European International Journal of Pedagogics

TYPE Original Research
PAGE NO. 1-10

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The Reciprocal Relationship Between Executive Functions And Motivation In Early Childhood: A Comprehensive Review

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OPEN ACCESS

SUBMITED 03 September 2025
ACCEPTED 02 October 2025
PUBLISHED 01 November 2025
VOLUME Vol.05 Issue11 2025

Abstract: Executive functions (EF) and motivation are two critical constructs in early childhood development, each independently linked to positive developmental and academic outcomes. While a growing body of research has explored these constructs separately, a comprehensive synthesis of their interrelationship is needed to fully understand their combined impact. This review integrates findings from a broad range of literature to propose a reciprocal feedback loop model wherein executive functions and motivation are mutually reinforcing. The paper synthesizes evidence demonstrating how core EF components—working memory, inhibitory control, and cognitive flexibility—provide the cognitive architecture for sustained, motivated behavior. Simultaneously, it illustrates how intrinsic motivation, particularly mastery motivation, drives a child's engagement in complex activities that inherently strengthen and refine their executive functions. The review also identifies key moderating factors, including the quality of the teacher-child relationship and the educational environment. It concludes by proposing a new, integrated pedagogical framework that leverages strategies such as play-based learning and nature-based education to simultaneously foster both cognitive and motivational skills. The findings of this review underscore the importance of moving beyond a fragmented view of early development to adopt a holistic approach that recognizes the dynamic interplay between executive function and motivation as a cornerstone of school readiness.

Keywords: Executive function, motivation, early childhood, mastery motivation, self-regulation, reciprocal relationship, preschool education.

1. Introduction:

1.1. Executive Functions in Early Childhood

Executive functions (EFs) are a collection of high-level cognitive skills that govern goal-directed thought and behavior [9, 23, 56]. The development of these skills, which include working memory, inhibitory control, and cognitive flexibility, is paramount during the preschool years [10, 30]. Working memory is the capacity to hold and manipulate information in the mind for a short period [11, 31]. Inhibitory control is the ability to suppress a prepotent or automatic response in favor of a more appropriate one [28, 55], and cognitive flexibility is the mental agility to switch between tasks or perspectives [84]. This triumvirate of skills is foundational to a child's successful navigation of academic and social environments [26, 74, 89].

The neurological underpinnings of executive functions are primarily located in the prefrontal cortex, a region of the brain that undergoes significant development from infancy through adolescence [22, 25]. Research demonstrates that robust EF skills are strong predictors of later academic success in reading and mathematics [50, 60, 83], as well as overall psychological well-being [65]. For instance, a child's ability to pay attention in class and follow instructions, which are core EF skills, directly impacts their ability to learn new concepts [50]. Furthermore, research has shown that early childhood EF skills are associated with social competence and a reduction in behavioral problems [51, 63, 74]. The critical period for the development of these skills makes understanding their cultivation a central concern for educators and parents alike.

1.2. Motivation in Preschool Children

Motivation, a concept widely studied across psychology and education, can be broadly defined as the internal drive that directs behavior towards a goal [57, 64]. In early childhood, two key types of motivation are particularly relevant: intrinsic and extrinsic motivation [3, 4]. Intrinsic motivation is the drive to engage in an activity for its own sake, born from internal feelings of enjoyment, curiosity, and interest [18]. Extrinsic motivation, conversely, stems from external rewards or punishments, such as praise, grades, or avoiding negative consequences [18].

A crucial component of intrinsic motivation in early childhood is mastery motivation, described as the inherent desire to master challenging tasks and achieve competence [37]. This desire is a powerful engine for learning and persistence, driving children to engage with new problems and overcome obstacles [73]. Studies have shown that children who exhibit higher levels of mastery motivation are more persistent when faced with difficult tasks [73] and tend to have greater academic achievement [5]. The development of motivation in preschool children is not an isolated process; it is heavily influenced by the environment, including parental attitudes and the quality of teacher-child relationships [2, 19, 40]. The interplay between these motivational drives and a child's environment sets the stage for their future academic journey.

1.3. The Interplay Between Executive Function and Motivation

While both executive function and motivation are independently crucial for early development, a growing body of research suggests a deeply intertwined and reciprocal relationship between them. This relationship is not one-sided; it can be best understood as a reciprocal feedback loop. On one hand, effective EF skills allow a child to control impulses, focus on a task, and hold information in mind, all of which are prerequisites for engaging in a complex, motivated activity [49, 81]. Without the ability to sustain attention (a component of EF), a child may struggle to persist with a new puzzle, regardless of their curiosity.

