



**Università
di Genova**

DISFOR DIPARTIMENTO
DI SCIENZE DELLA FORMAZIONE

SCUOLA DI
SCIENZE SOCIALI

University of Genoa

Department of Educational Sciences

DOCTORAL SCHOOL IN SOCIAL SCIENCES

CURRICULUM: PSYCHOLOGY AND COGNITIVE SCIENCES

XXXVIII CYCLE

**Socioeconomic Influences on Children's Cognitive, Linguistic, and Socio-
Emotional Development: The Potential of Board Game-Based Interventions in
Educational Contexts**

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English summary

This doctoral dissertation investigates the influence of socioeconomic disparities on children's development, with a particular focus on executive functions (EFs), pragmatic language (PL), and Social, Emotional and Behavioural (SEB) skills, also known as soft skills. By combining cross-sectional studies and school-based interventions, the dissertation explores how socioeconomic status (SES) relates to these domains and whether structured, board game-based activities can strengthen self-regulation, socio-emotional competences, and learning in educational contexts. The first empirical study investigates the association between EFs and SEB skills (also known as soft skills), contributing to the validation of the BESSI-45 in primary school children. Data indicate that EFs, more than intelligence, gender, or SES, are the strongest predictors of SEB skills. This supports the idea that cognitive self-regulation provides the foundation for socio-emotional competences, while highlighting the need for further research to refine our understanding of this relationship.

The second study explores the links between SES, executive functions, grammar comprehension and pragmatic language, a set of skills particularly important in school-age children, as it supports communication with peers and teachers. Results show that grammar comprehension and EFs are strong predictors of pragmatic competences, and that grammar comprehension mediates the relationship between SES and pragmatic language. These findings suggest that the influence of SES on pragmatic language is largely indirect, with important implications for interventions targeting both core linguistic competences and EFs.

On the applied side, the dissertation evaluates a board game-based intervention. A pilot study demonstrated its feasibility and potential to strengthen EFs. A larger, more structured intervention revealed protective effects across cognitive, socio-emotional, and academic domains: improvements in teacher-reported executive functioning, increased self-reported Emotional Resilience (among soft skills), and stable performance in Italian and mathematics in the intervention group, in contrast with

a decline in the control group. These results point to the potential of board games, when integrated within a metacognitive and narrative framework, as low-cost and transferable tools to mitigate SES-related disparities.

In conclusion, the dissertation underscores the central role of SES in shaping cognitive, linguistic, and socio-emotional development, and identifies structured, board game-based interventions as a promising approach to fostering children's growth in educational contexts, particularly in disadvantaged settings. The implications extend to both international research – by clarifying the mechanisms mediating the effects of SES – and educational practice, by offering sustainable, engaging, and easily implementable school-based strategies.

Italian summary

Questa tesi di dottorato indaga l'influenza delle disuguaglianze socioeconomiche sullo sviluppo dei bambini, con particolare attenzione alle funzioni esecutive (FE), alla pragmatica del linguaggio (PL) e alle competenze sociali, emotive e comportamentali (Social, Emotional and Behavioural—SEB—skills), note anche come soft skills. Combinando studi trasversali e interventi scolastici, la tesi esplora come lo status socioeconomico (SES) si relazioni a questi domini e se attività strutturate basate su giochi da tavolo possano potenziare l'autoregolazione, le competenze socio-emotive e l'apprendimento nei contesti educativi.

Il primo studio empirico indaga l'associazione tra FE e SEB skills (o soft skills), contribuendo alla validazione del BESSI-45 nei bambini della scuola primaria. I dati indicano che le FE, più dell'intelligenza, del genere o del SES, sono i predittori più forti delle competenze SEB. Ciò supporta l'idea che l'autoregolazione cognitiva costituisca il fondamento delle competenze socio-emotive, sottolineando al contempo la necessità di ulteriori ricerche per affinare la comprensione di tale relazione.

Il secondo studio esplora i legami tra SES, funzioni esecutive, comprensione grammaticale e pragmatica del linguaggio, un insieme di abilità particolarmente importanti in età scolare, in quanto sostengono la comunicazione con pari e insegnanti. I risultati mostrano che la comprensione grammaticale e le FE sono forti predittori del linguaggio pragmatico e che la comprensione grammaticale media la relazione tra SES e pragmatica del linguaggio. Questi risultati suggeriscono che l'influenza del SES sulla pragmatica del linguaggio sia in larga misura indiretta, con importanti implicazioni per interventi che mirino sia alle competenze linguistiche di base sia alle FE.

Sul piano applicativo, la tesi valuta un intervento basato su giochi da tavolo. Uno studio pilota ne ha dimostrato la fattibilità e il potenziale nel potenziamento delle FE. Un intervento più ampio e strutturato ha rivelato effetti protettivi nei domini cognitivi, socio-emotivi e accademici:

miglioramenti nel funzionamento esecutivo riportato dagli insegnanti, incremento della Resilienza

Emotiva auto-riferita (tra le soft skills) e stabilità delle prestazioni in italiano e matematica nel gruppo sperimentale, a fronte di un calo nel gruppo di controllo. Questi risultati indicano il potenziale dei giochi da tavolo, se integrati all'interno di una cornice metacognitiva e narrativa, come strumenti a basso costo e trasferibili per mitigare le disuguaglianze legate al SES.

In conclusione, la tesi sottolinea il ruolo centrale del SES nel plasmare lo sviluppo cognitivo, linguistico e socio-emotivo e identifica gli interventi strutturati basati su giochi da tavolo come un approccio promettente per favorire la crescita dei bambini nei contesti educativi, in particolare in quelli svantaggiati. Le implicazioni si estendono sia alla ricerca internazionale – chiarendo i meccanismi che mediano gli effetti del SES – sia alla pratica educativa, offrendo strategie scolastiche sostenibili, coinvolgenti e facilmente implementabili.

Chapter 1

General introduction

1.1. The influence of socioeconomic factors on child development

A large body of research has consistently demonstrated that socioeconomic status (SES)—typically defined by indicators such as parental education, occupational prestige, and family income—plays a critical role in shaping children’s developmental trajectories across multiple domains (Bradley & Corwyn, 2002; Finn et al., 2017; Hackman & Farah, 2009; Noble et al., 2007). Children from socioeconomically disadvantaged backgrounds are more likely to experience limited access to cognitive stimulation, reduced exposure to enriched linguistic input, and higher levels of stress in the family environment (Farah et al., 2006; Ursache & Noble, 2016). These contextual differences, in turn, have been associated with disparities in cognitive, social-emotional, and academic outcomes (Lawson et al., 2018; Sirin, 2005).

Several studies have highlighted the pervasive impact of SES on children’s health, well-being, and neurocognitive development (Bradley & Corwyn, 2002; Noble & Giebler, 2020). For instance, disparities in brain structure and function emerge as early as infancy and have been documented in cortical and subcortical regions supporting language, executive function, and memory (Noble & Giebler, 2020). These neurodevelopmental findings converge with behavioral evidence indicating that children from lower SES families often perform more poorly in executive function tasks, language measures, and academic achievement tests (Letourneau et al., 2013; Mata et al., 2017; Pace et al., 2017; Rosen et al., 2018; Ursache & Noble, 2016).

Importantly, the influence of SES is not uniform but operates through multiple pathways. Family investment models emphasize that higher SES affords greater opportunities for learning materials and stimulating interactions (Conger & Donnellan, 2007), whereas family stress models highlight the negative impact of economic hardship on parenting and child outcomes (Evans & Kim, 2013). Moreover, SES-related disparities in developmental outcomes often operate indirectly, through

intermediate cognitive processes. Evidence suggests that the direction of these mediating pathways may vary across developmental stages. For instance, language input has been shown to mediate the association between SES and executive function in early childhood (Romeo et al., 2022), whereas in other studies executive functions emerge as mediators linking SES to children's language development, self-regulation, and academic achievement (Farah et al., 2006; Lawson et al., 2018; Noble et al., 2005, 2007; Pace et al., 2017).

A recent systematic review including studies on participants aged 10 to 24 years further extended this perspective, showing that low SES is consistently associated with weaker EF, reduced language skills, and lower academic performance (Rakesh et al., 2025). The authors identified key mediators and moderators of these associations, grouped into five categories: stress, support, stimulation, child characteristics, and broader contextual factors (e.g., schools and neighbourhoods). Cognitive stimulation emerged as the most consistent mediator, linking SES to EFs, language, and achievement. Supportive relationships (parental warmth, teacher–student closeness) also buffered negative effects, while stressors (economic hardship, parental stress, household instability) often exacerbated them. Educational expectations and self-efficacy further mediated the SES–achievement link, underscoring the role of motivational and relational factors (Rakesh et al., 2025). Importantly, the review highlights modifiable targets for intervention, such as enhancing cognitive stimulation at home and in schools.

Taken together, these findings underscore the multifaceted nature of socioeconomic influences on child development. SES affects not only the resources available to children but also the neurocognitive and socio-emotional systems that underlie their capacity to learn, regulate behaviour, and thrive in academic and social contexts. The following subsections will examine in greater detail the influence of socioeconomic factors on developmental outcomes.

1.1.1. Self-regulation in development: executive functions and metacognitive mechanisms

Self-regulation is a broad construct that encompasses the ability to modulate behaviour, cognition, and emotion in order to achieve goals and adapt to changing contexts. It involves multiple interacting domains, including cognitive, emotional, and motivational processes, and is expressed behaviourally in children's capacity to control impulses, maintain attention, and flexibly adapt strategies in learning environments (Nigg, 2017). Within this framework, executive functions, metacognition, and performance monitoring mechanisms represent key components of self-regulation, each contributing in specific ways to children's learning and development.

