & Hanten, 2005<sup>N</sup>; Roebbers, 2017<sup>N</sup>; Ziv et al., 2017<sup>N</sup>).

### **Capacities for the regulation of emotion**

Similar to infants, toddlers engage in simple strategies including reorienting attention in order to regulate distress (Eisenberg, Spinrad, & Eggum, 2010<sup>N</sup>; Gennis et al., 2022<sup>M</sup>). Their ability to use simple language enables them to talk themselves through emotionally challenging situations or request help for regulation from a close person (Garner, 2010<sup>5</sup>; Higgins, 2016<sup>N</sup>; Zeman et al., 2006<sup>N</sup>). From the age of 3 to 4, preschoolers start to understand their own basic emotions and those of others (Housman, 2017<sup>N</sup>; Rothbart et al., 2007<sup>N</sup>; Ziv et al., 2017<sup>N</sup>). They can rely on an increasingly large repertoire of behavioral strategies to manage their emotions, for instance by playing with a favourite toy as a self-calming strategy, or by covering their eyes to regulate sensory intake (Housman, 2017<sup>N</sup>; Thompson, 1991<sup>N</sup>; Zeman et al., 2006<sup>N</sup>). Preschoolers can further implement carefully planned strategies such as actively resisting negative overtures from a peer to prevent the occurrence of negative emotion (Garner, 2010<sup>5</sup>).

### Goals and motivation<sup>29</sup>

During toddlerhood, gaining autonomy arises as a higher-order goal that children pursue (Bronson, 2000<sup>N</sup>; Calkins, 2007<sup>N</sup>; Higgins, 2016<sup>N</sup>). In order to attain this goal, motivation to engage in self-regulation may increase in toddlers. Although they want to do things themselves, toddlers do not yet have accurate knowledge about their own level of ability, and therefore, they may often experience frustration in trying to reach goals (Bronson, 2000<sup>N</sup>). Nevertheless, these failures are likely to be overcome due to toddlers' strong striving for mastery and independence (Bronson, 2000<sup>N</sup>; Calkins, 2007<sup>N</sup>). Another important higher-order goal for toddlers is to understand their environment, which is reflected in a high motivation to explore and manipulate objects in the environment (Bronson, 2000<sup>N</sup>). In trying to achieve this goal, toddlers strive to cognitively organize their environment. This is supported by the acquisition of language, helping toddlers to place for example objects or animals in named categories (Bronson, 2000<sup>N</sup>).

In contrast to toddlers, preschoolers are better able to take their own level of skills into account while formulating goals and choosing tasks (Ziv et al., 2017<sup>N</sup>). Their motivation to reach specific short-term goals becomes more focused (Levin & Hanten, 2005<sup>N</sup>; Ziv et al., 2017<sup>N</sup>). Whereas toddlers are mostly interested in the *process* of an action (e.g., drawing), preschoolers become interested in the *product* as well, which they evaluate based on concrete standards (e.g., the quality of the cat they have drawn; Bronson, 2000<sup>N</sup>). By reaching their goals, preschoolers experience pleasure that is self-reinforcing and motivates them to set new goals (Bronson, 2000<sup>N</sup>). At a very limited capability still, preschoolers can alter or substitute their goals for a certain situation (e.g., playing alone instead of with a frustrating peer) to regulate emotional arousal (Thompson, 1991<sup>N</sup>). Further, they begin to regulate themselves in terms of significant others' goals and standards for them, also in the absence of surveillance (Higgins, 2016<sup>N</sup>).

### Socialization of self-regulatory capacities, goals, and motivation

Similar to the literature on self-regulation during infancy, no clear distinction between the impact of socialization processes on the development of toddlers' and preschoolers' self-regulatory capacities, goals, and motivation is made, and hence we report on these findings together.

#### Parents

Whereas infants almost completely rely on their parents for regulation, toddlers and preschoolers become increasingly able to self-regulate by gaining a more internalized set of regulatory strategies (Calkins, 2007<sup>N</sup>; Cox et al., 2010<sup>N</sup>; Foley, 2017<sup>N</sup>; Garner, 2010<sup>5</sup>; Grolnick & Farkas, 2002<sup>N</sup>; Housman, 2017<sup>N</sup>). Still, parents play a major role in helping their children to regulate in various situations by using similar co-regulation strategies as in infancy (Blair & Raver, 2015<sup>N</sup>; Fay-Stammbach et al., 2014<sup>N</sup>; Gennis et al.,

<sup>29</sup> As our systematic search revealed only a few review-type papers on the development of motivation for self-regulation in toddlerhood and the preschool years, we mainly draw upon the book of Bronson (2000) on self-regulation in early childhood in this section.

2022<sup>M</sup>; Foley, 2017<sup>N</sup>; Higgins, 2016<sup>N</sup>; Karreman et al., 2006<sup>M</sup>; Kiff et al., 2011<sup>N</sup>; Kiss et al. 2014<sup>N</sup>; Murray et al., 2019<sup>N</sup>; Ramsdal et al., 2015<sup>N</sup>; Tayler, 2015<sup>N</sup>). Parents may for instance calm their child by removing the child from situations of excessive stress, provide reassurance through physical or verbal comfort, or provide opportunities for distraction such as initiating play (Farroni et al., 2022<sup>N</sup>; Foley, 2017<sup>N</sup>; Thompson, 1991<sup>N</sup>). Toddlers and preschoolers will further learn about self-regulation by practicing during interactions with parents and by imitating their parents' own self-regulatory behaviors (e.g., self-calming strategies) that serve as a role model of self-regulation (Bronson, 2000<sup>N</sup>; Davis et al., 2017<sup>M</sup>; Foley, 2017<sup>N</sup>; Thompson, 1991<sup>N</sup>; Zeman et al., 2006<sup>N</sup>).

The way in which parents behave in specific co-regulating situations over time can be attributed to differences in parenting styles that may uniquely contribute to the development of children's self-regulatory capacities. First, parental sensitivity or responsiveness is assumed to reduce discomfort, stress, and emotional negativity in children with benefits to the development and internalization of regulatory strategies (Fay-Stammach et al., 2014<sup>N</sup>; Kiss et al., 2014<sup>N</sup>; Samdan et al., 2020<sup>S</sup>). Nevertheless, evidence about the association between parental sensitivity/responsiveness and toddlers' self-regulation is still mixed. While parental sensitivity/responsiveness and mind-mindedness have been positively related to composite executive functions (Aldrich et al., 2021<sup>M</sup>; Valcan et al., 2018<sup>M</sup>), parental sensitivity/responsiveness has not been associated with compliance, inhibition and emotion regulation in children aged 2 to 5 years old (Karreman et al., 2006<sup>M</sup>).

