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Cognitive development mechanisms underlying socioemotional learning

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ABSTRACT

The term executive functions (EFs) refers to related processes that are relevant to planning, decision-making, and regulating behavior and emotions. EFs show developmental change from infancy through adolescence. EFs partially underlie many of the processes that regulate socioemotional learning and subsequent achievement. Here we discuss the brain and cognitive developmental bases of EFs and their connection to socioemotional learning in early childhood. We use the We Love Reading program as an example of how programming can incorporate elements that may naturally support EF development in early childhood.

KEYWORDS

socioemotional learning, social cognition, cognitive development, executive functions, children, early childhood development, reading, neuroscience

Socioemotional learning and executive functions

Socioemotional learning is a term used to reflect behaving appropriately across contexts and layers of one's social ecology. A recent paper by West, Buckley, Krachman, and Bookman (2018) argues that there are at least four high-level constructs that together define socioemotional learning: self-efficacy, growth mindset, self-management, and social awareness. Socioemotional learning, then, reflects flexibly managing one's emotions and thoughts (self-management), showing appropriate empathy for others (social awareness), and working within a positive motivational framework to achieve short- and long-term goals (self-efficacy and growth mindset). As such, socioemotional learning development in early childhood involves promoting competencies in a number of developmentally appropriate cognitive processes. Among others, these include inhibition of impulsive behaviors, awareness and regulation of feelings, accurate perception of the perspectives of others, correct identification of problems and development of positive and informed goals and solutions to problems (Zins, Elias, Greenberg, & Weissberg, 2000). These skills are thought to promote self-regulation in children, which has been shown to be a predictor of resilience and future academic achievement (Blair, 2002). Within the science of cognitive development, a number of processes supporting socioemotional learning fall under the umbrella of executive functions. Executive functions (EFs) are a group of related developing processes that are relevant to planning, decision-making, and regulating one's behavior and emotions (Diamond, 2013). The ability to inhibit impulses, shift attention from one task to another, plan, initiate tasks, and utilize working memory are all components of EFs. These skills undergo important development during early childhood and into adolescence (Diamond, Kirkham & Amso, 2002; Davidson, Amso, Anderson, & Diamond, 2006; Amso, Haas, McShane, & Badre, 2014).

Executive functions can be identified as either 'hot' or 'cool'. The hot and cool designations reflect exerting control over emotion-neutral cognition (cool) versus exerting control in emotionally taxing situations (hot) (Zelazo & Carlson, 2012). Cool executive functions generally refer to the goal-directed, future-oriented skills involved in planning, inhibition, flexibility, and working memory that are manifested under relatively 'decontextualized, non-emotional, and analytical testing conditions' (Hongwanishkul et al., 2005; Miyake et al., 2000). Hot executive functions are goal-directed processes elicited in contexts that 'prompt emotion, motivation, and a tension between immediate gratification and long-term rewards' (Hongwanishkul et al., 2005).

While one might be tempted to sort socioemotional learning under the hot executive functions category, it is more likely that the broad umbrella of socioemotional learning development encompasses both hot and cool executive functions. Indeed, the region of the brain primarily implicated in EFs is called the prefrontal cortex (PFC). The PFC is a highly interconnected neural system that sends and receives information from almost every other part of the developing brain, allowing it to both be enriched by cognitive experiences and to shape other developing learning and memory systems (Amso & Scerif, 2015). The more variable the context in which a child has to implement the same rule-guided behavior, the more efficiently the PFC learns to flexibly adapt, learn, and control behavior and emotion when confronted with entirely novel contexts (Amso, Salhi, & Badre, 2018; Werchan & Amso, 2017). Moreover, children's application and integration of EF skills has shown to serve as a mediator in socioemotional competence and helps foster the development of self-regulatory and social-emotional skills (McClelland, Cameron, Wanless, & Murray, 2007).

Beyond the regulation of behavior and emotion, the PFC and EFs have been implicated in the efficiency of social cognitive processes, including empathy and theory of mind. Empathy is defined as a response to and sharing of another's emotional state and includes both the regulation of emotion and the capacity

to take and understand the perspective of others (Decety, 2010). Theory of mind refers to one's ability to infer and understand the mental state of others, such as their beliefs, intentions, and desires, given the knowledge that one has available (Wellman, 2004). While these are complicated skills that deserve their own consideration in shaping socioemotional learning, many theoretical frameworks link these developing skills to EFs. Findings from Wellman et al. (2009) suggest a critical role for the prefrontal cortex in both the development and engagement of theory of mind. In addition, research suggests that success on tasks that assess EFs predicts success on tasks related to theory of mind, as both emerge at around the same time in children's development (Diamond, 2006). Research on preschoolers found that those with more advanced EF skills are better able to hold multiple perspectives in mind at once and are more efficient in switching between those perspectives (Diamond, 2006). The cognitive mechanisms underlying empathy, particularly perspective-taking processes, are rooted in the stable relationship between theory of mind and executive functions (Decety, 2010). Research is continuing to work towards understanding the directionality of these developing skills and their relationship to one another.