Executive functions constitute the cognitive core of self-regulation, providing the top-down processes that support goal-directed behaviour, while self-regulation more broadly also involves bottom-up mechanisms (Nigg, 2017). Core executive functions include inhibitory control, (updating of) working memory, and cognitive flexibility (or shifting), which lay the foundation for complex skills such as reasoning and problem-solving (Diamond, 2013; Miyake et al., 2000; Friedman & Miyake, 2017; Zelazo & Carlson, 2020). Developmentally, EFs and self-regulated behaviour show rapid and nonlinear growth during early childhood (Ferguson et al., 2021). Around age two, children begin to display emerging inhibitory control, though their ability to coordinate multiple skills is still limited (Montroy et al., 2016). Between ages three and five, a qualitative shift occurs, with substantial gains in working memory, inhibition, and cognitive flexibility, allowing children to follow rules and flexibly adapt their behaviour (Montroy et al., 2016; Reilly et al., 2022). By age six, most children can more consistently apply these skills to academic and social contexts, although growth continues at a slower pace and individual differences remain evident (Reilly et al., 2022; Sankalaite et al., 2021).

By enabling children to inhibit irrelevant information, update and manipulate representations, and flexibly shift between tasks, EFs play a direct role in the acquisition of academic skills, particularly in mathematics and literacy, while also supporting adaptive classroom behaviors (Blair & Razza, 2007; Best et al., 2011; Cortés Pascual et al., 2019; Gandolfi et al., 2021; Traverso et al., 2022; Viterbori et al., 2015; Viterbori et al., 2017). For instance, a recent longitudinal study by Kitil et al.

(2025) examined how EFs in 4th and 5th grades predict academic achievement and wellbeing in 11th and 12th grades. Results showed EFs in that 4th and 5th grades significantly predicted academic grades eight years later, even after controlling for age and gender. The study underscores the importance of strengthening EFs in childhood and early adolescence, as they are malleable and predictive of later academic success. Within this framework, a distinction is often made between “cool” and “hot” executive functions. Cool executive functions are primarily engaged in abstract, decontextualized, and emotionally neutral problem-solving situations, such as working memory or cognitive flexibility tasks with minimal motivational load. In contrast, hot executive functions are recruited in contexts that involve affect, motivation, or reward, such as delay of gratification, decision-making under risk, or emotionally salient choices (Zelazo & Carlson, 2012). This distinction is particularly relevant for understanding self-regulation in development, as children are frequently required to regulate behaviour in emotionally charged and socially meaningful situations. Beyond EFs, self-regulation also involves metacognition, defined as the ability to monitor and control one’s own cognitive processes. Research has highlighted how metacognitive monitoring and control interact with EFs to sustain effective learning, supporting children’s ability to evaluate performance, detect errors, and adapt strategies (Roebbers, 2017). This integrative view underscores that EFs and metacognition are distinct yet interrelated processes that jointly contribute to self-regulation.

A particularly illustrative example of how children regulate their behaviour after cognitive challenges is post-error slowing (PES), the tendency to slow down responses following an error. PES is considered a behavioral marker of performance monitoring, reflecting adjustments in control aimed at optimizing subsequent performance. It has been interpreted within the conflict monitoring theory as an adaptive response to error detection (Botvinick et al., 2001) and within the dual mechanisms of control framework as an instance of reactive control (Braver, 2012). Developmental research shows that PES is present from early childhood across all developmental stages (Brewer & Smith, 1989; Ger & Roebbers, 2023a, 2023b; Jones et al., 2003; Smulders et al., 2016; Yeshua &

Berger, 2024), with higher PES observed in young children and older adults indicating less efficient proactive control (which refers to the active preparation and maintenance of task goals before the occurrence of cognitively demanding events) (Brewer & Smith, 1989; Dubravac et al., 2020; Smulders et al., 2016). Recent findings further suggest associations between PES, intelligence, and academic performance, although results vary depending on the task and developmental stage (de Mooij et al., 2021; Jacobs et al., 2024; Varriale et al., 2021).

1.1.2. How socioeconomic factors shape cognitive and metacognitive development

Regarding the influence of socioeconomic factors on executive functions, it is known that children from lower socioeconomic backgrounds often show reduced performance in tasks measuring working memory, inhibitory control, and cognitive flexibility compared to their higher-SES peers (Hackman et al., 2015; Lawson et al., 2018; Rakesh et al., 2025). Research suggests that these disparities are mediated by differences in environmental stimulation, stress exposure, and access to educational resources (Noble et al., 2005, 2007; Rakesh et al., 2025). Moreover, neuroimaging evidence indicates that socioeconomic status is associated with structural and functional differences in brain regions underlying executive functions, such as the prefrontal cortex (Farah, 2017; Ursache & Noble, 2016).

Socioeconomic status also influences metacognition. In a study Pappas et al. (2003) examined 4- to 5-year-old children from different SES backgrounds while solving mathematical problems and found that upper-SES children were more articulate in explaining their thinking than their peers. This highlights that SES shapes early metacognitive skills, particularly their verbal expression, even before formal schooling. More recently, Maximino-Pinheiro et al. (2024) found that preschoolers from higher-SES families displayed stronger metacognitive abilities, including both knowledge and regulatory skills. These abilities, in turn, mediated the relationship between SES and children's performance in language and mathematics. This study provides the first evidence that the effect of family SES on preschoolers' language and mathematical abilities is mediated by the effect of family

SES on their metacognitive abilities suggesting that enhancing metacognitive development may represent a promising avenue to reduce educational inequalities. However, as discussed in detail in the following paragraphs, SES affects language development through multiple pathways, including differences in parental input, exposure to diverse vocabulary, availability of cognitive and educational resources, and the broader sociocultural environment in which children grow up, and language itself constitutes a foundational basis for the growth of metacognitive skills. For instance, Buehler et al. (2025) showed that higher language abilities in kindergarten predicted stronger monitoring accuracy development in grade one, suggesting that language serves as a precursor of metacognitive. Although this pattern was observed only in native speakers from higher SES backgrounds—likely due to a bias in the metacognitive measures, which were administered in a second language and thus disadvantaged non-native speakers—the literature consistently shows that SES is strongly associated with children’s language proficiency (Farah et al., 2006; Noble et al., 2005, 2007; Pace et al., 2017; Lawson et al., 2018; Ursache & Noble, 2016; Merz et al., 2019). Future studies should further investigate the relationship between SES, metacognitive abilities, and language through longitudinal studies, examining whether SES affects metacognitive development through its influence on language abilities and how this pathway relates to school achievement.

Regarding socioeconomic influence on PES research is still limited. In paediatric TBI (Traumatic Brain Injury), lower SES predicted reduced PES (i.e., poorer post-error adjustment), over and above injury severity and timing, indicating that socioeconomic factors may uniquely contribute to error-monitoring processes beyond clinical variables (Ornstein et al., 2009). Converging work also shows SES associations with neural error-processing (e.g., ERN) in childhood (Brooker, 2018). At the same time, evidence directly linking SES to PES in typically developing samples remains limited, highlighting an important gap in the literature. Taken together, these findings indicate that SES influences self-regulation at multiple levels. These findings highlight the importance of considering socioeconomic context when studying cognitive and metacognitive development and suggest the need for cognitive and metacognitive interventions to mitigate SES-related disparities.

1.1.3. Pragmatic language: a key competence in school-aged children

Pragmatic language (PL) refers to the ability to use language appropriately in context, including skills such as conversational turn-taking, adapting speech to the listener, understanding implied meanings, and interpreting non-literal expressions like irony and metaphors (Ariel, 2010; Matthews et al., 2018). These abilities develop gradually from infancy through adolescence, supported by joint attention, vocabulary, and grammar acquisition (Alduais et al., 2022; Longobardi et al., 2017; O'Neill, 2007). Beyond its role in everyday social interactions, PL is particularly important in school contexts. Children rely on PL to understand teachers' instructions, participate in group activities, and adjust communication to diverse academic and social situations. As a result, difficulties in PL are associated with poorer peer relationships, lower classroom participation, and reduced psychological well-being (Camia et al., 2021; Conti-Ramsden et al., 2019; Eigsti et al., 2011; Hendrix et al., 2020; Leonard et al., 2011).

From a developmental perspective, pragmatic abilities emerge in a sequential pattern that reflects the growing complexity of children's communicative skills. Early signs appear in infancy, when children between 9 and 18 months engage in joint attention and begin to interpret others' intentions (Alduais et al., 2022). In the preschool years, children gradually acquire the ability to adapt their speech to different communicative contexts: by around age 2–3 they adjust their utterances depending on the listener, and by age 4 they demonstrate sensitivity to conversational cues and politeness conventions (Longobardi et al., 2017; O'Neill, 2007). During the school years, pragmatic competence becomes increasingly sophisticated, with substantial improvements in the comprehension and production of non-literal meanings such as irony, sarcasm, and metaphors—developments that are closely linked to advances in vocabulary and grammar (Matthews et al., 2018; Wilson & Bishop, 2021). Pragmatic development continues into adolescence, when exposure to more diverse and complex social settings supports the refinement of inferential and conversational skills, enabling children to navigate a broader range of communicative demands (O'Neill, 2007).

1.1.4. Pragmatic language in the light of socioeconomic context

The role of socioeconomic factors in language and cognitive development is well established. SES influences children's exposure to linguistic input, the availability of enriching resources, and the level of family stress, all of which affect language and cognitive growth (Farah et al., 2006; Lawson et al., 2018; Letourneau et al., 2013; Noble et al., 2005, 2007; Pace et al., 2017; Ursache & Noble, 2016). Specifically, children from lower SES backgrounds tend to show weaker performance in vocabulary and grammar as well as in EFs, such as working memory, inhibition, and cognitive flexibility (Merz et al., 2019; Romeo et al., 2022; Sarsour et al., 2011). Instead, SES is consistently associated with both core language skills such as vocabulary and grammar (Farah et al., 2006; Noble et al., 2005, 2007; Pace et al., 2017; Lawson et al., 2018; Ursache & Noble, 2016; Merz et al., 2019) and with EFs (Farah et al., 2006; Noble et al., 2007; Sarsour et al., 2011; Romeo et al., 2022). These skills, in turn, have been identified as strong predictors of pragmatic competence (Matthews et al., 2018; Wilson & Bishop, 2021).