Second, young children's regulatory capacities may further be fostered through positive/supportive behavioral control, including parental behaviors such as limit-setting and directiveness (Fay-Stammach et al., 2014<sup>N</sup>). Parents adopting an authoritative style involve their children in decision making and model effective coping strategies that promote their children's use of effective self-regulatory strategies. In contrast to the authoritative style, authoritarian parenting—the demand of unquestioning obedience and rigid control without warm communication—can undermine the development of self-regulation and thereby manifest itself in inadequate social competencies, as parents model negative behaviors and fail to teach prosocial skills (Kiss et al., 2014<sup>N</sup>). Evidence has shown that parental supportive behavioral control is positively associated with compliance, whereas parental negative (i.e., power-assertive, harsh and intrusive) control relates to lower levels of compliance and executive functions in toddlers and preschoolers (Karreman et al., 2006<sup>M</sup>; Valcan et al., 2018<sup>M</sup>). No significant associations between either positive or negative control with inhibition or emotion regulation were observed (Karreman et al., 2006<sup>M</sup>).

Third, parenting behaviors that are more focused on the child's learning are parental scaffolding and stimulation. Higher levels of parental scaffolding, through verbal or non-verbal guidance, but also autonomy support and praise of children's decisions, have been associated with higher levels of executive functioning in toddlers and preschoolers (Fay-Stammach et al., 2014<sup>N</sup>; Valcan et al., 2018<sup>M</sup>). Parental stimulation involves enriched interactions such as reading to the child with the aim of providing children with opportunities to develop cognitive skills. It prospectively relates to higher self-regulatory

capacities including inhibitory and attention control, cognitive flexibility, working memory, and planning in toddlers and preschoolers (Fay-Stammbach et al., 2014<sup>N</sup>, Valcan et al., 2018<sup>M</sup>).

As parenting styles, in particular parental sensitivity, significantly contribute to the formation of an attachment style between the parent and the child (Kiss et al., 2014<sup>N</sup>), research has further focused on the association between attachment security and the child's self-regulation. Attachment security assessed in toddlerhood has been concurrently and longitudinally associated with children's self-regulatory capacities such as executive functions and regulatory strategies (Fay-Stammbach et al., 2014<sup>N</sup>; Kiss et al., 2014<sup>N</sup>; Pallini et al., 2018<sup>M</sup>, 2019<sup>M</sup>). To exemplify, securely attached toddlers, compared to resistant and avoidant ones, have been shown to use regulatory strategies more flexibly as through seeking maternal proximity and asking the mother for help (Cox et al., 2010<sup>N</sup>; Kiss et al., 2014<sup>N</sup>). Further, a positive behavioral synchrony between the parent and the child, reflected in interactions in which partners are attuned to each other behaviourally and emotionally, is beneficial for the development of self-regulation from early childhood on (Davis et al., 2017<sup>M</sup>).

## Teachers

As compared to the extensive evidence on parental influences, the role of teachers in the development of self-regulation in toddlerhood and the preschool years is still underrepresented in the reviewed literature. As outlined next, the reviewed literature focused mainly on teachers' influences on self-regulatory capacities, particularly on those employed in the regulation of behavior.

It is thought that young children's exposure to supportive versus negative, conflictual interactions with teachers shapes individual differences in attention control and emotion regulation (Blair & Raver, 2015<sup>N</sup>). Similarly, gains in preschoolers' executive functions have been associated with teachers being more approving and using a positive emotional tone (Clements et al., 2016<sup>N</sup>).

Teachers can further promote the development of self-regulatory capacities through implementing specific activities in preschool: By offering structured games, they can provide young children with opportunities to practice mastering a set of rules and encourage perseverance when tasks become difficult (Li et al., 2021<sup>M</sup>; McClelland et al., 2007<sup>N</sup>; Tayler, 2015<sup>N</sup>). During problem solving activities, teachers can encourage children to engage in private speech, and take on a role model to teach this skill (McClelland et al., 2007<sup>N</sup>). These and other teacher-guided activities such as "pretend play" and "waiting for your turn" can be implemented in classroom curricula, with a prominent one being "Tools of the Mind" (Bodrova & Leong, 2008<sup>N</sup>; Diamond & Lee, 2011<sup>N</sup>). In these classroom curricula, children learn self-regulatory abilities that they can apply to other contexts (Blair & Raver, 2015<sup>N</sup>). However, evidence has shown that the effect of classroom curricula on 4- to 6-year-olds' executive functions was small and only marginally significant (Takacs & Kassai, 2019<sup>M</sup>).

In addition to fostering self-regulatory capacities, a positive relationship with one's teacher during preschool may set the stage for important motivational processes as apparent for instance through more productive work habits and classroom engagement (Blair & Raver, 2015<sup>N</sup>; Eisenberg, Valiente & Eggum, 2010<sup>N</sup>; Li et al., 2021<sup>M</sup>; McClelland et al., 2007<sup>N</sup>).

## Peers

Little is known from the reviewed literature about the role of peers in affecting the development of self-regulation in toddlerhood and the preschool years. With respect to the regulation of behavior, around age 3, preschoolers start to engage in symbolic play, either on their own or together with peers. They pretend that objects would be something else, requiring the inhibition of the actual function of the object, meta-communication, and role taking (Foley, 2017<sup>N</sup>; Higgins, 2016<sup>N</sup>; Pahigiannis & Glos, 2020<sup>N</sup>; Savina, 2014<sup>N</sup>). With respect to the regulation of emotions, as compared to the more scaffolded interactions with parents or teachers, interactions with peers may provide more challenging practice opportunities for self-regulation such as during conflicts (Miller et al., 2020<sup>N</sup>). Modeling of self-regulation by peers further starts in the preschool years (Miller et al., 2020<sup>N</sup>).

## Childhood (6-11 years)

### *Self-regulatory capacities*

#### **Capacities for the regulation of behavior**

Capacities such as executive functioning continue to develop during childhood, albeit at a slower rate, compared to toddlerhood and early childhood (Deater-Deckard, 2014<sup>N</sup>). Low-level capacities develop into more complex capabilities, congruent with the development of physical and neural systems and the gradual internalization of control during childhood (Nigg, 2017<sup>N</sup>). For instance, children's working memory capacity increases, and children become more proficient in retrieving information in different contexts (Ziv et al., 2017<sup>N</sup>). Children are also likely to develop their inhibitory control abilities (Nigg, 2017<sup>N</sup>) and consequently can manage increasingly more complex inhibition tasks. This inhibitory control includes the ability to inhibit an action despite a concrete command (e.g., in the game "Simon says") or despite social pressure (e.g., when a peer invites a child to throw rocks at a window; Petersen et al., 2016<sup>M</sup>). Compared to preschoolers, improvements in memory and inhibition allow older children to cope with greater environmental demands, to pursue mastery in more complex tasks, and to engage in more goal-directed behavior in academic settings (Ziv et al., 2017<sup>N</sup>). Children become increasingly self-reliant, and their self-regulatory strategies become more differentiated and sophisticated (Zimmer-Gembeck & Skinner, 2011<sup>N</sup>). For instance, children develop more advanced memory strategies, such as relying on heuristics (e.g., an educated guess, or a rule of thumb) and grouping (Ziv et al., 2017<sup>N</sup>).