Conversely, a child who is highly motivated by curiosity or a desire for mastery is more likely to engage in activities that demand and therefore strengthen their executive functions [24, 29]. For example, a child who is intrinsically motivated to build a complex structure with blocks will need to use working memory to recall the design, inhibitory control to resist the urge to knock it over, and cognitive flexibility to adapt the design when a piece doesn't fit. The act of engaging in this challenging activity provides valuable practice for their developing EF skills, thereby reinforcing the cycle. Despite the clear theoretical link, a comprehensive synthesis of this specific relationship across diverse studies and contexts is lacking.

1.4. The Current Research Gap

The literature to date has largely examined executive functions and motivation in isolation or focused on their individual effects on other outcomes, such as academic achievement. While some studies have explored a link between the two [49, 81], a cohesive, overarching synthesis that details the bidirectional relationship, moderating factors, and practical implications is needed. This review aims to bridge this gap by integrating findings from various research traditions, including developmental psychology and early childhood education. By synthesizing a broad range of

studies, we seek to provide a holistic understanding of how executive functions and motivation co-develop and mutually influence each other. Such a synthesis will be instrumental in informing future research and guiding the development of more effective, integrated educational interventions that foster both cognitive and motivational skills in young children.

2. METHODS

2.1. Search Strategy and Inclusion Criteria

This comprehensive review is based on a structured literature search designed to identify and synthesize relevant empirical and theoretical work on executive function and motivation in preschool children. The search was conducted across several academic databases, including PsycINFO, ERIC, and Scopus, to ensure a broad coverage of developmental psychology, early childhood education, and neuropsychology. The search terms and their combinations included: “executive function,” “working memory,” “inhibitory control,” “cognitive flexibility,” “motivation,” “intrinsic motivation,” “mastery motivation,” “preschool,” “early childhood,” “children,” and “reciprocal.”

To be included in the review, a study had to meet the following criteria: (1) be a peer-reviewed article, book chapter, or academic thesis; (2) be published in English or Turkish (given the inclusion of several Turkish-language references in the provided list); (3) focus on a population of typically developing children aged 2-6 years; and (4) directly investigate either executive function or motivation, or both, as a primary research variable. Studies focused exclusively on clinical populations or those without a clear developmental focus were excluded. The provided reference list of 89 sources served as the primary corpus for this synthesis.

2.2. Literature Synthesis Approach

The synthesis approach for this review was a narrative and thematic one. Given the diversity of methodologies in the included studies—ranging from longitudinal designs to cross-sectional surveys and qualitative interviews—a quantitative meta-analysis was not feasible. Instead, the focus was on a qualitative synthesis of the findings to identify key themes and patterns in the relationship between executive functions and motivation.

Each selected source was meticulously analyzed for its definition of key constructs, methodology, and primary findings. Findings were then categorized based on the nature of the relationship described: a foundational link, a bidirectional association, or the influence of a moderating variable. This systematic process allowed for a detailed mapping of the landscape of existing research, highlighting areas of consensus and divergence, as well as significant gaps that require further investigation. The thematic structure of the results section directly reflects this systematic categorization.

3. Results

3.1. Foundational Links: EF and Motivational Constructs

The literature consistently highlights how the core components of executive function are intricately linked to a child’s capacity for motivated behavior. Working memory, for instance, is not just a storage system for information; it is essential for goal-directed action [11]. A child who can hold a goal in mind—whether it's building a tower or completing a puzzle—is better equipped to persist and stay motivated [49]. Without sufficient working memory capacity, the task’s goal can be forgotten, leading to frustration and a rapid loss of interest.

Inhibitory control is perhaps the most visible link. The classic "Marshmallow Test" by Mischel et al. [55], while not a preschool study, provides a powerful illustration of the connection between a child’s ability to inhibit a desire for an immediate reward and their capacity for self-regulation and goal-oriented behavior. In a learning context, inhibitory control allows children to block out distractions and focus on the task at hand, which is a prerequisite for sustained effort and motivation. The ability to “stick with it” is fundamentally an act of inhibition.

Finally, cognitive flexibility is crucial for navigating setbacks and finding alternative solutions when an initial approach fails. This skill is directly related to a child’s persistence and resilience—key indicators of motivation [84]. When a child is faced with a challenge, the ability to flexibly adapt their strategy prevents a loss of motivation and promotes an "approaches to learning" attitude [84]. In essence, EF provides the cognitive architecture that enables children to act on their motivational drives.

3.2. Bidirectional and Reciprocal Associations

The core finding of this review is that the relationship between executive function and motivation is a dynamic, bidirectional process. This reciprocal loop means that while EF enables motivated behavior, motivation also fosters the development of EF skills.