When examining the direct relationship between SES and PL, the literature provides mixed findings. Bosco et al. (2013) reported that children from higher SES backgrounds showed stronger pragmatic abilities, while other studies found only partial or no direct effects of SES on PL (Bosco & Gabbatore, 2017; Qasem et al., 2022; Schulze & Saalbach, 2022). This inconsistency suggests that SES may not exert a straightforward influence on PL but rather shapes it indirectly by affecting the linguistic and cognitive resources that underpin pragmatic abilities.

Finally, SES often overlaps with multilingual background (MB). Many children from low-SES families are also raised in bilingual or multilingual households. While exposure to multiple languages can both foster and challenge pragmatic development (van Wonderen et al., 2023), some evidence indicates that observed differences may reflect SES-related disparities rather than MB per se (Bellocchi & Bonifacci, 2023). Future studies should further disentangle these intertwined factors to clarify their specific contributions to PL.

In sum, PL is essential not only for children's social functioning but also for their academic adjustment. While SES does not consistently predict pragmatic competence directly, it is closely associated with the development of core language skills and EFs, which serve as key foundations for children's ability to meet the communicative demands of school and everyday life. Understanding the pathways through which SES influences PL may offer valuable insights for designing interventions to strengthen PL in school-age children.

1.2. Conceptualizing soft skills: the SEB model and the BESSI

Over the last two decades, soft skills have increasingly been acknowledged as central to education, well-being, and success across the life span. Frequently referred to as non-cognitive skills or 21st century skills, they encompass a broad set of competencies such as collaboration, communication, adaptability, creativity, and self-regulation. International organizations such as the OECD and the National Research Council have emphasized that these skills are essential complements to cognitive ability, helping individuals adapt to the complex social, academic, and occupational demands of contemporary societies (National Research Council, 2012; OECD, 2015). Empirical evidence has confirmed this institutional perspective: large-scale reviews and meta-analyses of social and emotional learning programs have consistently shown that interventions targeting social-emotional skills are associated with improvements in academic performance, mental health, and long-term social outcomes, indicating that these abilities are malleable (Durlak et al., 2011; Taylor et al., 2017). Despite this consensus on their relevance, the field has long been characterized by conceptual fragmentation. Various terms—such as socio-emotional competencies, character strengths, and non-cognitive skills—have been used interchangeably, and multiple taxonomies have been proposed, often overlapping but not fully aligned (Duckworth & Yeager, 2015; Berg et al., 2017). This proliferation of definitions and measures has made it difficult to integrate findings and has sometimes obscured the distinction between personality traits, which capture people's typical behaviors across situations, and functional capacities, which reflect what individuals can actually do

when circumstances demand it. To address these challenges, Soto and colleagues (2021) introduced the framework of Social, Emotional, and Behavioral (SEB) skills, offering a theoretically coherent and psychometrically robust model. SEB skills are defined as functional capacities that allow individuals to maintain social relationships, regulate emotions, and manage goal- and learning-directed behaviors (Napolitano et al., 2021). This definition highlights the difference between skills and traits: while traits reflect average patterns of behaviour, skills represent maximal performance and therefore provide unique insights into how individuals can adapt and thrive in specific contexts (Lechner et al., 2022; Postigo et al., 2024).

The Behavioral, Emotional, and Social Skills Inventory (BESSI) was developed as a comprehensive tool to measure SEB skills. It is a 192-items self-report questionnaire, and it assesses 32 skill facets grouped into five higher-order domains: Self-Management, Cooperation, Social Engagement, Emotional Resilience, and Innovation (Soto et al., 2022). The Italian version of the BESSI has recently been validated by Feraco et al. (2024). Moreover, shorter forms of the inventory, such as the BESSI-45, have been validated in different cultural contexts, including Germany, Spain, and Peru, confirming their factorial structure, internal consistency, and measurement invariance (Lechner et al., 2022; Postigo et al., 2024; Sewell et al., 2024; Vega-Dienstmaier et al., 2024).

Research has shown that the BESSI not only shows strong psychometric properties, but also predicts consequential outcomes such as academic achievement, occupational interests, well-being, and social relationships, often above and beyond the effects of personality traits (Soto et al., 2023). These findings suggest that SEB skills provide a unifying framework to overcome the conceptual fragmentation of the soft skills literature and to guide both research and applied interventions.

However, the SEB skills remain unexplored in primary school children, despite increasing attention from policymakers, educators, and researchers. Moreover, the BESSI has not yet been validated in this population, underscoring an important gap in the literature.

At the same time, studies show that SEB skills are not significantly associated with measures of intelligence, suggesting that they represent a distinct component of individual differences (Lechner

et al., 2022). Yet, it remains to be clarified whether SEB skills are related to other cognitive abilities, such as executive functions.

1.2.1. From SEB skills development to their links to executive functions

From a developmental perspective, research on SEB skills is still limited since studies using the BESSI have mainly concentrated on adolescents and adults (Soto et al., 2022; Lechner et al., 2022), highlighting the need to extend this line of research to younger children. Moreover, since SEB skills are assessed through self-reports, very young children may have limited capacity to reliably describe their own soft skills. This highlights the need for observational tools to assess these abilities, as well as for longitudinal studies that can trace their developmental trajectories from early childhood. However, previous studies on social and emotional learning interventions showed that such skills are malleable and can be promoted through educational and social experiences, highlighting their relevance well before adolescence (e.g., Durlak et al., 2011; Taylor et al., 2017). Indeed, schools represent a central context for the development of these skills, providing opportunities for students to practice self-regulation, collaboration, and problem solving in structured environments. Beyond formal education, extracurricular activities such as sports, music, and volunteering also play an important role, offering authentic settings in which students can develop adaptability, perseverance, leadership, and social awareness (Shulruf, 2010; Feraco & Meneghetti, 2022). This already reveals a first parallel with executive functions, which have likewise been shown to benefit from engagement in sports such as aerobics, martial arts, and yoga, and a variety of extracurricular activities (Diamond & Ling, 2011; 2016).

Regarding the impact of SEB skills on academic outcomes, although some studies report that SEB skills significantly predict academic outcomes in adolescents (Sewell et al., 2023; Soto et al., 2023; Yoon et al., 2024), research on their impact in younger age groups is lacking. Feraco et al. (2022) found that the effect of soft skills on academic achievement is mediated by self-regulated learning and motivation in a sample aged 10 to 18. They concluded that, in the school context, soft skills

support the expression of learning motivation and the use of appropriate self-regulated learning strategies, both of which can strongly influence students' academic trajectories and foster their success. It should be noted, though, that this study was conducted before the introduction of the SEB model and the BESSI. Moreover, disentangling soft skills from other psychological constructs, such as motivation or self-esteem, and determining the unique contribution of each to academic performance, remains difficult, underscoring the need for further research.

Another relatively unexplored aspect of SEB skills concerns their cognitive underpinnings.

Although research indicates that they do not strongly correlate with intelligence (Feraco et al., 2022; Lechner et al., 2022), a particularly promising direction for future work is to consider their potential interplay with executive functions. Both constructs converge on self-regulation and adaptive goal pursuit, but they potentially capture different levels of functioning. Executive functions, including inhibition, working memory, and cognitive flexibility, are core cognitive processes that enable individuals to control attention, regulate impulses, and flexibly shift strategies. SEB skills, in contrast, are self-perceived capacities that reflect the application of these regulatory processes in everyday social and emotional contexts. For instance, it is plausible that Self-Management skills such as planning and organization draw on executive processes like working memory and shifting. Notably, planning and organization are not only commonly described as self-management skills but are also explicitly included as higher-order components in several models of executive functioning (Diamond, 2013; Miyake, 2000). From this perspective, the relationship between SEB skills and executive functions can be understood not as redundancy, but as reflecting different levels of analysis: executive functions capture underlying cognitive control processes, whereas SEB skills reflect their habitual and self-perceived application in everyday social, emotional, and motivational contexts. In the same way, Emotional Resilience skills, which include regulating stress and resisting impulsive reactions, may rely on inhibitory control. Similarly, Social Engagement skills, involving perspective-taking and effective communication, could be supported by cognitive flexibility and updating of working memory. However, considering SEB skills as self-perceived regulatory

processes in everyday contexts, their connection with EFs may emerge more clearly with executive functioning assessed through teacher or parent reports than with performance-based tasks. Whereas tasks capture executive processes at a single point in controlled settings, informant reports better reflect their consistent use across real-life contexts, aligning more closely with the nature of SEB skills. Within the executive function framework, some authors distinguish between “cool” executive functions, which are primarily involved in abstract and cognitively demanding tasks, and “hot” executive functions, which are engaged in situations characterized by emotional or motivational salience (Zelazo & Carlson, 2012). Given that SEB skills refer to self-perceived capacities to regulate behaviour, emotions, and social interactions in everyday contexts, it is plausible that hot executive functions may play a role in supporting the enactment of these skills, particularly those related to emotional regulation, stress management, and socially adaptive behaviour. However, to date, empirical studies explicitly examining the relationship between SEB skills and hot executive functions are lacking. Moreover, the present thesis focuses on cool executive functions, as they are more directly linked to academic learning processes and can be more reliably assessed in childhood through standardized tasks and informant reports, ensuring conceptual and methodological coherence with the aims of the empirical studies.

In conclusion, understanding how these two domains interact is crucial for capturing the full range of abilities that allow children and adolescents to adapt, learn, and succeed in complex environments. By linking SEB skills with executive functioning, researchers and educators can develop more comprehensive approaches to fostering resilience, academic achievement, and social adjustment in school-aged children.