Shaping the development of EFs

The research literature has considered the variables that shape the development of EFs. A variety of positive and negative early life experiences have been found to shape EFs and, thereby, academic achievement outcomes (e.g., Lawson & Farah, 2017). Stressful life events, experienced through poverty, violence, or trauma have been shown to have a negative impact on EFs (Amso & Lynn, 2017) and socioemotional regulation and competence (Thompson, 2014). For instance, children who experience inconsistent or disrupted caregiving have been shown to have higher levels of cortisol than children without these caregiving disruptions (Tarullo & Gunnar, 2006). Cortisol levels are a biomarker of stress. This effect is also

evident in children with prenatal substance exposure and domestic violence exposure, and these effects have a cumulative and lasting impact on a child's cognitive architecture and future behavioral outcomes (Lester et al., 2010). In particular, stress in children's home environments, or stress experienced by caregivers, has recently been shown to impact developing EFs (Farah, 2018).

In contrast, cognitive enrichment opportunities that offer children practice in implementing flexible behavior in different contexts are a boon to EFs development (Amso, Salhi, & Badre, 2018). Parental engagement and caregiving are also key to supporting children in managing emotions and developing strong self-regulatory skills. For example, Sameroff & Fiese (2000) showed that the transactional or reciprocal nature of secure attachments in parent–child relationships plays a critical role in considering child socioemotional behaviors in context. Attachment quality has been shown to play a key role in being able to delay gratification in Western children (Jacobsen, Huss, Fendrich, Kruesi, & Ziegenhain, 1998). In Cameroonian Nso families, culture-specific maternal socialization goals supported better delay of gratification (Lamm et al., 2017). This is the ability to resist immediate gratification for a later, more valued, outcome and is a critical component of children's socioemotional competence (Mischel, Shoda, & Rodriguez, 1989). Research has suggested that the ability to delay gratification is linked with inhibitory control, a component of EF, and that this distinct form of self-control is linked to children's socioemotional development, particularly 'the ability to resist temptation and to regulate frustration and stress' (Mischel, Shoda, & Rodriguez, 1989; Sethi et al., 2000).

It is therefore not surprising that a great many studies have attempted to train EFs (Karbach & Unger, 2014). Training protocols might be applied in normative development or in populations that suffer from neurodevelopmental differences as in Attention Deficit Hyperactivity Disorder. Most research-based EF training protocols have involved computer-based training programs and regimens. In general, these have been

fairly successful in supporting what is called narrow transfer (Diamond & Lee, 2011). Narrow transfer refers to performance improvement for EFs and tasks closely related to the training regimen, but effects do not generalize broadly to other EFs (Willoughby, Magnus, Vernon-Feagans & Blair, 2017).

These data would suggest that intensive and repetitive training protocols may be missing the mark on supporting EF developmental process, and in turn its impact on socioemotional learning (Amso & Scerif, 2015). The PFC is highly interconnected with sensory, midbrain learning and motivation, and motor systems. Programming that naturally integrates EFs into rich and variable activities may thus play a stronger role in supporting EF development. Diamond and Lee (2011) argued that the development of EFs may depend on activities that support self-control and being able to flexibly switch behavior with changing task demands. These activities might include mindfulness, martial arts, sports, and social pretend play and interaction. The ultimate goal is to support the development of executive functions and promote self-regulatory capabilities, regardless of the activity itself. Moreover, EFs might benefit from more natural, semi-structured programs that include adult and parental engagement. The positive influence of caregivers has been shown to buffer the stress response in children; moreover, it allows children the opportunity to structure rules and interactions in ways that support interactive planning, rule-following, and mental manipulation of ideas, objects, words, or movements (Diamond & Lee, 2011).

We Love Reading as an example program

Here we deconstruct the We Love Reading program (WLR) using the constructs introduced in the previously reviewed literature. WLR is a Jordanian-based program that has spread to over 42 countries. It is primarily designed to engage children in reading for pleasure and involves training local ambassadors to hold routine read-aloud sessions for children aged 2–10 years old in public spaces of their

neighborhoods. The read-aloud method involves animated, lively readings, encourages children to listen attentively and engage with the story but not to participate in an academic discussion of the book. The books are always in the native language of the child and use illustrations to support understanding. After the read-aloud sessions, WLR provides children with the opportunity to take the books home to read with parents, making use of what is called a 'living library.'