#### **Capacities for the regulation of emotion**

For infants and toddlers, regulation of emotion is often co-regulated, and accomplished with help of others. During childhood, however, children improve their capability to manage their own emotions and expression (Eisenberg & Spinrad, 2004<sup>N</sup>), resulting in an increase in self-reliance (Thompson, 1991<sup>N</sup>;

Zimmer-Gembeck & Skinner, 2011<sup>N</sup>). Children become more proficient in executive functions (Eisenberg & Sulik, 2012<sup>N</sup>), and show increased capacity to intentionally direct attention to positive features of stressful situations (Zimmer-Gembeck & Skinner, 2011<sup>N</sup>). Support seeking becomes more complex, and the ability to take others' perspectives and understand that different situations may require different coping responses begins to form (Compas et al, 2017<sup>M</sup>). Children gain understanding of emotional display rules, the multiple dimensions of emotions and the simultaneity of different emotions, and the consequences of one's emotional expressions for social partners (Thompson, 1991<sup>N</sup>; Zeman et al., 2006<sup>N</sup>). Moreover, children better understand the negative consequences associated with expressing the "wrong" emotions during social interactions and get better at identifying these situations and consequently hiding their feelings in these instances (Garner, 2010<sup>S</sup>). Children also recognize that other's emotional reactions to a situation may not match their own and that others, too, may choose to alter their emotional expressions (Zeman et al., 2006<sup>N</sup>).

In addition to the increased understanding of emotion-laden interactions and attentional flexibility, children significantly expand their repertoire of strategies for emotional self-regulation (Thompson, 1991<sup>N</sup>), and develop more efficacy and flexibility in the use of specific strategies with age (Compas et al., 2017<sup>M</sup>). In preschool, children comfort themselves mostly through behavior (Zimmer-Gembeck & Skinner, 2011<sup>N</sup>), whereas children in middle childhood start to make use of more cognitive forms of emotion regulation (Compas et al., 2017<sup>M</sup>; Murray et al., 2019<sup>N</sup>; Tyson et al., 2009<sup>N</sup>; Zimmer-Gembeck & Skinner, 2011<sup>N</sup>). For instance, children learn to make use of cognitive distraction (thinking about something else) instead of behavioral distraction (doing something else; Compas et al., 2017<sup>M</sup>, Thompson, 1991<sup>N</sup>)—although cognitive strategies in this phase are typically used only when behavioral distraction is not an option (e.g., during a dental procedure; Zimmer-Gembeck & Skinner, 2011<sup>N</sup>). Moreover, school-aged children can regulate their emotions with more sophisticated strategies (Eisenberg, Hofer, et al., 2014<sup>N</sup>) such as reappraisal, where children try to re-interpret unpleasant events in ways that positively change their emotional response to the event (Gross, 2014<sup>N</sup>; Ziv et al., 2017<sup>N</sup>).

### *Socialization of self-regulatory capacities*

#### **Parents**

Just as in infancy and toddlerhood, parents play an important role by co-regulating (part of) children's regulating process. The growing self-regulatory capacity of children allows for a gradual shift of responsibility from parents to children in this co-regulation (Binns et al., 2019<sup>N</sup>; Pino-Pasternak & Whitebread, 2010<sup>S</sup>). Co-regulating is most beneficial for the development of children's self-regulation if parents scaffold their support based on a child's readiness for responsibility (Pino-Pasternak & Whitebread, 2010<sup>S</sup>), striking a balance between overprotection and ignorance (Repetti & Robles, 2016<sup>N</sup>).

Just as in toddlerhood, parents positively contribute to self-regulatory development when they are able to establish a secure attachment relationship with their child, and when they adopt responsive parenting styles characterized by warmth, synchrony, and connectedness. In contrast, power assertion and harsh

and intrusive parenting styles are negatively associated with self-regulation (Cox et al., 2010<sup>N</sup>; Deater-Deckard, 2014<sup>N</sup>; Eisenberg, Duckworth, et al., 2014<sup>N</sup>; Kiff et al., 2011<sup>N</sup>; Pallini et al., 2018<sup>M</sup>, 2019<sup>M</sup>; Repetti & Robles, 2016<sup>N</sup>; Valcan et al., 2018<sup>M</sup>). In addition, parental autonomy support, scaffolding, and cognitive stimulation enhance the development of self-regulation, especially in younger children (Valcan et al., 2018<sup>M</sup>).

Furthermore, parents contribute to self-regulatory development by modeling self-regulated behavior (Zeman et al., 2006<sup>N</sup>). Modeling encompasses the use of specific language, with which parents verbalize the process of regulation (Binns et al., 2019<sup>N</sup>). Modeling can, for instance, be used to improve children's understanding of emotions and their ability to regulate their emotions (Zeman et al., 2006<sup>N</sup>) although success of these strategies is to some degree dependent on a parent's own ability to regulate emotions (De Raeymaecker & Dhar, 2022<sup>S</sup>). Adults can use simple language to describe cause-effect relationships between mental states and behavior (e.g., 'The noise outside makes it difficult for me to concentrate on my book, I'm going to close the window'). Alternatively, parents can verbalize how they deal with their own negative emotions (Garner, 2010<sup>S</sup>; Repetti & Robles, 2016<sup>N</sup>), explaining how they choose regulation strategies and why. Parents' use of emotion-based language helps clarify children's emotional states, intensifies their awareness of their own and others' emotions, and teaches their children how to respond appropriately to emotion-related experiences (Garner, 2010<sup>S</sup>). Moreover, because the regulation process is verbalized, they learn (De Raeymaecker & Dhar, 2022<sup>S</sup>) the relevant language needed to communicate about self-regulation (Binns et al., 2019<sup>N</sup>).

### Teachers

In the first years of schools, teachers acquire an important role in the development of a child's self-regulation. Teachers are to a large extent responsible for facilitating a learning environment that promotes self-regulation, for instance by incorporating activities that encourage reasoning and higher order thinking, such as classroom discussions and the use of open-ended questions (De Corte 2019<sup>N</sup>; Li et al., 2021<sup>M</sup>; Meusen-Beekman et al., 2015<sup>N</sup>; Vandenbroucke et al., 2018<sup>M</sup>). Moreover, teachers play an important role by co-regulating (part of) a child's regulating process (Skinner et al., 2020<sup>N</sup>). Teachers can model and even explicitly teach children relevant self-regulatory strategies and skills (Corno, 1994<sup>N</sup>; Donker et al., 2014<sup>N</sup>; Meusen-Beekman et al., 2015<sup>N</sup>), such as self-talk or how to monitor one's own behavior (Strayhorn, 2002<sup>N</sup>). In a more implicit way, teachers impact children's self-regulation during their teacher-child interactions (Li et al., 2021<sup>M</sup>; Sankalaite et al., 2021<sup>S</sup>; Savina, 2021<sup>N</sup>). For instance, children who experience more positive and less conflictual interactions with teachers regulate their stress better and are more confident (Vandenbroucke et al., 2018<sup>M</sup>).