1.2.2. Are SEB skills affected by socioeconomic disparities?

The role of socioeconomic factors in shaping SEB skills has received limited attention so far, and the available findings remain inconsistent. Lechner et al. (2021) analysed data from 9,300 ninth-grade secondary school students from the German National Educational Panel Study (NEPS) to

explore social inequality in SEB skills by parental SES as well as by school track, gender, and migration background. They found that differences in the levels of these traits between adolescents with different parental SES were small, especially when compared with SES-related differences in cognitive skills. The authors conclude that social inequality in SEB skills may be less pronounced than inequality in cognitive skills. However, recent findings from Lechner and Urban (2024) indicate that SES is a significant predictor of adolescents' social, emotional, and behavioral skills as measured with the BESSI. In a large-scale German study, the authors showed that parental education and migration background were the strongest and most consistent sources of inequality across SEB skills. Adolescents whose parents completed academic education reported consistently higher SEB skills in all domains and on most skill facets. The largest differences emerged in the most cognitively laden Innovation domain, with the social categories explaining up to 3.6% of the variance in these facets. Conversely, adolescent with a migration background reported lower SEB skills in all domains and on all but one facet. These findings suggest that SES-related disparities may extend beyond academic outcomes, shaping socioemotional capacities that are crucial for educational and life success. At the same time, these are initial results, and more research is needed to understand the relationship between SES and SEB skills.

1.3. Interventions against disparity

A growing body of research has investigated interventions designed to reduce disparities among children from socioeconomically disadvantaged backgrounds, with a particular focus on executive functioning (e.g., Company-Córdoba et al., 2025; Katz & Shah, 2017; Poon et al., 2020). In a recent systematic review, Company-Córdoba and colleagues (2025) reported that cognitive interventions targeting children and adolescents from low socioeconomic backgrounds show the most consistent improvements in executive functions and attention, whereas findings for other domains are more mixed and uncertain, largely due to study heterogeneity and methodological limitations. In terms of setting, the interventions reviewed were implemented across diverse contexts: many were delivered

individually, either in laboratory-like environments or through computer- and tablet-based activities, while others relied on parent-administered training at home. Group-based interventions, often embedded in preschool or classroom settings, represented about a quarter of the studies. Given their reach and ecological validity, schools emerge as an especially promising setting for implementing such interventions, as they allow for structured delivery, reduce inequalities in access, and facilitate the integration of cognitive training into daily educational practices.

In general, school-based activities aimed at enhancing executive functions typically include video game-based interventions and gamified learning strategies, which have been shown to improve attentional control and problem-solving skills in school-aged children (Gray et al., 2019; Johann & Karbach, 2020; Nin et al., 2023). Mindfulness-based curricula represent another promising evidence-based approach, with demonstrated benefits for both EFs and emotion regulation across diverse educational contexts (Flook et al., 2010; Lassander et al., 2020; Lam & Seiden, 2020).

Importantly, interventions tailored for children with adverse life experiences or those in foster care emphasize the role of EFs training in strengthening behavioural and emotional control, suggesting that such programs may serve as protective factors against social and behavioral risks (Camuñas et al., 2022; Lawler et al., 2019; Spawton-Rice & Walker, 2022). Interestingly, collaborative initiatives involving teachers in the design and implementation of EFs interventions have been proposed as a means of bridging the gap between laboratory findings and classroom practice, thereby improving ecological validity of EFs interventions (Letang et al., 2020; Zelazo et al., 2024).

Taken together, these findings suggest that interventions can help mitigate disparities in the development of executive functions, and that school-based programs are particularly suitable given their ecological validity and the potential transferability of their effects to real-world contexts (Diamond & Ling, 2020; Diamond & Lee, 2016).

1.3.1. Board game interventions

Board games have recently emerged as an innovative and engaging tool to promote executive functions development, particularly among children who may struggle to access traditional training resources (Noda et al., 2019). Unlike purely computer-based interventions, board games offer a social and interactive environment that requires players to plan, inhibit impulsive responses, and flexibly adapt strategies in real time. These features align closely with the core domains of EFs, making board games a natural medium for intervention.

Evidence from clinical and educational contexts supports the efficacy of board game-based interventions. For instance, Estrada-Plana et al. (2019) reported that children with ADHD who participated in a structured cognitive training program based on board games showed significant improvements in EFs compared to controls, underscoring their potential as a complementary therapeutic strategy. Beyond clinical populations, classroom studies have also highlighted the benefits of structured board game interventions in enhancing attention, working memory, and inhibitory control among typically developing children (Benzing et al., 2019; Johann & Karbach, 2020; Martinez et al., 2023). More recent large-scale trials have extended these findings: Vita-Barrull et al. (2024) reported that board games significantly improved cognitive and educational outcomes, while Estrada-Plana et al. (2024) showed that board games can enhance visuospatial memory and mathematical skills. Importantly, board games have also been shown to improve EFs in socially vulnerable children: Moya-Higueras et al. (2023) found that modern board and card games fostered significant gains in populations at risk of social exclusion, pointing to their potential to support inclusion and equal opportunities.

The success of board game interventions lies not only in their capacity to train EFs skills directly, but also in their ability to promote motivation and engagement more than many traditional training paradigms, which are often repetitive and perceived as artificial (Gray et al., 2019). Moreover, the collaborative and competitive dynamics of board games can foster additional socio-emotional skills, such as cooperation, turn-taking, and frustration tolerance, which are highly relevant for reducing disparities in academic and social outcomes. Nevertheless, the literature still lacks validated school-

based interventions, conducted by teachers in classroom settings, that specifically address the needs of children from low-income families.

In conclusion, board game–based interventions represent a promising, ecologically valid, and engaging approach to fostering EFs in educational settings. Their potential to simultaneously target cognitive and socio-emotional skills makes them especially relevant for reducing disparities.

1.4. Aims and hypotheses of the present dissertation

Grounded in evidence that socioeconomic disparities affect children’s cognitive, linguistic, socio-emotional, and academic development through both environmental stimulation and stress-related pathways (Bradley & Corwyn, 2002; Noble & Giebler, 2020; Pace et al., 2017), and that executive functions are core self-regulation skills and are related to learning and adaptation (Diamond, 2013; Miyake et al., 2000; Zelazo & Carlson, 2020), this dissertation pursues three interrelated aims. The first aim is to examine the association between socioeconomic status (SES) and the other developmental domains. The second aim is to examine the association between EFs and Social, Emotional, Behavioural (SEB) skills (also known as soft skills), contributing to the validation of the BESSI in middle childhood. The third aim is to evaluate the feasibility and effectiveness of a school-based, board game–based intervention designed to strengthen EFs, SEB skills, and academic outcomes, with additional exploratory analyses on post-error slowing (PES) as an index of performance monitoring. These aims are addressed through four empirical studies:

- I. Study 1 aimed to test the factorial validity of the BESSI-45 in primary school children and examine the association between SES and SEB skills and between EFs and SEB skills. The hypotheses were:
 - H1. The BESSI-45 shows factorial validity comparable to that found in older samples (Feraco et al., 2024).
 - H2. SES is not strongly correlated with SEB skills (Lechner & Urban, 2024).

H3. SEB skills are positively associated with EFs, consistent with theoretical frameworks on SEB skills (Soto et al., 2021; 2022) and on EFs (Diamond, 2013; Miyake et al., 2000).

- II. Study 2, published in the *Journal of Child Language* (Cravet & Usai, 2025), aimed to test direct and indirect links among SES, grammar comprehension (GC), EFs, and PL, in light of mixed findings on SES–PL associations. The hypotheses were:

H1. GC and EFs directly predict PL (Ariel, 2010; Matthews et al., 2018; Wilson & Bishop, 2021; Filipe et al., 2020; Nilsen et al., 2021; Ouerchefani et al., 2024; Razavi et al., 2019).

H2. SES predicts GC and EFs (Farah et al., 2006; Merz et al., 2019; Noble et al., 2005, 2007; Pace et al., 2017).

H3. SES does not directly predict PL (Bosco & Gabbatore, 2017; Qasem et al., 2022; Schulze & Saalbach, 2022).

H4. Exploratorily, and based on the effects anticipated in H1, H2, and H3, we expect that both GC and EFs mediate the relationship between SES and PL, although the limited prior evidence prevents this from being stated as a strong hypothesis.

- III. Study 3, published on the *Journal of Cognitive Enhancement* (Cravet & Usai, 2024), aimed to test the feasibility and short-term cognitive effects of a brief, teacher-led board game program embedding a narrative to support metacognitive reflection and motivation. The hypotheses were:

H1. The intervention is easily implementable in the school context.

H2. The intervention has the potential to enhance children's EFs, in line with findings from structurally similar programs (Benzing et al., 2019).

- IV. Study 4 aimed to investigate the effects of a 10-week, teacher-led board-game intervention with a metacognitive narrative framework on EFs, teacher-reported executive functioning, SEB skills, and school achievement. In addition, it explores whether the intervention has an effect on PES and the association between PES and SES.

The hypotheses were:

H1. Consistent with prior findings, the intervention is expected to show potential benefits for EFs task performance (Benzing et al., 2019; Vita-Barrull et al., 2024).

H2. The intervention will improve teacher-reported executive functioning, consistent with evidence that including metacognitive strategies enhance generalization of EFs trainings (Diamond & Ling, 2016; Pozuelos et al., 2019).

H3. The intervention would increase SEB skills, particularly Emotional Resilience, given the role of EFs in supporting self-regulation in social contexts and emotional control (Camuñas et al., 2022). Moreover, board games require children to adhere to social norms, wait for their turn, and control their impulses to avoid giving away information, such as revealing their cards. These behaviors provide valuable opportunities for children to practice self-regulation and social interaction (Gashaj et al., 2021).

H4. The intervention will produce a far transfer effect on school achievement in line with prior evidence on far-transfer effects of game-based programs (Vita-Barrull et al., 2024).

H5. Exploratorily, since PES is a behavioral marker of performance monitoring and metacognitive adjustment after errors (Botvinick et al., 2001; Braver, 2012) and given that the intervention incorporates a metacognitive and reflective component (Benzing et al., 2019; Traverso et al., 2015), it is plausible that the intervention might influence PES.

Nevertheless, this hypothesis remains exploratory due to the absence of prior evidence in this domain.