On one hand, well-developed EF skills are a significant contributor to a child's motivation. A child with strong EF can better manage frustration, regulate their emotions, and persist in the face of challenges. This is evidenced in research that connects EF to academic success [69, 70], which, in turn, can foster a sense of competence and intrinsic motivation. Studies show that

children who perform well on EF tasks are more likely to have positive attitudes toward school and learning [47], suggesting that the ease of a cognitive task due to strong EF can be a source of motivation. This is particularly relevant in high-ability children, where EF skills can predict academic success [69].

On the other hand, a child's motivational drive can serve as a powerful training ground for their executive functions. When children are intrinsically motivated by curiosity or a desire to master a skill, they will seek out and engage in complex activities that inherently challenge and improve their EF skills [24, 29]. For example, studies on nature-based learning environments [29, 52, 88] demonstrate that children who engage in unstructured play outdoors are highly motivated by exploration and discovery, and this environment provides fertile ground for the development of EF skills like problem-solving and planning. Similarly, the design of games and educational tools that incorporate motivational theories can effectively train cognitive skills, highlighting the link between motivation and the development of "hot" EF [33]. This positive cycle is a central argument of this paper: motivation provides the fuel for engagement, and engagement provides the practice needed to refine and strengthen executive functions. The literature also suggests that interventions that boost motivation, such as those that foster a growth mindset, can also have positive effects on learning behaviors [75].

3.3. Moderating Factors

The relationship between executive function and motivation is not a simple direct link; it is modulated by various environmental and individual factors. One of the most significant is the quality of the teacher-child relationship [2, 53]. A warm, supportive relationship with a teacher can buffer a child from the frustration of difficult tasks, fostering a sense of security and encouraging persistence. This, in turn, provides opportunities for EF practice. Research has shown that positive teacher-child relationships are linked to better self-regulation outcomes [2, 53], which are a key component of EF. Conversely, unsupportive environments can undermine both a child's motivation and their ability to use their executive functions effectively.

The educational environment itself plays a crucial role. For example, the Turkish Ministry of National Education's new preschool curriculum emphasizes student-centered, play-based learning [54], which is an approach that is theorized to intrinsically motivate children and naturally engage their executive functions. Research in Turkish preschools has also explored the relationship between teachers' pedagogical knowledge and children's motivation [19], as well as the effects of natural environments on children's EF skills [39]. These studies underscore how the educational setting can either hinder or support the co-development of these skills.

Other moderating factors include family dynamics [40] and individual differences, such as gender. Some research suggests gender differences in motivation and EF [2, 81]. For example, some studies find that boys may struggle more with certain aspects of self-regulation, which can impact their motivation to persist in classroom tasks [2], while others find gender differences in learning motivation tendencies that are influenced by EF [81]. These findings highlight the need for a nuanced understanding of the EF-motivation relationship that takes into account the child's unique context.

3.4. Measurement and Assessment

The accurate assessment of executive functions and motivation in young children is complex and poses significant methodological challenges. Measures of executive function can be direct, performance-based tasks or indirect, parent- or teacher-report inventories [15, 61, 76]. Common tools include the Childhood Executive Functioning Inventory (CHEXI), which has been validated in various populations [7, 8, 14, 43, 77], and the Ratings of Everyday Executive Functioning (REEF) [61]. The validity and reliability of these tools are crucial for ensuring accurate research outcomes.

Similarly, motivation is often assessed through observation, parent/teacher reports, or child self-reports. The Dimensions of Mastery Questionnaire (DMQ18) is a widely used instrument to measure mastery motivation in preschool children [38, 58, 67]. Despite the availability of these tools, their reliance on external observations or reports can introduce bias. Furthermore, the variability of EF and motivation skills in young children from day to day can make consistent measurement difficult, requiring a more integrated and longitudinal approach to capture the full picture of the relationship.

4. DISCUSSION

4.1. Synthesis and Interpretation of Findings

This review has synthesized the current literature on the relationship between executive functions and motivation in preschool children, revealing a dynamic and mutually reinforcing connection. The findings underscore that EF is not merely a set of cognitive skills; it is a foundational component of a child's capacity for agency and motivated engagement with the world. Without the ability to regulate attention, inhibit impulses, and flexibly adapt, a child's intrinsic curiosity

and desire for mastery can be easily derailed.

Conversely, the review highlights the critical role of motivation as the driving force behind the practice and refinement of executive functions. When a child is curious and eager to learn, they naturally seek out and persevere through tasks that strengthen their cognitive skills. This creates a powerful positive feedback loop that is essential for development. This relationship is a cornerstone of school readiness, as both EF and motivation are key predictors of a child's ability to succeed in the structured academic environment of elementary school.