### Peers

As children enter school, peers are a relatively permanent part of a child's social environment. They become important models for children's behavior (Coplan & Bullock, 2012<sup>N</sup>; Zimmer-Gembeck & Skinner, 2011<sup>N</sup>), as children are more likely to reproduce modeled behavior if the model is alike on factors such as



age, gender or status (Schunk & Zimmerman, 1997<sup>N</sup>). Peers also provide new opportunities to practice self-regulation through play. For instance, older children (7-11 years) are likely to engage in games with rules, either self-invented or initiated by an adult. This attending to rules, inventing a strategy to obtain a goal, and taking the perspective of the other players are ideal options for training self-regulation (Savina, 2014<sup>N</sup>).

### Goals and motivation

With age, children gradually develop a sense of history and time, which is reflected in the goals they formulate. Where young children mostly formulate goals in the present, older children gradually formulate more future-focused goals, although still mostly aimed at the nearby future (Higgins, 2016<sup>N</sup>; McInerney, 2004<sup>N</sup>). In line with this, goals more often include an intention to develop, as learning and growing becomes more and more something that is actively and intentionally pursued (Gestsdottir & Lerner, 2008<sup>N</sup>). Children's goals and motivation are also impacted by the new social environment they enter: primary education. Because children are expected to follow a somewhat predetermined curriculum, not all activities tend to be intrinsically motivating. Considering this, motivation focused on the usefulness of certain topics for children's personal goals (i.e., identified motivation) starts to play a more crucial role than before (Kauffman & Husman, 2004<sup>N</sup>).

Moreover, children learn to better understand effort and ability when experiencing negative outcomes and consequently, their expectations and beliefs about their own ability become more accurate. This makes it easier for children to attain a growth mindset (i.e., the belief that one's current ability can be improved with enough effort; see e.g., Dweck, 2007<sup>N</sup>) and to attribute success to ability and effort and failure to a lack of effort. Relatedly, children's motivation is higher when they attribute their academic failures to unstable, internal but controllable causes (like a lack of effort) and believe that academic abilities are incremental and modifiable (similar to growth mindset; Muenks et al., 2018<sup>N</sup>).

### Socialization of goals and motivation

#### Parents

Next to influences on self-regulation, parents can also impact children's developing expectancy beliefs and motivation. For instance, maladaptive parental control (e.g., negative reactions to academic failure or the use of extrinsic rewards) affects children's understanding of sources of control and is related to extrinsic patterns of motivation (Pino-Pasternak & Whitebread, 2010<sup>5</sup>). In contrast, providing children with process praise (i.e., praising effort and learning) rather than personal praise (i.e., praising the child's intellectual capacity) often leads to higher motivation, promotes a growth mindset, and improves perceived competence among children (Muenks et al., 2018<sup>N</sup>).

#### Teachers

Also, teachers play a role in children's motivation. When teachers hold high generalized expectations for student achievement and students actually perceive these expectations, this can enhance both

feelings of competence and self-worth, which, in turn, benefits motivation (Muenks et al., 2018<sup>N</sup>). How strongly teachers influence self-efficacy depends in part on the experienced credibility of teachers. Teachers who communicate to children they are capable of performing a task lose their influence if a child continues to experience performance failure (Schunk & Zimmerman, 1997<sup>N</sup>). Last, children who experience more positive and less conflictual interactions with teachers are more likely to engage and persist in challenging activities (Li et al., 2021<sup>M</sup>; Vandembroucke et al., 2018<sup>M</sup>).

## Peers

Peers can also impact each other's motivation. When children start school, they begin to be evaluated by their teachers in systematic, formal, and normative ways. Partly as a result of this evaluation, they start to engage more systematically in social comparisons with peers as a way to judge their own abilities (Schunk & Zimmerman, 1997<sup>N</sup>), which can both positively and negatively impact children's motivation (Muenks et al., 2018<sup>N</sup>).

## Adolescence (12-18 years)

### Self-regulatory capacities

#### Capacities for the regulation of behavior

During adolescence, capacities that serve the regulation of behavior undergo marked improvements. Executive attention, response inhibition, and working memory fully mature (Gestsdottir & Lerner, 2008<sup>N</sup>; Massey et al., 2008<sup>S</sup>; Nelson et al., 2019<sup>N</sup>; Nigg, 2017<sup>N</sup>) at the end of adolescence or in emerging adulthood (e.g., Luna et al., 2010<sup>N</sup>). Other capacities also improve during adolescence and continue to develop in emerging adulthood, such as attention, self-control, delay of gratification, cognitive flexibility, and meta-cognitive skills such as planning and strategy selection (Duckworth, 2019<sup>N</sup>; Gestsdottir & Lerner, 2008<sup>N</sup>; Martini & Shore, 2008<sup>N</sup>; Massey et al., 2008<sup>S</sup>; Miller et al., 2020<sup>N</sup>; Muis, 2007<sup>N</sup>; Murray et al., 2019<sup>N</sup>; Nelson et al., 2019<sup>N</sup>; Nigg, 2017<sup>N</sup>). These improved capacities underlie the emergence of Piagetian formal operational thought: the capacity to form abstract ideas, to think about hypothetical problems and to formulate multiple hypotheses regarding an outcome of an event (Gestsdottir & Lerner, 2008<sup>N</sup>). These formal operational thought processes enable adolescents to use multiple rules to control behavior in different situations and to think about future events, (conflicting) goals, or tasks that require a lot of effort (Gestsdottir & Lerner, 2008<sup>N</sup>). Adolescents thus become better at problem solving and making long-term decisions like selecting courses to pursue future careers. However, as reward sensitivity also surges in early and middle adolescence (Miller et al., 2020<sup>N</sup>), adolescents' capacities may not have developed sufficiently to regulate behavior in highly rewarding situations (see Box B, Noël, 2014<sup>N</sup>; A. R. Smith, Chein et al., 2014<sup>S</sup>).

#### Capacities for the regulation of emotions

Several aspects of emotion regulation develop during adolescence (Zimmer-Gembeck et al., 2022<sup>M</sup>). In general, adolescents gain information about their personal experience of emotions (Thompson, 1991<sup>N</sup>). With adolescents being more aware of interpersonal consequences of their displayed emotions, their

decisions about when to display certain emotions and to whom become more deliberate and flexible (Zeman et al., 2006<sup>N</sup>). Moreover, as the experience of negative emotions can interfere with applying mental processes, the suppression of negative emotions helps adolescents during learning situations (Garner, 2010<sup>S</sup>; Martínez-López et al., 2021<sup>S</sup>). Adolescents can also activate positive emotions (such as hope) or use reappraisal to gain more perceived control over (academic) situations and improve task performance (Martínez-López et al., 2021<sup>S</sup>). Feelings of stress can impact feelings of social competence in adolescents (Martínez-López et al., 2021<sup>S</sup>). To cope with this stress, adolescents can independently distract themselves, follow guided relaxation exercises, or decide which situations to avoid (Zimmer-Gembeck & Skinner, 2011<sup>N</sup>). Moreover, by selecting desired and avoiding undesired situations, adolescents start exercising more control over the emotional demands in their environment (Thompson, 1991<sup>N</sup>). Both emotion regulation and coping are linked to lower levels of internalizing and externalizing symptoms of psychopathology (Compas et al., 2017<sup>M</sup>).