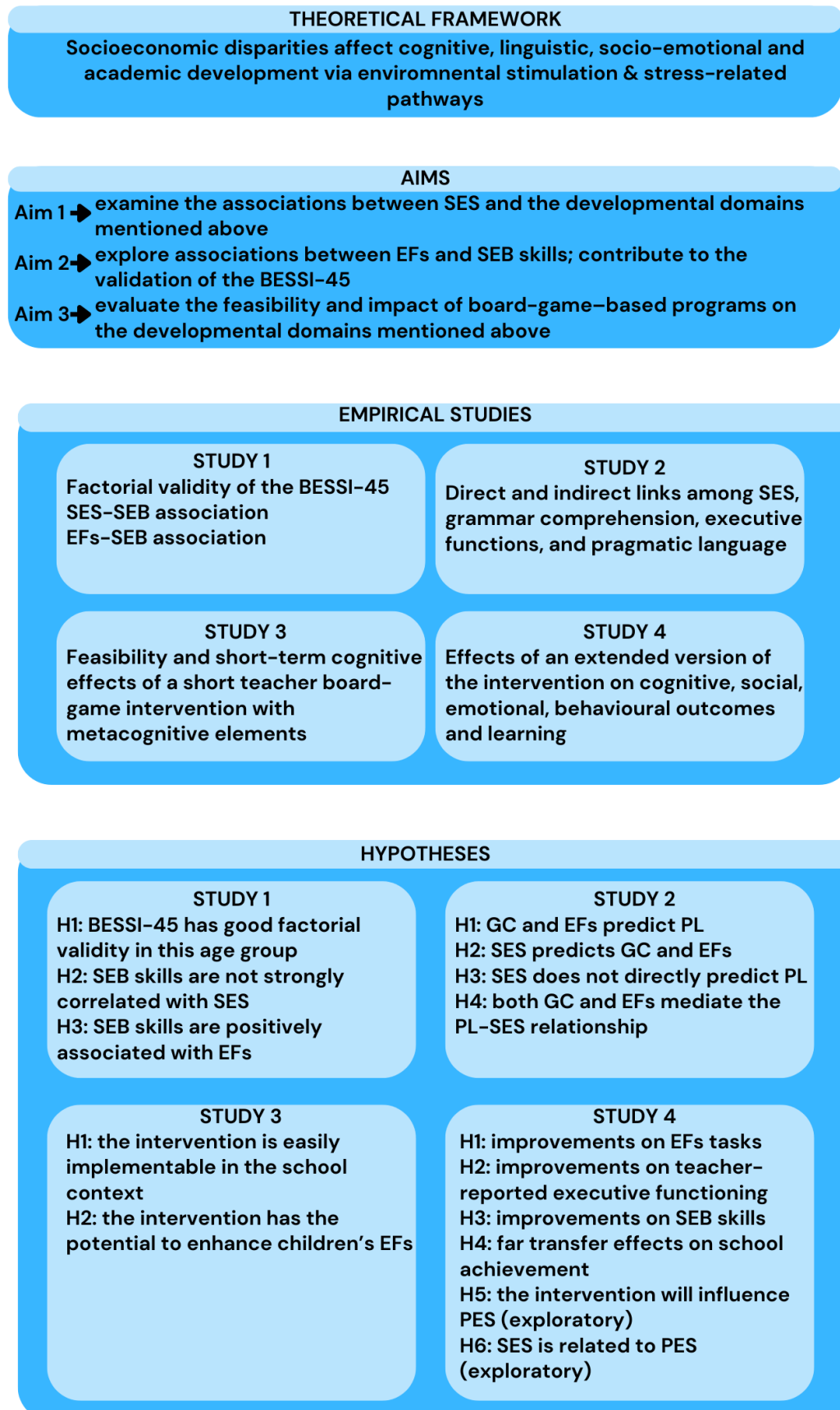
H6. Exploratorily, given the limited evidence on the association between PES and SES, strong hypotheses cannot be formulated. However, based on the study Ornstein et al. (2009) it can be hypothesized that lower SES may be related either to reduced PES or even to exaggerated PES.

A graphical overview of the dissertation is provided in Figure 1.1.

Taken together, these four studies provide a multi-level approach to understanding how SES shapes children's cognitive, linguistic, and socio-emotional development, and to testing whether structured,

game-based interventions can foster self-regulation and reduce SES-related disparities in school contexts. By combining cross-sectional and intervention studies, the dissertation seeks to advance both theoretical knowledge on the mechanisms linking SES, EFs, PL, and SEB skills, and practical insights into sustainable educational practices that can be implemented in everyday classrooms.

Figure 1.1. Graphical overview of the dissertation.



Chapter 2

Study 1: Exploring soft skills in middle childhood: the predictive role of executive function

Abstract

This study aimed to examine the factorial validity of the 45-item Behavioral, Emotional, and Social Skills Inventory (BESSI-45) in children attending primary school and to explore the relationship between executive functioning (EF), Socioeconomic Status (SES) and Social, Emotional, and Behavioural (SEB) skills in this age group. SEB skills are often referred to as soft skills and include abilities such as cooperation, emotional resilience, and self-management, which are considered fundamental for children's adjustment and development. A total of 144 children aged 8 to 11 years completed the BESSI-45 as a self-report questionnaire. Since the BESSI relies on children's own perception of their skills in daily life, we decided to relate these measures to EF as reported by teachers, rather than to performance-based EF tasks. Teacher ratings were collected using the Behavior Rating Inventory of Executive Function, Second Edition (BRIEF-2), which provides an ecologically valid perspective of how children regulate their behaviour, emotions, and cognition in daily life. This methodological choice allowed us to compare children's self-reports of SEB skills with teachers' observations of their EF, ensuring consistency in the type of measurement. Confirmatory Factor Analyses supported the factorial validity of four BESSI domains in this younger population: Self-Management, Cooperation, Social Engagement, and Emotional Resilience. The Innovation domain showed weaker evidence of validity, suggesting that this construct may be less well defined or more difficult to self-report at this developmental stage. Correlational analyses showed no correlation between SES and SEB skills, while a correlation between SEB skills and EF emerged. Structural Equation Models indicated that EF was the strongest predictor of SEB skills, whereas intelligence, gender, and SES played a minor role. These findings highlight the close link between EF and SEB skills in middle childhood, showing that children with better executive functioning are also more likely to report stronger social,

emotional, and behavioural skills. Finally, these results support the BESSI-45 as a promising instrument for assessing SEB skills in younger populations and provide a foundation for further validation in larger and more diverse samples.

2.1. Introduction

2.1.1. Definition and assessment of soft skills

In recent years, increasing interest has focused on non-technical and malleable competencies that can support students in achieving their academic goals (OECD, 2021). These competencies have been described under different labels, such as soft skills, life skills, or character qualities, but only recently an integrative psychological framework has been proposed for defining and assessing what are now referred to as Social, Emotional, and Behavioural (SEB) skills. According to Soto and colleagues (2021, 2022a, 2022b), SEB skills represent functional capacities that individuals use to pursue goals, regulate emotions, learn from experience, and establish social relationships. Given their strong links with personality-related behavioural tendencies, these skills have been organised into five domains: self-management, innovation, social engagement, cooperation, and emotional resilience.

To assess SEB skills, Soto and colleagues developed the Behavioral, Emotional, and Social Skills Inventory (BESSI), which has been adapted into different languages and contexts for participants from age 12 to adulthood. Findings from studies using the BESSI indicate that the five domains of SEB skills are associated with outcomes such as academic achievement, well-being, school engagement, procrastination, self-efficacy, occupational interests, and social relationships (Feraco et al., 2024; Lechner et al., 2022; Sewell et al., 2023; Soto et al., 2021, 2022b; Yoon et al., 2024). These associations hold even when controlling for personality traits, supporting the unique importance of SEB skills for student achievement and well-being (Sewell et al., 2023; Soto et al., 2021, 2022b; Yoon et al., 2024). Nevertheless, despite recommendations highlighting primary

school as a key stage for skill development, evidence on SEB skills in this younger age group remains limited.

2.1.2. Cognitive foundations and social inequalities in soft skills

Research on the antecedents of Social, Emotional, and Behavioural (SEB) skills is still limited, and findings remain somewhat inconsistent. Regarding cognitive factors, Lechner et al. (2022) examined the association between SEB skills and both fluid and crystallized intelligence, reporting near-zero correlations between BESSI facets and cognitive ability. These results suggest that SEB skills are largely independent from intelligence (Soto et al., 2022a, 2022b). However, this does not imply that they are unrelated to cognitive functioning more broadly. A promising avenue of investigation concerns their link with Executive Function (EF), a set of higher-order processes—including working memory updating, cognitive flexibility, and inhibition—considered the basis for more complex abilities such as reasoning and problem solving (Diamond, 2013; Miyake, 2000). EF plays a central role in regulating behaviour, particularly in situations that require overriding habitual responses (Doebel, 2020), and is generally described as the capacity to employ higher-order processes to guide and coordinate lower-level ones (Diamond, 2013; Miyake, 2000). Strong EF supports school readiness and adjustment, enabling children to manage tasks, regulate behaviour, and adapt to classroom demands (Blair & Diamond, 2008; Cartwright et al., 2020). Conversely, weak EF is associated with academic difficulties in reading, mathematics, and language, and predicts long-term challenges including school dropout (Spiegel et al., 2021; Swanson et al., 2009). A long-standing debate concerns whether EF should be considered distinct from intelligence (Roebers, 2017). Friedman et al. (2006) tested the tripartite model of EF proposed by Miyake et al. (2000) and explored its relation to fluid and crystallized intelligence. Their results showed moderate correlations between EF and intelligence but ultimately supported a model that treated EF, fluid intelligence, and crystallized intelligence as separate constructs. Taken together, existing evidence suggests that both EF (Friedman et al., 2006; Roebers, 2017) and SEB skills (Lechner et al., 2022;

Soto et al., 2022a, 2022b) are not reducible to intelligence. Nonetheless, EF may act as a cognitive foundation for SEB skills, facilitating the regulation of emotions, the pursuit of goals, learning from experience, and the development of social relationships.