This simple, sustainable program meets many of the demands of developing EFs, and in doing so, supports the constructs that define socioemotional learning. First, one of the stated goals of the WLR program is to empower the child to be an agent of change in their home environment (self-efficacy). Children bring the books home and engage their parents in reading. Research has shown that intrinsic motivation, control, agency, and self-efficacy over one's environment are important for executive functions (Pessoa, 2009; Shenhav, Botvinick, Matthew, & Cohen, 2013). These variables also capacitate children to overcome stressful events and motivate children to become more resilient in the face of adversity (Conger & Conger, 2002; Masten, 2014). Moreover, WLR engages the community and parents with the child, offering various sources of social scaffolding known to be powerful motivators in early childhood resilience (growth mindset) and particularly so in collectivist cultures (Serbin & Karp, 2004; Opperman, 2016).

Second, the read-aloud method supports extended focus during a pleasurable experience, supporting the type of delay-of-gratification skills (self-management) needed to control behavior to obtain a valuable reward—in this case, waiting to finish a story with the group in order to borrow and take it home. Third, reading stories and the vocabulary growth associated with this activity are a type of cognitive enrichment opportunity that has multiple values for cognitive development. Complexity of language and turn-taking have both been shown to mediate the relationship between early language abilities and EFs (Brito & Noble, 2014; Romeo et al., 2018).

Romeo et al. (2018) found that these effects are largely driven by the number of conversational turns between the caregiver and child, rather than the number of adult words spoken to the child. That is, engaging with the child in the context of reading, rather than the reading process itself, seems to be the variable driving positive change in the processes that underlie learning and achievement. Ultimately, reading in this form is an enrichment opportunity that allows turn-taking, verbal interaction with caregivers, practice with object forms (the written word), opportunities for imaginative play, creative thought, and learning others' perspective (social awareness).

All of these components of reading are important for supporting the development of EFs. A preliminary study investigated the WLR read-aloud method on EFs development and reading attitudes in a group of 6–8-year-old Jordanian children. (Dajani, Al Sager, Placido, & Amso, in press). We found that the WLR read-aloud sessions drove spontaneous change in the number of books in the home and the number of children in the sample that consider reading a hobby. In addition, there was a significant effect of the change in reading attitudes and practices on executive functions development. Specifically, we found that keeping two rules in working memory, and flexibly switching between these rules, improved over the course of the 6 months that children participated in the program. These data suggest immense value of the WLR program on developing EFs and further demonstrate how reading, as one example, can be used as a medium to motivate and encourage young children to realize that they have the ability to think independently.

A particular feature of WLR is its scalability, for example through transfer to interested agencies or organizations (see Dajani in this volume). The fundamental nature of EFs development, through motivation around reading and social interaction between children and their caregivers, suggests that similar benefits may be obtained when other entities add the WLR activity as a supplementary module to their primary activities.

Summary

In sum, socioemotional learning involves developmentally-appropriate experiences that allow children to practice behavioral and emotional control in various natural contexts. Programs that are age- and culture-appropriate, that require children to engage in challenging but attainable activities (Diamond & Lee, 2011), that target their mental manipulation and working memory skills through creativity and imagination, and that allow them to be agents of positive change in their social environments may support executive functions and socioemotional learning. The 'read aloud' approach has been used informally for as long as children's stories have been written. For the development of the EFs and holistic social and emotional learning, this process has great promise, both on its own and as an integral component of literacy efforts.

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Developmental Changes in Learning: Computational Mechanisms and Social Influences. Florian Bolenz 1 * , Andrea M. F. Reiter 1,2 and Ben Eppinger 1,3,4. 1 Chair of Lifespan Developmental Neuroscience, Department of Psychology, Technische UniversitÃ¤t Dresden, Dresden, Germany.Â Another important qualitative advantage of computational models is that they can provide access to latent cognitive processes. For example, many researchers are interested in the psychological processes underlying performance monitoring or in the question of how people handle conflicts between habitual and goal-directed response tendencies. Computational models allow us to formalize these latent processes and make them accessible for empirical approaches. What cognitive mechanisms might underlie this? Architecture of the mind. Before we can piece together the cognitive mechanisms underlying creativity, we must briefly look at how episodes of experience, as well abstract items such as concepts, attitudes, and stories, are stored in memory. Memory is Sparse. The human mind would have to have more memory locations than the number of particles in the universe to store all the permutations of sound, colour, and so forth that the senses are capable of detecting. Socioemotional selectivity theory (SST; developed by Stanford psychologist Laura L. Carstensen) is a life-span theory of motivation. The theory maintains that as time horizons shrink, as they typically do with age, people become increasingly selective, investing greater resources in emotionally meaningful goals and activities. According to the theory, motivational shifts also influence cognitive processing. Aging is associated with a relative preference for positive over negative information in Social learning theory explains human behavior in terms of continuous reciprocal interaction between cognitive, behavioral, an environmental influences.Â Because it encompasses attention, memory and motivation, social learning theory spans both cognitive and behavioral frameworks. Banduraâ€™s theory improves upon the strictly behavioral interpretation of modeling provided by Miller & Dollard (1941). Banduraâ€™s work is related to the theories of Vygotsky and Lave which also emphasize the central role of social learning.