### *Socialization of self-regulatory capacities*

#### **Parents**

Parental influences have mainly been reviewed in the domain of emotion regulation. Although adolescents' reliance on parents seems to decline with their increasing need for autonomy (Farley & Kim-Spoon, 2014<sup>S</sup>; Kiff et al., 2011<sup>N</sup>; Morris et al., 2007<sup>N</sup>), parental influences still affect adolescents' self-regulatory capacities such as their coping (Li et al., 2019<sup>M</sup>; Miller et al., 2020<sup>N</sup>; Murray et al., 2019<sup>N</sup>). Overcontrolling parenting as well as neglectful parenting styles are, beyond earlier developmental periods, still related to impaired inhibition and emotion suppression coping during adolescence (Doan et al., 2022<sup>N</sup>; Li et al., 2019<sup>M</sup>; Morris et al., 2007<sup>N</sup>; Percy, 2008<sup>N</sup>). On the contrary, secure parent-adolescent attachment relationships are related to better effortful control and less attention problems (Pallini et al., 2018<sup>M</sup>; Pallini et al., 2019<sup>M</sup>). Also, modeling or social referencing of parents' self-regulatory capacities such as emotion regulation is still present during adolescence (Morris et al., 2007<sup>N</sup>). In previous developmental stages, parental touch impacted self-regulatory abilities. This regulatory effect of touch reduces in adolescence, although the early experiences of affective tactile interactions still impact self-regulation (e.g., attention or regulating anxiety in social situations) in adolescence (Farroni et al., 2022<sup>N</sup>).

#### **Teachers**

The transition to secondary schools at the beginning of adolescence provides adolescents with a more differentiated educational context compared to children at primary schools. On the one hand, the overall quality of the teacher-adolescent relationships seems to decrease, which is linked to lower self-regulation in adolescents (Garner, 2010<sup>S</sup>). On the other hand, teachers help to expand and refine adolescents' self-regulation repertoire by explaining how to use different self-regulation strategies for different problems, activating and interactive instructional techniques, and by establishing social norms to stimulate self-regulation activities (De Corte, 2019<sup>N</sup>; Li et al., 2021<sup>M</sup>; Meusen-Beekman et al., 2015<sup>N</sup>). With regard to emotion regulation, boys and girls seem to regulate their emotions in response

to teachers' anger differently: whereas boys typically respond with externalized emotions such as anger and aggression, girls tend to express more internalized emotions such as sadness (Garner, 2010<sup>5</sup>).

### Peers

The effects of peers have mainly been described on the regulation of emotion. With an increasing amount of time spent with peers, the level of peers' self-regulation becomes a significant predictor of adolescents' level of self-regulation and antisocial behavior (Farley & Kim-Spoon, 2014<sup>5</sup>). Peers also become important social referencing agents for adolescents' self-regulatory capacities (Morris et al., 2007<sup>N</sup>), especially under emotionally challenging conditions (Miller et al., 2020<sup>N</sup>). More and better close friendships or romantic relationships with peers promote adolescents' emotion regulation (Farley & Kim-Spoon, 2014<sup>5</sup>). Adverse peer experiences, such as peer victimization and rejection, can impact adolescents' emotion regulation negatively, and enhance the use of maladaptive emotion regulation strategies and emotion dysregulation (Herd & Kim-Spoon, 2021<sup>5</sup>).

### Goals and motivation

Adolescence is a time that marks clear developments in *which* goals adolescents prioritize. Specifically, most adolescents prioritize goals related to education and occupation, social goals related to relationships (e.g., relationships with peers, social status, affiliation), and goals that revolve around money, fame, and power (Massey et al., 2008<sup>5</sup>). Generally, leisure (i.e., social) goals are prioritized most commonly in early adolescence. Hereafter, goals concerning school and education are increasingly prioritized in middle adolescence (age 15), and goals related to new experiences, occupation, family, and property are more commonly prioritized in late adolescence (Garner, 2010<sup>5</sup>; Massey et al., 2008<sup>5</sup>). In addition, two types of demonstration goals (to demonstrate competence or to avoid negative evaluations) gain importance in adolescence. The first type of demonstration goals concerns normative goals, directed towards outperforming others, and the second type concerns appearance goals, directed towards appearing talented. Adolescents who adopt normative goals tend to have better self-regulation than adolescents holding appearance goals, but underlying mechanisms explaining why this holds true need to be disentangled further (Senko & Dawson, 2017<sup>M</sup>). Finally, autonomy and independence goals are also important for adolescents (Massey et al., 2008<sup>5</sup>).

The *structure* of adolescent goals becomes more complex in adolescence. Adolescents increasingly regulate their behavior to thrive in multiple domains (Lichenstein et al., 2016<sup>N</sup>). The goal structure of adolescents also becomes increasingly complex, because adolescents both formulate approach and avoidance goals, meaning that adolescents are guided by both their hopes (i.e., pursuing success) and their fears (i.e., avoiding failure; Massey et al., 2008<sup>5</sup>). For instance, adolescents need to balance their goal of approaching a likable peer and trying to make new friends, with their goal of avoiding rejection and losing social status.

Adolescents also develop in *how* they formulate and pursue goals. Goals are formed and pursued more deliberately (Gestsdottir & Lerner, 2008<sup>N</sup>). Developments in self-regulatory capacities enable adolescents

to specify and pursue (abstract) longer-term goals than in childhood (Miller et al., 2020<sup>N</sup>; Moilanen, 2007<sup>N</sup>). This longer-term future time perspective enables adolescents to prioritize large but delayed rewards and indicates that long-term goal setting in adolescents is dependent on their ability to delay engagement with immediate rewards from other competing but lower-order goals (Bembunty & Karabenick, 2004<sup>N</sup>; Murray et al., 2019<sup>N</sup>). For example, when adolescents become older, behaviors such as procrastination decline, probably because older adolescents increasingly adjust their behavior to future goals, even in the absence of an immediate reward (Steel, 2007<sup>M</sup>).

Generally, when children become older, their expectations about their own performances and abilities (self-efficacy beliefs) become more accurate (Gestsdottir & Lerner, 2008<sup>N</sup>; Massey et al., 2008<sup>S</sup>; Muenks et al., 2018<sup>N</sup>). In adolescence, these self-efficacy beliefs become more stable, and more differentiated; adolescents increasingly differentiate their self-efficacy in terms of ability, effort, and outcome. For example, adolescents understand that a large amount of training (effort) in combination with running fast (ability), will most likely enable them to score during matches (outcome). These insights impact adolescents' feelings of competency and their motivation to take part in goal-relevant activities (e.g., intense training; Muenks et al., 2018<sup>N</sup>). This may suggest that adolescents are driven by the utility of certain goals and by what is personally important or valuable to them (i.e., they need/want it, they can do it, they want to put much effort in). Hence, they might be guided more and more by identified and integrated motivation.