Beyond cognitive processes, socioeconomic background has also been examined as a potential determinant of SEB skills, though results remain mixed. Lechner et al. (2021), using data from more than 9,000 German secondary school students, reported only small differences in SEB skills across parental SES groups, especially when compared to the much larger SES-related disparities observed in cognitive abilities. These findings suggested that SEB skills might be less sensitive to socioeconomic inequality than cognitive outcomes. However, more recent work points to a stronger role of SES. Lechner and Urban (2024), in a large German sample using the BESSI, found that parental education and migration background were the most consistent predictors of adolescents' SEB skills. Adolescents with academically educated parents showed higher scores across most domains, while those with a migration background reported lower SEB skills in nearly all domains and facets. The largest gaps were observed in the Innovation domain, where social background explained up to 3.6% of the variance.

Overall, available evidence indicates that while SEB skills are not reducible to intelligence, they may be grounded in executive functioning, and their development can also be shaped by socioeconomic conditions. These findings suggest that both cognitive and social factors contribute to the emergence of SEB skills, but further research is needed to clarify how these influences interact, particularly in childhood.

2.1.3. The importance of integrating soft skills and executive function frameworks

Understanding the relationship between EF and SEB skills is important for several reasons. SEB skills are considered malleable and can be strengthened through specific interventions (Soto et al., 2021; Soto et al., 2022a, 2022b). If EF is linked to SEB skills, programs may be designed to target both simultaneously, promoting more comprehensive approaches to child development. Evidence

shows that extracurricular activities such as sports, music, scouting, and volunteering can enhance SEB skills (Feraco & Meneghetti, 2022; Feraco et al., 2022), while activities such as aerobics, martial arts, yoga, and mindfulness contribute to improvements in EF (Diamond & Ling, 2016). Integrating these activities into school curricula has the potential to foster children's capacity to regulate emotions, collaborate with others, and remain engaged in learning (Blair & Diamond, 2008; Diamond, 2013).

Examining the EF–SEB link also aligns with broader efforts to promote well-being in education. Scholars and international organizations highlight the importance of cultivating both cognitive and socio-emotional skills from the early years (National Research Council, 2012; OECD, 2015).

Investigating this relationship in primary school children may help create educational contexts that support the whole child by addressing both cognitive and emotional needs.

Finally, EF and SEB skills represent complementary foundations for student development. EF provides the cognitive structure needed for self-regulation, goal-oriented behaviour, and adaptability in academic contexts (Diamond, 2013; Miyake et al., 2000), while SEB skills sustain children's ability to manage emotions, build relationships, and engage positively with peers and teachers (Soto et al., 2021; Soto et al., 2022a, 2022b).

2.1.4. Aims and hypotheses of the present study

The first aim of the present study was to assess the psychometric properties of the BESSI-45 in children aged 8 to 11 years. Since the BESSI has been shown to be a reliable and valid instrument in samples over the age of 11 (Soto et al., 2022; Feraco et al., 2024), we expected the inventory to demonstrate comparable feasibility and reliability when used with younger children (H1). The second aim was to investigate the relationship between SEB skills, SES, and EF in this age group. While we expected the SEB-SES association to be weak (H2), in line with previous findings (Lechner & Urban, 2024), based on the SEB skills (Soto et al., 2021; 2022a; 2022b) and EF

(Diamond, 2013; Miyake et al., 2000) frameworks, we hypothesised that EF would be positively associated with SEB skills (H3) and serve as a predictor of individual differences in SEB skills.

2.2. Materials and methods

2.2.1. Participants

The initial sample included 150 children. Of these, three did not complete the BESSI-45, and for another three the BRIEF-2 was missing. The final sample therefore consisted of 144 children ($M_{\text{age}} = 117.24$ months, $SD = 7.35$; 74 females). Participants were recruited from a school located in an urban area characterized by marked socioeconomic and sociocultural diversity and generally classified as a working-class neighbourhood. All children were enrolled in Grades 4 or 5 of primary school and were able to complete all the experimental tasks; although no clinical information was available, participation in the study required the absence of severe physical or psychological conditions that would prevent task completion. Parental consent was obtained before children participated in the study. Verbal assent was obtained from the children prior to the start of each session.

2.2.2. Materials

BRIEF-2 Teacher Report. To assess children's EF within the school environment, we used the Italian version of The Behaviour Rating Inventory of Executive Function for teachers, Second Edition (BRIEF-2) (Gioia et al., 2015). The BRIEF-2 is a standardized tool for children aged 5 to 18 years that comprises 63 items converging into 9 clinical scales, which are grouped into 3 indices: (I) Behavioral Regulation Index (BRI), (II) Emotion Regulation Index (ERI), and (III) Cognitive Regulation Index (CRI). The sum of the three indices BRI, ERI, and CRI forms the General Executive Functioning Composite (GEC). For each item, teachers are asked how often they observe a specific behaviour, with response options being 1 (never), 2 (sometimes), and 3 (always). Higher scores on each subscale indicate more EF problems. The BRIEF-2 showed high reliability in our

sample, with Cronbach's α coefficients ranging from .77 (Initiate) to .94 (Working Memory and Emotional Regulation) across different domains.

BESSI-45. Children's SEB skills were assessed using the 45-item Behavioral, Emotional, and Social Skills Inventory (BESSI; Soto et al., 2022), freely available for research purposes at the following link <http://www.sebskills.com> and translated into Italian by the second author. The instrument measures five domains—Social Engagement, Cooperation, Self-Management, Emotional Resilience, and Innovation—through short items describing behaviours, thoughts, or feelings. Each item is rated on a 5-point scale ranging from 1 (not at all well) to 5 (extremely well). The full 192-item BESSI has been extensively validated in adolescents and adults and recently standardized in Italian in a large sample aged 11–69 years (Feraco et al., 2024), showing excellent reliability (McDonald's ω between .78 and .89 across domains). For the present study, we opted for the shorter 45-item form, which is more practical for administration to younger children in school settings. Although the Italian short version has not yet been formally standardized, we examined the reliability of its subscales through Confirmatory Factor Analyses, reported below. To further support comparability, evidence of measurement invariance between children and adolescents is presented in the supplementary materials.

Socioeconomic Status. Socioeconomic status (SES) was computed through a Principal Component Analysis (PCA), as detailed below. The analysis included mother's and father's educational attainment as well as their occupational status. Parental occupations were classified according to the International Standard Classification of Occupations (ISCO-08; Ganzeboom, 2010), which distinguishes ten categories ranging from high-ranking to elementary occupations. Educational levels were coded following the International Standard Classification of Education (ISCED-11; OECD, Eurostat, & UNESCO Institute for Statistics, 2015), which spans nine levels, from preschool to doctoral or post-graduate specialization. In the informed consent form, parents were

provided with these categories for educational qualifications and occupation and were asked to indicate their own by placing an “x” in the appropriate category.

Fluid intelligence. Fluid intelligence was measured using the Raven’s Coloured Progressive Matrices (CPM; Raven et al., 1998; Italian standardization: Belacchi et al., 2008), a non-verbal test assessing abstract reasoning and problem-solving in children up to 11 years of age. The CPM consists of 36 coloured matrices, each displaying a pattern with a missing element that participants must complete by selecting the correct option from several alternatives. For analysis, we used the total raw score. In the present sample, the internal consistency of the CPM items was acceptable (Cronbach’s $\alpha=.77$), though lower than the values reported in prior studies with Italian school-aged children ($\alpha\approx.91$; Belacchi et al., 2008).

2.2.3. Procedure

The experimental protocol was approved by the Ethics Committee of the University of Genoa (approval no. 20230518). The study was first presented to parents during meetings held in the school context. All assessments were conducted by master’s students in psychology, supported by undergraduate trainees. Children completed the BESSI-45 (Soto et al., 2022) in group sessions conducted in their classrooms, while teachers simultaneously filled out the BRIEF-2 (Gioia et al., 2015). The CPM (Raven et al., 1998; Italian standardization by Belacchi et al., 2008) was likewise administered in classroom-based group sessions.

2.2.4. Data analyses

Data analyses were conducted in R (R Core Team, 2024, version 4.4.1). SES was derived through a Principal Component Analysis (PCA) using the “princals” function from the “Gifi” (Mair & De Leeuw, 2022) R package, which is specifically designed to handle ordinal data. Specifically, we collected information on mothers’ and fathers’ education and occupation and submitted these four variables to a Principal Component Analysis (PCA). After standardization, we extracted the first principal component using the “princals” function from the “Gifi” package (Mair & De Leeuw,

2022). This component explained 68% of the variance and was used to derive the SES index by multiplying standardized scores with the loadings of the first principal component.

The validity of the BESSI-45 was evaluated through Confirmatory Factor Analysis (CFA). For each of the five domains, a latent factor was specified based on the nine corresponding items, with correlated residuals included for item pairs within the same skill facet. An exception was made for the Self-Management domain, which comprises nine items drawn from distinct facets. Following previous validation studies (Feraco et al., 2024; Sewell et al., 2024), all items were treated as ordinal variables, and model estimation was carried out using Diagonally Weighted Least Squares (DWLS; Brauer et al., 2023; Shi et al., 2020). Associations among SEB skills, EF, SES, gender, and fluid intelligence were examined using Pearson's correlation matrices.

To explore the structural relations between SEB skills and EF, we employed Structural Equation Modelling (SEM). Four SEM models were estimated, each corresponding to one latent factor identified by the CFA (excluding the Innovation scale since it showed a scarce reliability).

Predictors included gender, fluid intelligence, the General Executive Composite (GEC) from the BRIEF-2 (Gioia et al., 2015), and the SES index obtained from the PCA. Model fit was evaluated through the normed chi-square (χ^2/df), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), and Standardized Root Mean Square Residual (SRMR). A lower chi-square indicates better fit but should be interpreted considering degrees of freedom and sample size. CFI and TLI values above .95, along with SRMR values below .08, were considered indicative of good model fit. For both the CFAs and the SEMs, we utilized the “sem” function from the R package “lavaan” (Rosseel, 2012).

2.3. Results

Descriptive statistics of the variables are presented in Table 2.1. Correlations among variables are presented in table 2.2. None of the BESSI-45 scales showed a significant association with SES, whereas all scales were correlated with executive functioning (GEC). Only the Innovation and

Cooperation scales were correlated with fluid intelligence (CPM). Figure 1.1. shows the bivariate relations among the study variables in a scatterplot matrix.