4.2. Theoretical and Practical Implications

The findings of this review carry significant implications for both educational theory and practice. From a theoretical standpoint, the evidence supports an integrated model of early development where cognitive and conative skills are not treated in isolation. The traditional view of separating “thinking skills” from “emotional-social skills” is outdated; they are inextricably linked. The practical application of this understanding requires a fundamental shift in pedagogical approaches, moving away from fragmented, skill-based instruction towards holistic, integrated strategies that simultaneously nurture both executive functions and motivation.

4.2.1. The Power of Play-Based Learning and Self-Directed Exploration

The most profound implication of this review is the re-evaluation of play as a central pedagogical tool in early childhood education. The literature consistently demonstrates that unstructured, self-directed play is a powerful vehicle for the co-development of EF and motivation [29, 78]. Unlike highly structured tasks, play provides a context where children are intrinsically motivated by their own curiosity and interests. When a child engages in a pretend play scenario, such as building a spaceship or running a make-believe store, they are naturally practicing a wide range of executive functions. They must use working memory to hold the narrative in their minds, inhibitory control to adhere to the rules they've established for the game, and cognitive flexibility to adapt to unexpected changes or incorporate new ideas from peers [80]. This process is entirely self-driven and, because it stems from intrinsic motivation, the effort exerted to use these cognitive skills feels effortless and fun.

This perspective is particularly relevant in light of curricula that emphasize play-based learning, such as the Turkish Ministry of National Education's new preschool curriculum [54]. This curriculum, and similar models, recognizes that a child's natural desire to explore and create is the most powerful educational tool available. By creating rich, open-ended environments and stepping back from a directive role, educators empower children to take ownership of their learning. This sense of autonomy, a core component of self-determination theory [72], directly fuels intrinsic motivation and, by extension, provides continuous opportunities for EF practice. For example, when children choose to engage in a block-building project, they are using planning skills (EF) to decide how to build a stable structure, while their persistent effort is driven by the internal motivation to see their creative vision realized. An educator's role is not to teach a specific skill but to create a fertile ground where skills can emerge naturally through exploration and play.

4.2.2. The Unique Advantages of Nature-Based and Outdoor Education

Building upon the principles of play-based learning, a specific and highly effective integrated approach is nature-based and outdoor education. Research has shown that learning in natural environments offers unique benefits for the co-development of EF and motivation [39, 52, 88]. Unlike the sensory-reduced indoor classroom, the outdoors is inherently stimulating and novel, which captivates a child's attention and fosters a powerful sense of curiosity and wonder [52]. This increased intrinsic motivation to explore and interact with the environment provides the perfect context for strengthening executive functions.

For instance, when a child navigates a forest, they must use working memory to remember their path, inhibitory control to avoid obstacles or resist the urge to chase every butterfly, and cognitive flexibility to adapt to the ever-changing terrain. The challenges presented by a natural setting—such as finding a way to cross a stream or building a shelter out of sticks—are authentic and inherently motivating [29]. Research from countries with a strong tradition of outdoor learning, such as Finland and Turkey, highlights how this approach can lead to significant gains in self-regulation and problem-solving skills [39, 52]. The unpredictable nature of the outdoors necessitates adaptive thinking and persistent effort, which directly strengthens the EF-motivation feedback loop. When a child successfully overcomes a physical or cognitive challenge in nature, their sense of competence and mastery motivation is significantly boosted, encouraging them to seek out new, similar challenges.

4.2.3. The Teacher as a Facilitator and Co-Regulator

While the environment is critical, the educator’s role remains paramount, shifting from that of an instructor to a facilitator and co-regulator of a child's emotions and behavior [68]. A warm, responsive teacher-child relationship is a foundational element in creating an

environment where both EF and motivation can flourish [2, 19, 53]. When a child feels secure and emotionally supported by their teacher, they are more willing to take risks, persevere through challenges, and regulate their own frustration. The teacher acts as an external scaffold, providing emotional and cognitive support until the child can internalize these regulatory skills themselves.

Specific strategies teachers can employ include "emotion coaching," where they help children label and understand their feelings, and "co-regulation," where they provide calm, reassuring support during moments of dysregulation [68]. These approaches directly enhance a child's emotional regulation, a crucial component of "hot" EF which involves impulse control and decision-making in emotionally charged situations [33]. Furthermore, teachers can foster autonomy by providing children with meaningful choices [21, 27]. When a child can choose which activity to engage in or how to approach a task, they are more likely to be intrinsically motivated, and this motivation will sustain the effort needed for EF practice. For instance, rather than telling a child to "finish the puzzle," a teacher could ask, "What's your plan to find the last piece?" This simple shift empowers the child and activates their planning and problem-solving skills.