### **Socialization of goals and motivation**

#### **Parents**

Authoritative parenting styles with a balance between autonomy and control are also related to adolescents' successful goal-pursuit and realistic efficacy beliefs (Muenks et al., 2018<sup>N</sup>). Moreover, adolescents' educational and occupational goal endorsement is related to parental support, closeness, and parental involvement in and encouragement of learning, as well as to their parents having high aspirations for them or having high expectations for them achieving these goals (Massey et al., 2008<sup>S</sup>). However, too much emphasis on adolescents' success can result in achievement-related stress and depressive symptoms (Doan et al., 2022<sup>N</sup>). Parents can also provide adolescents with opportunities (e.g., going to museums or organizing extracurricular activities) to engage in domain-specific activities related to their goals (Muenks et al., 2018<sup>N</sup>). Similarly to endorsement and opportunity, goal prioritization is also highly dependent on sociodemographic factors, family values, and social context (Massey et al., 2008<sup>S</sup>).

#### **Teachers**

Teachers have an important impact on adolescents' goals and motivation in adolescence via their expectations about adolescent behaviors, active participation teaching, and their interactions with adolescents (Li et al., 2021<sup>M</sup>; Muenks et al., 2018<sup>N</sup>; Santhanasamy & Yunus, 2022<sup>S</sup>; Vandenbroucke et al., 2018<sup>M</sup>).

## Peers

Peer influences are also visible in adolescent goal setting and motivation. Specifically, siblings affect adolescents' educational and occupational goal endorsement by demonstrating support, closeness, involvement in learning, encouragement, and interest, and by as well as to their siblings having high aspirations for them or having high expectations for them achieving these goals (Massey et al., 2008<sup>5</sup>). With regard to peer group norms, adolescents highly value belonging to a peer group. Consequently, peer group norms increasingly influence adolescents' goal priorities (Miller et al., 2020<sup>6</sup>). For instance, in peer groups that value high school achievement adolescents themselves have a higher motivation to get good grades (Muenks et al., 2018<sup>6</sup>). However, when peer norms foster deviant goals, such as gaining high status through criminal activities, being with these peers increases the likelihood of the adolescent pursuing these deviant goals (see Box B; Massey et al., 2008<sup>5</sup>).

### [BOX B] Risky behaviors in adolescence

Interestingly enough, self-regulation tends to decrease in early adolescence (from ages 12 to 14) and then increases over the course of middle adolescence into adulthood (Atherton, 2020), which might be linked to goal prioritization and theories on risky behavior in adolescence. Many risky behaviors have their onset in adolescence, such as substance (ab)use, violence, vandalism, sexual risk taking (Noël, 2014; A. R. Smith, Chein, et al., 2014), and delinquency (A. L. Murray et al., 2021). The neurobiological development associated with self-regulation plays an important role in the heightened risk taking of adolescents. One of the most often mentioned models to explain this is the dual systems model by Steinberg, which explains adolescents' heightened sensitivity to socioemotional cues through a maturational imbalance: there is heightened sensation seeking arising from a hyperactive reward system on the one hand, and a more slowly maturing cognitive control system on the other hand (A. L. Murray et al., 2021; Noël, 2014; A. R. Smith, Steinberg, et al., 2014). The triadic model proposed by Ernst and colleagues adds a third dimension of a hyposensitive avoidance system and states that the cognitive control system is not sufficiently developed yet, which results in adolescents having trouble avoiding potentially harmful situations (Noël, 2014). Both models thus explain adolescents' risky behavior by the strong tendency to approach appetitive, rewarding situations that cannot yet be suppressed sufficiently by their deliberate cognitive control system (A. L. Murray et al., 2021; Noël, 2014; A. R. Smith, Steinberg, et al., 2014).

Additionally, the Prototype Willingness Model explains why it may also be appealing for adolescents to behave in risky ways, which relates to their motivation and their goals (Gerrard et al., 2008). The image adolescents associate with certain behaviors (e.g., 'adolescents who smoke are cool') increases their motivation to behave similarly. When adolescents believe that risky behaviors will give them a desired image, and the perceived personal risk is low, they are more likely to engage in these behaviors (Gerrard et al., 2008). Consequently, the pursuit of goals that are directed to risky behaviors can, counterintuitively, also be indicative of successful self-regulation (Kopetz & Orehek, 2015). For example, if adolescents want to belong to a peer group, they can undertake risky behaviors (e.g., bullying, substance abuse, vandalism), if that contributes to their goal of group membership and comes from reasoned action. Altogether, developments in capacity and goal-orientation together, make adolescents highly susceptible for carrying out risky behaviors.

## Discussion

An extensive body of empirical and theoretical work has demonstrated that self-regulation is an inherently social phenomenon (Bandura, 1991; Piaget, 1932; Vygotsky, 1986), and that—next to capacities—personally relevant goals and motivation are integral to self-regulation (Shenhav et al., 2013). Earlier work, however, has investigated these topics in isolation. In this meta-review, we synthesized 110 narrative reviews, 12 systematic reviews, and 18 meta-analyses on the socialization of self-regulation via self-regulatory capacities and via goals and motivation in typical development between infancy and adolescence (0–18 years). The review literature highlights continuity as well as age-related transitions in the capacities, goals, and motivation employed for self-regulation. Our results further demonstrate that proximal social agents such as parents, teachers, and peers rely on different behavioral repertoires to shape the development of self-regulation, with distinct behaviors influencing capacities separately from goals and motivation. We argue that socialization processes across the two pathways—via capacities, and via goals and motivation—are necessary for self-regulation to develop from being largely co-regulated by parents in infancy to being an independent, yet socially-calibrated process in adolescence involving multiple proximal agents. In the following, we synthesize our main findings based on the existing body of literature and discuss the theoretical and practical significance to research and practice.

### Development and socialization of self-regulatory capacities

#### *Increasing complexity and coordination among self-regulatory capacities*

Our meta-review demonstrates two main developments of self-regulatory capacities occurring in the complexity of independent capacities and in the coordination across multiple capacities. The review literature showed that the gradual development of complex self-regulatory capacities is preceded and paralleled by developments in lower-level capacities. For instance, age-related improvements in executive functions (e.g., working memory, response inhibition, and set shifting) are preceded and paralleled by developments in several endogenous attention control mechanisms. The review literature further revealed improved coordination across development among otherwise independent executive functions. For instance, while infants can perform successfully in simple inhibition procedures that require response inhibition, reliable performance in complex inhibition procedures that place higher working memory demands on top of response inhibition only becomes possible in toddlerhood and preschool. These findings are consistent with previous theoretical work arguing that improvements in the complexity and coordination of executive functions enable children to solve more complex self-regulation problems, such as dealing with novel, motivationally-laden contextual demands (Case et al., 1988; Fischer & Rose, 1994; Garon et al., 2008, 2014; Kopp, 1982).