Table 2.1. Descriptive Statistics.

Variable	N	Mean	SD	Median	Skew	Kurtosis
Age in months	144	117.243	7.356	117.5	-.029	-1.036
CPM	144	30.743	4.120	32	-1.362	1.812
SM	144	3.789	.667	3.889	-.684	.810
INN	144	3.816	.574	3.889	-.368	.101
COO	144	3.845	.650	3.889	-.551	.591
SE	144	3.620	.638	3.667	-.648	.791
ER	144	3.357	.824	3.333	-.110	-.636
GEC	144	12.466	3.546	11.017	1.260	.986
SES	144	0	2.684	-.780	.722	-.400

Note. CPM = Raven's Coloured Progressive Matrices. SM = Self-Management; INN = Innovation; COO = Cooperation; SE = Social Engagement; ER = Emotion Resilience, scales of the BESSI-45. GEC = General Executive Composite of the BRIEF-2. SES = Socioeconomic Status Index. Skew= Skewness.

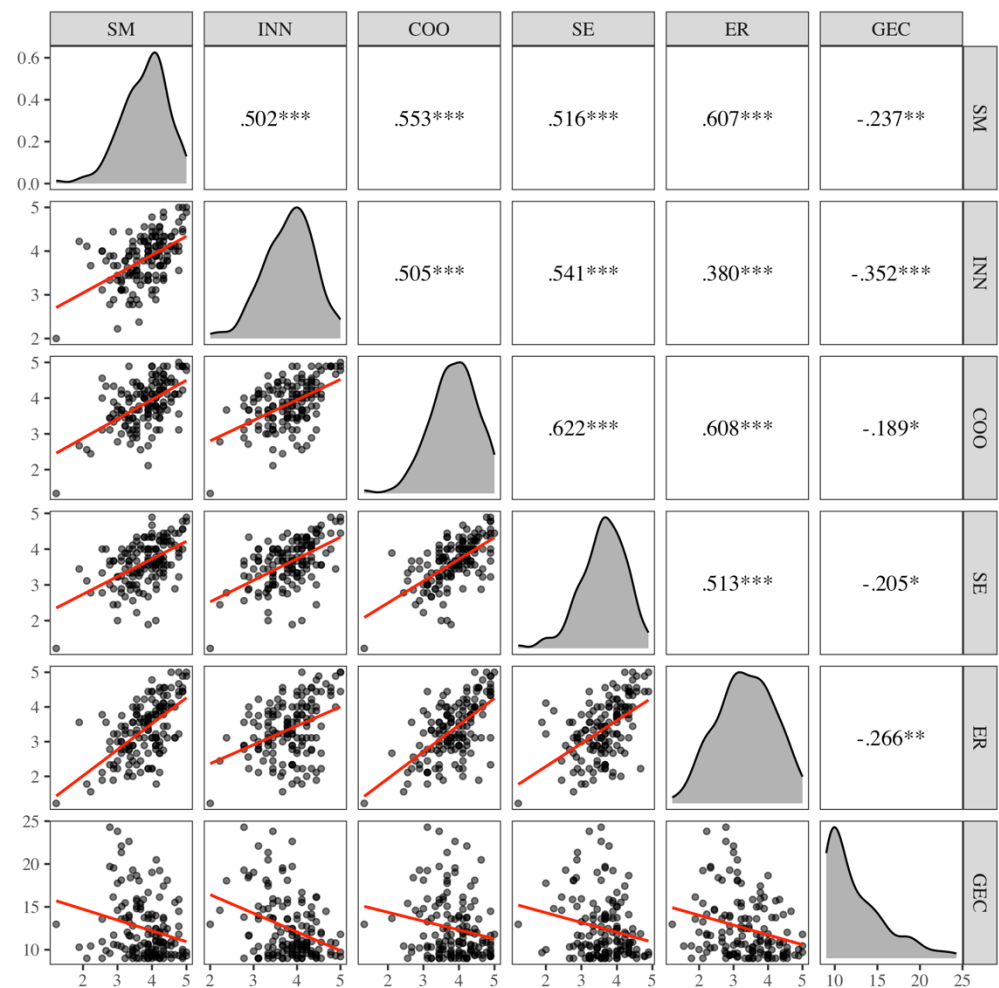
Table 2.2. Correlations between Variables.

Variable name	1	2	3	4	5	6	7	8	9
1. SM	-								
2. INN	.502***	-							
3. COO	.553***	.505***	-						
4. SE	.516***	.541***	.622***	-					
5. ER	.607***	.380***	.608***	.513***	-				
6. GEC	-.237**	-.352***	-.189*	-.205*	-.266**	-			
7. CPM	.014	.297***	.214**	.103	.044	-.288***	-		
8. SES	-.053	.042	.056	.006	-.097	-.165*	.090	-	
9. Gender	-.120	-.089	.026	.010	-.014	.326***	-.054	-.118	-

Note. N = 144. SM = Self-Management; INN = Innovation; COO = Cooperation; SE = Social Engagement; ER = Emotion Resilience, scales of the BESSI-45 (Innovation scale was excluded from the analyses). GEC = General Executive Composite of the BRIEF-2. CPM = Raven's Coloured Progressive Matrices. SES = Socioeconomic Status Index.

$p < .05$, ** $p < .01$, *** $p < .001$.

Figure 2.1. Scatterplots Illustrating Bivariate Relations Among Main Study Variables.



Note. Pearson correlation coefficients are reported in the upper panels. The diagonal panels display kernel density estimates of each variable, illustrating their univariate distributions. SM = Self-management; INN = Innovation; COO = Cooperation; SE = Social engagement; ER = Emotion regulation; GEC = General executive competence. $p < .05$. $p < .01$. $p < .001$.

The results of the CFAs were mainly satisfactory. Except for the Innovation model, CFI and TLI were always higher than .98, SRMR was always lower than .07 and Cronbach's α and McDonald's ω ranged between .67 and .86. Innovation did not fit the data well (CFI = .90; TLI = .84; SRMR = .12) and ω was low (.59). All the results are reported in Table 2.3.

Table 2.3. Fit Indices of the Five Measurement Models of the BESSI 45.

	Parameters	χ^2	df	CFI	TLI	SRMR
SM	45.00	34.216	27.00	.99	.99	.06
INN	49.00	83.32	23.00	.90	.84	.12
COO	49.00	20.91	23.00	1.00	1.00	.05
SE	49.00	25.439	23.00	.99	.99	.06
ER	49.00	40.26	23.00	.99	.98	.07

Note. N = 144. SM = Self-Management; INN = Innovation; COO = Cooperation; SE = Social Engagement; ER = Emotion Resilience, scales of the BESSI-45.

To compare the factorial validity and structure of the BESSI-45 in our primary-school sample with the middle and high-school sample of the validity study, we replicated the same analyses using the open data (702 adolescents from 12 to 20 years old) provided by Feraco et al. (2024; <https://doi.org/10.17605/OSF.IO/VYZPN>) and compared the model indices using multigroup CFAs. Model fit and reliability coefficients were similar in the two datasets (Table A1 in Appendix 1). Multigroup CFAs also confirm that the models are mainly equivalent in the two age groups (Table A2 in Appendix 1). Specifically, we achieved strong scalar invariance (equality of factor loadings and intercepts) for Self-Management, Cooperation, and Emotional Resilience and metric

invariance (equality of the factor loadings) for Social Engagement and Innovation. The results of this additional analysis are reported in the Appendices (Appendix 1).

The results of the structural equation models are presented in Table 2.4. The goodness-of-fit indices for all models indicate a satisfactory fit: Self-Management, $\chi^2/df = 1.13$, CFI = .992, TLI = .995, RMSEA = .030, SRMR = .067; Cooperation, $\chi^2/df = .96$, CFI = 1.000, TLI = 1.002, RMSEA = .000, SRMR = .054; Social Engagement, $\chi^2/df = 1.06$, CFI = .991, TLI = .994, RMSEA = .020, SRMR = .058; Emotional Resilience, $\chi^2/df = 1.18$, CFI = .994, TLI = .996, RMSEA = .035, SRMR = .064.

Table 2.4. Standard Estimates and Confidence Intervals of Predictors on the BESSI 45 Scales from the Structural Equation Models.

Paths			Estimates ^a	SE	95% CIs		<i>p</i>
					LL	UL	
Self-Management	predicted by	Gender	-.051	.096	-.241	.138	.594
Self-Management	predicted by	CPM	-.048	.088	-.222	.125	.584
Self-Management	predicted by	SES	-.110	.095	-.297	.076	.245
Self-Management	predicted by	BRIEF-2 GEC	-.286	.085	-.453	-.119	.001**
Cooperation	predicted by	Gender	.087	.102	-.113	.288	.394
Cooperation	predicted by	CPM	.171	.088	-.002	.344	.053
Cooperation	predicted by	SES	-.005	.090	-.181	.171	.953
Cooperation	predicted by	BRIEF-2 GEC	-.195	.089	-.369	-.021	.028*
Social Engagement	predicted by	Gender	.103	.105	-.103	.310	.327
Social Engagement	predicted by	CPM	.042	.100	-.154	.239	.674
Social Engagement	predicted by	SES	-.038	.095	-.223	.148	.691
Social Engagement	predicted by	BRIEF-2 GEC	-.261	.094	-.445	-.076	.006**

Emotional Resilience	predicted by	Gender	.079	.091	-.099	.257	.384
Emotional Resilience	predicted by	CPM	-.031	.092	-.212	.149	.734
Emotional Resilience	predicted by	SES	-.134	.091	-.312	.044	.141
Emotional Resilience	predicted by	BRIEF-2 GEC	-.333	.089	-.507	-.159	<.001***

Note. N=144. ^astandardized estimates. SM = Self-Management; INN = Innovation; COO = Cooperation; SE = Social Engagement; ER = Emotion Resilience, scales of the BESSI-45 (Innovation scale was excluded from the analyses). GEC = General Executive Composite of the BRIEF-2. CPM = Raven's Coloured Progressive Matrices. SES = Socioeconomic Status Index. LL = Lower limit; UL = Upper limit.