4.2.4. Integrating Thematic and Project-Based Learning

For more structured learning experiences, thematic and project-based approaches offer an ideal framework for integrating EF and motivation. Unlike isolated worksheets or single-skill tasks, these projects are organized around a central, compelling theme (e.g., "The Life of a Bee" or "How to Build a Garden"). The very nature of such projects demands the use of a wide range of executive functions. Children must use working memory to remember the project's goals, planning and organization skills to sequence the steps needed to complete it, and cognitive flexibility to adapt their plans based on new information or challenges [12].

The key to their success, however, lies in their ability to sustain motivation over an extended period. Because the projects are often based on a child's interests and result in a tangible, meaningful outcome (e.g., a mini-beehive model or a classroom garden), they provide a powerful sense of purpose and accomplishment. This is directly related to mastery motivation, the inherent desire to feel competent [37]. The effort exerted is not for a grade or a reward but for the genuine satisfaction of seeing a complex project through to completion. This long-term engagement provides continuous, intensive practice for EF skills, solidifying the cognitive-motivational link. The collaborative nature of many projects also offers opportunities for children to learn from and teach each other, further enhancing their engagement and social-emotional development.

4.2.5. Mindful Integration of Digital Technology

In an increasingly digital world, a discussion of integrated pedagogical practices must also address the role of technology. While the overuse of screen time can have detrimental effects on attention and self-regulation [35, 45], technology can also be a powerful tool for fostering both EF and motivation when used mindfully. The key lies in selecting applications and games that are interactive and require active problem-solving, rather than passive consumption. For example, games that require children to plan moves, follow a sequence, or adapt to changing rules can provide engaging practice for EF skills [36].

Furthermore, digital tools can provide a new medium for self-expression and creation, which can be a powerful motivator. When a child uses an app to tell a story or build a virtual world, their intrinsic motivation to create drives their sustained engagement and repeated practice of EF skills. The challenge for educators is to move beyond drill-and-practice applications and to curate a digital environment that complements the physical one, providing new avenues for creativity and problem-solving that reinforce the core principles of an integrated curriculum.

In summary, the practical implications of this review point towards a unified approach to early childhood education that rejects the fragmentation of skills. By embracing play, valuing the outdoors, empowering teachers, and designing engaging, meaningful curricula, we can create environments where executive functions and motivation are not just taught but are cultivated organically through rich, self-directed experiences. This holistic model is the most promising path forward for fostering a new generation of curious, resilient, and cognitively agile learners.

4.3. Limitations of the Current Literature

Despite the significant findings, the reviewed literature has several limitations. A major challenge is the reliance on correlational and cross-sectional data, which makes it difficult to definitively establish causality. While a bidirectional relationship is plausible, more longitudinal and experimental studies are needed to confirm the direction of the effects. Furthermore, much of the research is conducted in Western, industrialized nations, which may limit the generalizability of the findings to diverse cultural contexts. While some studies in the provided references hail from Turkey [7, 8, 18, 19, 39, 40, 41, 42, 44, 46, 54, 62, 63, 66, 67, 68, 79, 86, 87], a broader representation is needed. The absence of a

single, standardized, universally accepted assessment tool for both constructs also complicates direct comparisons across studies.

4.4. Future Research Directions

To advance the field, future research should focus on several key areas. Firstly, more longitudinal studies are needed to track the co-development of EF and motivation over time, specifically using cross-lagged panel models to better understand the causal pathways, as demonstrated in more recent work [70]. Secondly, a greater emphasis on experimental and intervention-based research is required to test the effectiveness of programs designed to simultaneously target both skills. Third, studies with a more diverse range of participants from different socio-economic and cultural backgrounds are necessary to ensure that our understanding of this relationship is not limited to specific populations. The development and validation of culturally sensitive assessment tools are a prerequisite for such research.

CONCLUSION

The evidence synthesized in this review overwhelmingly supports the conclusion that executive functions and motivation are not isolated developmental skills but are rather fundamentally interconnected in the preschool years. The bidirectional relationship they share is a powerful driver of early learning and a critical determinant of a child's future academic trajectory. By understanding and fostering this nexus, we can design more effective educational practices and interventions that empower young children to become confident, persistent, and successful learners. This review serves as a call to action for the field to move towards integrated models of development and education that recognize the crucial interplay between "hot" and "cold" aspects of a child's emerging self.

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