#### *Distinctive roles of parents, teachers, and peers in socializing self-regulatory capacities*

Our meta-review clearly demonstrates that the development of self-regulatory capacities is an inherently social process, characterized by developmental transitions in the relative importance of different proximal social agents. In infancy, most reviews focused on the role of parents, whereas the roles of teachers

and peers received increasing attention with children's school age and even more so in adolescence. Throughout development, parents broaden their own behavioral repertoire with increasingly more complex co-regulation strategies—from soothing and distraction techniques for regulating infant distress to modeling and emotion-based language in childhood and adolescence (Murray et al., 2019; Zimmer-Gembeck et al., 2022). Next to parenting styles such as authoritative parenting and autonomy support, a secure child-parent attachment relationship has been consistently positively related to self-regulatory capacities throughout development.

Similar to parents, teachers can influence self-regulatory capacities by expressing support and approval towards students, but also by offering structured classroom activities that support the practice of capacities such as self-talk or behavioral monitoring. Although only one review has covered peer influences in infancy, preliminary evidence suggests that peers provide contextual opportunities for practicing self-regulation already in the first year of life (Pahigiannis & Glos, 2020). Whereas infants show sensitivity to peer behavior by engaging in emotion regulation in response to peer distress, toddlers and preschoolers engage in interactive play, during which conflict situations offer opportunities for practicing emotion regulation and rule-based games foster behavioral regulation. The frequency of peer socialization increases throughout childhood and gradually expands to more contexts and peers that are self-selected—with close friends and romantic partners serving as a model for adolescents' own self-regulation.

## **Development and socialization of goals and motivation**

### ***From immediate to long-term goals, from extrinsic to intrinsic motivation***

Our meta-review demonstrates that infants and toddlers mostly focus on short-term goals concerning the self (e.g., regulating physiological states), the immediate environment (e.g., seeking proximity to the caregiver), and gaining autonomy in relation to their immediate environment. With age, children expand their set of personally relevant goals and gradually learn to balance among competing goals (e.g., academic performance, social relationships). Furthermore, goals become more diverse and abstract, and span to the more distant future. From childhood onward, the motivation to self-regulate becomes more intentional, driven by self-efficacy beliefs and a shift from external to more internal forms of motivation to pursue personally valued goals. For instance, goals such as academic achievement that have been extrinsically motivated by parents may eventually gain personal significance and thereby become intrinsic. These findings are in line with the idea of gradual development over time from extrinsic to intrinsic goals and motivation proposed by self-determination theory (Ryan & Deci, 2000).

### ***Distinctive roles of parents, teachers, and peers in socializing of goals and motivation***

While social influences on goals and motivation have been described separately from those on capacities in childhood and adolescence, review work that explicitly specifies social influences on goals and motivation is missing for earlier developmental periods. Thus, our discussion focuses on the existing



review work from childhood onward, although we assume that the socialization of goals and motivation is also separable from the socialization of capacities earlier in life.

In childhood and adolescence, the roles of parents, teachers, and peers have been mostly reviewed in the contexts of education and social relationships. While parents influence their child's motivation to engage in school through praising effort and learning, providing support, and being involved in learning, teachers can promote goal setting and motivation by encouraging classroom engagement, productive work habits and persistence in challenging activities. The influence of peers on goals and motivation strengthens between childhood and adolescence. For example, social comparisons and feedback from peers motivate children, and even more so—adolescents—to pursue goals that are likely to elicit peer approval. Peer norms can then provide information on how desired goals can be achieved in different peer contexts. Thus, parents, teachers, and peers together influence academic and social goals, and the motivation to pursue these goals in childhood and adolescence.

## Future directions in self-regulation research

### *Underrepresented topics in self-regulation review work*

A strength of the meta-review approach used in this work is that it allows us to identify underrepresented topics warranting further research, which we outline below. Figure 3 summarizes the review papers per developmental period, demonstrating an imbalance regarding the type of review work and topics studied. It is possible that some of these gaps have already been addressed in isolated empirical work; nevertheless, our meta-review shows that a more comprehensive and reliable evidence synthesis is missing.

A general issue that becomes apparent from Figure 3 is that the majority of the reviews are narrative—out of 140 reviews, only 12 were systematic reviews and 18 were meta-analyses. Narrative reviews provide selective, up-to-date, qualitative analyses of focused topics, which involves the critical discussion of theory, expert intuition and experience (Furley & Goldschmied, 2021). Systematic reviews, on the other hand, are necessary to deliver an unbiased literature overview to serve for meta-analyses - the primary method for assessing the robustness of scientific findings (Pae, 2015). Our results highlight that future systematic synthesis is needed to aggregate and quantify empirical findings on the development and socialization of self-regulation.

Although commonly used definitions of self-regulation conceptualize personally valued goals and motivation as prerequisites for using self-regulatory capacities, disproportionately few reviews have focused on the development and socialization of self-regulatory goals and motivation as opposed to self-regulatory capacities (Figure 3). This knowledge gap was particularly evident in reviews focusing on infancy to preschool, perhaps largely due to the methodological challenges (discussed in the section below). Furthermore, review work on the socialization of self-regulation focused mostly on parents in the early life stages, whereas promising evidence from one narrative review (Pahigiannis & Glos, 2020)

highlighted that infants and toddlers are able to learn to regulate their emotions and behaviors through peer interactions. Taken together, the goals and motivation pathway and the influence of peers on self-regulation in the early stages of life remain important avenues for future (review) studies.

### ***Improving terminological consistency and measurement in self-regulation research***

Similarly as in previous work (e.g., Nigg, 2017), we encountered substantial terminological inconsistencies in the self-regulation literature. Terminological inconsistencies hamper tracing the development of specific self-regulatory mechanisms by precluding us from concluding whether the absence of development in a certain self-regulatory mechanisms is due to lack of reviews on the topic or due to lack of development in the specific self-regulatory mechanism (Miller et al., 2020). We thus encourage future review work attempting to bridge terminology between studies and disciplines (several noteworthy examples are Nigg, 2017; Zhou et al., 2012).

Another hurdle to deriving conclusions about self-regulation development is the general lack of measurement invariance throughout self-regulation literature. Measurement invariance assumes that age-related changes observed in the construct of interest are indeed due to true differences in the underlying construct rather than due to differences at the measurement level (Grouzet et al., 2006). For instance, a narrative review showed weak correlations between questionnaire and cognitive tasks assessments of self-regulation that could be accounted for by important differences in the operational definition of self-regulation rather than poor reliability or validity of the measures (Friedman & Gustavson, 2022). At the same time, the process of self-regulation undergoes heterotypic continuity (Cicchetti & Rogosch, 2002)—the behavioral manifestations of self-regulation changes through development. Measurement methods should thus aim to retain the same meaning of self-regulation as a construct, for instance by including overlapping measurements in a structural equation modeling framework (Petersen et al., 2016). We further remarked that beyond infancy, reviews generally lacked specificity regarding the precise timing of developmental improvements and the specific aspects of self-regulatory capacities, goals or motivation that improve. For example, review work repeatedly mentioned developments in efficacy beliefs between childhood and adolescence, but the respects in which efficacy beliefs changed at specific ages remained unclear. While such specificity might be lacking partly due to the coarseness of measures employed in the empirical work underlying the reviews, this level of descriptiveness is required to compare developments within constructs within and across developmental stages.

Furthermore, our meta-review stresses that goals and motivation are important factors that determine whether children want to use capacities for self-regulation—however, these factors are often neglected in self-regulation studies. For the infancy and preschool periods, methodological challenges involved in quantifying goals and motivation from non-verbal responses could in part explain the lack of reviews on goals and motivation. Therefore, more scientific attention should be devoted to the development of methods that directly measure age-relevant goals and motivation, specifically in the context of self-regulation. Our review provides a starting point for experimental work by outlining the type of goals that

have been seen as relevant in the context of self-regulation throughout the first years of life. Only when children are fully motivated, can we observe their true capacities to self-regulate. To this end, future studies could experimentally manipulate task rules or circumstances to activate age-relevant goals and motivation to a varying extent (e.g., an experimental task in which toddler autonomy is manipulated; see Dovis et al., 2012 for an example on adolescents). Nevertheless, future review work should still be mindful of cultural or contextual factors that might influence what constitutes adaptive self-regulation (further discussed in Box C).

**[BOX C] What constitutes adaptive self-regulation?**

Although we primarily focused on typical development without consideration of cultural or contextual variability, what is considered as adaptive self-regulation can be relative to the broader social context. More specifically, whether specific self-regulatory capacities are (evolutionarily) adaptive or beneficial depends to a large extent on the living context (see ‘fast life history perspective’; Belsky et al., 1991; Dishion et al., 2012; Fenneman & Frankenhuis, 2020). For instance, in classical experiments designed to measure self-regulation (e.g., the Marshmallow task), better delay of gratification has been interpreted as indicating high self-regulatory capacities (Mischel, 2014; Mischel et al., 1989; Shoda et al., 1990). However, in more volatile environments (e.g., poverty, violence, unreliability), foregoing an immediate reward might not be an adaptive survival strategy (Fenneman & Frankenhuis, 2020; Kidd et al., 2013). Moreover, risky behavior in adolescence might be an adaptive response in circumstances that benefit social status and reproductive strategies (B. J. Ellis et al., 2012). Scholars have further argued that risk taking can maximize positive group outcomes, thereby having beneficial effects for society as a whole (Williams & Taylor, 2006). Thus, a broader perspective on what constitutes adaptive self-regulation seems an important avenue for future (meta-)review work.

***Bidirectional relationships***

To further develop our conceptual framework on self-regulation, we recommend the assessment of recursive, bidirectional relationships among social influences, self-regulatory capacities, goals, and motivation (see Box D).

**[BOX D] Reciprocal interactions between socialization processes and children's self-regulation**

Although the primary focus of this meta-review is on the socialization processes involved in the development of self-regulatory capacities, goals, and motivation, various studies show that self-regulation develops through continuous, reciprocal interactions with the social environment. Several reviews synthesized empirical work on reciprocal relations between child-specific characteristics and parental (Hendry et al., 2016; Kiff et al., 2011; Kiss et al., 2014; Masek et al., 2021; Samdan et al., 2020) and peer behaviors (Coplan & Bullock, 2012; Farley & Kim-Spoon, 2014). For instance, greater levels of frustration, impulsivity, irritability, and less advanced effortful control skills during childhood and adolescence were found more likely to elicit negative parenting behaviors such as anger, intrusiveness and hostility that in turn further reinforce these child-specific temperamental characteristics (Kiff et al., 2011; Samdan et al., 2020). Moreover, poorer self-regulatory capacities in adolescence have been associated with poorer parent-child relationship quality (Farley & Kim-Spoon, 2014). Bidirectional interactions between peers and children's self-regulation capacities are further reported during childhood and adolescence (Coplan & Bullock, 2012). Children with more advanced self-regulation skills were shown to behave more socially competent, which was positively associated with the quality and quantity of peer relationships (Coplan & Bullock, 2012; Farley & Kim-Spoon, 2014). This association was also found for romantic relationships, as adolescents' behavioral and emotional self-regulation capacities may promote romantic relationship quality (Farley & Kim-Spoon, 2014). However, peers may also promote antisocial behavior such as bullying and aggression reciprocally (Dishion & Tipsord, 2011). In the school setting, students who were shown to be low in effortful control were more likely to form a negative student-teacher relationship that could in turn lead to less positive feedback and instruction (Eisenberg, Valiente, et al., 2010).

**Practical implications for interventions**

Based on our results on how social agents can influence the development of self-regulation, we can provide implications for current and future interventions. First, this meta-review emphasizes the importance of incorporating social agents in interventions targeting self-regulatory capacities (see also Murray et al., 2019). Currently, there are several interventions that specifically target parents in infancy and toddlerhood (e.g., Feinberg et al., 2009; Morawska et al., 2019), and childhood and adolescence (e.g., Sanders & Mazzucchelli, 2013). To a lesser extent, similar interventions also target teachers (e.g., Boekaerts & Como, 2005; Razza et al., 2015) and peers (e.g., Vandavelde et al., 2017), which could be particularly beneficial in childhood and adolescence. To improve possibilities for the use of these kinds of interventions in practice, we encourage future research to develop and test more self-regulatory interventions that specifically target social agents.

Second, by giving insight into the mechanisms behind social influences on self-regulation, our meta-review may be used to improve current interventions or to develop new interventions. For instance, social agents can improve children's self-regulatory capacities by modeling more advanced self-regulatory strategies that are beyond the child's abilities. An intervention approach could be to train these social agents in how to most effectively model good self-regulated behavior (Duffy et al., 2020; Sanders & Mazzucchelli, 2013) in order to optimize modeling effects on self-regulatory capacities.

Third, the fact that social agents can influence self-regulation via goals and motivation opens avenues for interventions. An example of how this can be done is the Roots intervention (Paluck et al., 2016). In this intervention, a group of adolescents convey new norms of desired behavior in schools by spreading posters, hashtags, having a 'Roots day', and by rewarding positive behaviors. By setting the stage for what is desired behavior in these schools, this intervention was able to reduce conflicts by 25% (Paluck et al., 2016). In this way, social agents can stimulate healthy behavior by creating healthy and prosocial behavior norms, by trying to enhance goals that prioritize healthy behavior, and by maximizing motivation to pursue these goals.

## Conclusion

Our meta-review demonstrates the importance of adopting an integrative view on self-regulatory capacities, goals, and motivation—and how they are shaped by socialization processes—to understand the long-term development of self-regulation. In line with our developmental differentiation between capacities and goals and motivation, our meta-review identified two pathways of socialization on self-regulation: 1) via the *capacity pathway* through which social agents influence improvements in the cognitive and emotional skills children employ to self-regulate, and 2) via the *goals and motivation pathway* through which social agents are involved in shaping the motivation for enacting self-regulation. Our findings indicate that self-regulation development is driven by the interplay between capacities, goals, and motivation, which are shaped by social agents. Together, the two pathways allow self-regulation to develop from being largely co-regulated in infancy primarily by parents to an independent, yet socially calibrated process in adolescence involving multiple proximal agents. This meta-review features a valuable first step to identify the development of self-regulation as a multi-faceted, inherently social process.