$p < .05$; ** $p < .01$; *** $p < .001$

In all four the models, the GEC index of the BRIEF-2 emerged as a significant negative predictor of SEB skills. Specifically, higher GEC scores (indicating more EF difficulties) were associated with lower levels of Self-Management, Cooperation, Social Engagement, and Emotional Resilience. These results suggest that better EF is associated with better SEB skills. Conversely, fluid intelligence, SES, and gender did not show significant associations with any SEB scale, except for a marginal effect of CPM on Cooperation ($\beta = .171, p = .053$). These findings suggest that EF may play a meaningful role in explaining individual differences in SEB competencies in this age group.

2.4. Discussion

In recent years, increasing attention has been dedicated to so-called soft skills, often contrasted with hard skills such as technical or academic knowledge. Soft skills have been widely recognized by educators, policymakers, and employers as crucial for success in school, work, and everyday life, given their role in fostering adaptability, collaboration, and effective self-regulation. However, research in this area has long been characterized by considerable heterogeneity in definitions, measurement approaches, and theoretical frameworks, which has hindered the development of a cumulative body of evidence. To address this conceptual fragmentation, recent scholarship has

advanced the broader framework of Social, Emotional, and Behavioral skills (Soto et al., 2021; Soto et al., 2022), providing a more systematic and developmentally grounded account of the competencies underlying what has traditionally been referred to as soft skills. SEB skills refer to the functional capacities that individuals use to regulate emotions, manage goal-directed behaviors, and engage in effective social interactions (Soto et al., 2021; Soto et al., 2022a; 2022b). These competencies are foundational for children's adaptation in school and everyday life, as they contribute to academic achievement, well-being, and positive peer relationships (Lechner et al., 2022; Yoon et al., 2024). Early assessment of SEB skills is therefore crucial to promote timely interventions, particularly in middle childhood, a developmental stage where these skills undergo significant consolidation. The first aim of this study was to evaluate the psychometric properties of the BESSI-45 in children aged 8–11 years. In line with Hypothesis 1, four scales—Self-Management, Cooperation, Social Engagement, and Emotional Resilience—demonstrated satisfactory model fit and internal consistency, supporting the validity of the instrument in primary school populations. However, the Innovation scale did not reach acceptable levels of fit. One explanation is that traits such as creativity, curiosity, and openness to novelty are still emerging in middle childhood and may not be consistently observable or reportable at this age. As suggested by Soto et al. (2021) and Feraco & Meneghetti (2023), SEB skills, and particularly those linked to innovation, tend to become more differentiated during adolescence. Thus, the Innovation scale may require further refinement to ensure developmental appropriateness for younger children. The second aim addressed the associations of SEB skills with SES and EF. Regarding SES, our results revealed no significant correlations with SEB skills, as hypothesized (H2). This finding is consistent with earlier evidence suggesting that SEB skills may be less sensitive to socioeconomic disparities than cognitive outcomes. For example, Lechner et al. (2021) reported only small SES-related differences in SEB skills among German secondary school students, in contrast to the much larger inequalities observed in cognitive performance. At the same time, more recent research in adolescence has pointed to stronger effects of parental education and migration background on SEB

development (Lechner & Urban, 2024). One possible explanation for the discrepancy could be that in middle childhood SEB skills may be less directly shaped by structural inequalities. Another possible explanation is methodological. Although our sample was drawn from a socioeconomically heterogeneous context, it originated from a single school, which may have reduced the SES variability within the sample and, consequently, limited our ability to detect associations. Taken together, our findings suggest that the impact of SES on SEB skills may increase later in development and highlight the need for future research with larger and more socioeconomically diverse samples to clarify the extent and mechanisms of SES-related differences.

Supporting Hypothesis 3, EF—assessed through the General Executive Composite (GEC) of the BRIEF-2—was significantly associated with all four SEB domains, while the fluid intelligence was correlated only with the Cooperation scale. Higher SEB skills were linked to fewer EF difficulties, consistent with evidence that executive processes provide a cognitive foundation for the regulation of behaviour, emotions, and social interactions (Diamond, 2013; Doebel, 2020). Structural equation models further underscored EF as the only significant predictor of SEB skills across domains, highlighting its central role in socio-emotional development during middle childhood. Although a significant correlation was found between fluid intelligence and the Cooperation scale, this association became nonsignificant in the SEM when executive functioning was added to the model. These findings suggest that interventions designed to strengthen EF—through activities such as sports, music, mindfulness, or other structured extracurricular programs—may also enhance SEB skills (Diamond & Ling, 2016; Feraco et al., 2022; Feraco & Meneghetti, 2022). Despite these promising findings, several limitations should be acknowledged. The sample was drawn from a single school in Northern Italy and showed a restricted age range, limiting generalizability and preventing analyses of age-related differences, such as testing whether associations differed between younger and older participants. Moreover, the cross-sectional design does not allow conclusions about developmental trajectories or causal relations between executive functions and social–emotional and behavioral skills. Finally, the use of different informants for EF (teacher

report) and SEB skills (self-report) may introduce method-related bias. Future studies using larger, more diverse samples, longitudinal designs, and multi-informant approaches are needed.

In conclusion, this study provides initial evidence supporting the use of the BESSI-45 as a valid measure of SEB skills in middle childhood, apart from the Innovation scale. The findings underscore the central role of executive functioning in predicting SEB skills, while suggesting that SES may exert its influence through more indirect pathways. Together, these results highlight the importance of integrating cognitive and socio-emotional perspectives in educational practice, with the aim of fostering holistic child development and resilience.

Chapter 3

Study 2: Exploring the influence of socioeconomic status on pragmatic language: do executive functions and grammar comprehension have a mediating role?

Abstract

This study was recently published in the *Journal of Child Language* (Cravet & Usai, 2025). It originates as a continuation of my master's thesis project, in which I investigated pragmatic language skills in individuals with autism spectrum disorder without intellectual disability. Given the relevance of this still underexplored domain, I sought to examine the effects of socioeconomic status (SES) on pragmatic language (PL) in a typically developing sample, and to explore the role of executive function (EF) and grammar comprehension (GC) in this relationship. Specifically, this study explores the relationships among SES, EF, GC, and PL in children aged 8–11. By employing a structural equation modelling approach, we aimed to investigate the direct and indirect effects of these variables on PL, a crucial aspect of child development involved in the formation of social relationships and general well-being. Our final sample consisted of 128 children, who were the same participants included in Study 1 and corresponded to the two groups (intervention and control) of Study 4. Participants were assessed using the APL Medea, TROG-2, and TeleFE tests to measure their PL, GC, and EF, respectively. The findings reveal that GC and EF are important predictors of PL, with GC playing a central role in mediating the effects of SES. In conclusion, this study highlights the key role of GC in connecting SES and PL, with strong practical implications for interventions aimed at mitigating the adverse effects of socioeconomic factors.

In the subsequent paragraphs, I will present a synthesis of the paper, including its theoretical framework, objectives, methodology, and key results. Since a single overall EF score was computed from different EF tasks, the term “EF” (rather than “EFs”) will be used throughout this chapter.

3.1. Introduction

3.1.1. Definition of pragmatic language

Pragmatic language (PL) can be broadly defined as the use of language within communicative contexts (Ariel, 2010). This notion encompasses a wide set of abilities, including sustaining conversations, providing contextually appropriate responses, respecting politeness norms, interpreting implied meanings, and understanding non-literal expressions such as irony, sarcasm, or jokes (Matthews et al., 2018). The developmental trajectory of PL begins very early: between 9 and 18 months, children typically demonstrate sensitivity to others' intentions and engage in joint attention, which forms the foundation for later social interaction skills (Alduais et al., 2022). As development progresses, children acquire more sophisticated pragmatic strategies, such as adapting language to the listener's needs and interpreting conversational signals—skills that are already evident around the age of four (Longobardi et al., 2017). These abilities continue to evolve throughout childhood and adolescence, with gradual refinement driven by exposure to varied social contexts and communicative partners (O'Neill, 2007).

Lexical and grammatical knowledge, in both comprehension and production, are crucial for supporting PL development. As children's vocabulary and grammar expand, they become increasingly able to tailor their communicative style to different interlocutors and contexts, as well as to adopt the perspective of others—both central prerequisites for effective communication (Alduais et al., 2022; Longobardi et al., 2017; Matthews et al., 2018). However, while closely interconnected, vocabulary and grammar alone do not provide a sufficient account of linguistic competence. Pragmatic processing must also be considered, as it enables the listener to move beyond literal decoding and to construct a nuanced interpretation of the speaker's intended meaning in a given context (Ariel, 2010; Matthews et al., 2018; Wilson & Bishop, 2021).

The importance of PL for child development has been repeatedly underscored, given its central role in fostering social relationships, facilitating contextual adaptation, and contributing to general well-being (Camia et al., 2021). Evidence from clinical populations supports this claim: children with autism spectrum disorder (ASD) or with traumatic brain injuries (TBIs) often present with

pragmatic deficits, which are strongly associated with difficulties in social functioning (Eigsti et al., 2011; Hendrix et al., 2020). Moreover, PL has been shown to act as a mediator in the link between hyperactivity/inattention and social skills difficulties (Leonard et al., 2011). Longitudinal findings further confirm the impact of PL on socio-emotional development: for instance, children with developmental language disorder who displayed persistent emotional and peer-related difficulties from childhood into adolescence were found to have significantly lower PL scores at age 11 (Conti-Ramsden et al., 2019). Finally, evidence from typically developing populations suggests that higher PL proficiency predicts stronger social skills, independent of diagnostic status (Pierpont et al., 2018). Collectively, these findings underline that pragmatic competence constitutes a pivotal element of social functioning and, ultimately, of overall well-being.

3.1.2. Relationship between pragmatic language and executive function

Executive functions (EFs) refer to a set of neurocognitive processes that enable the deliberate, top-down regulation of attention, behaviour, and emotions (Friedman & Miyake, 2017; Zelazo & Carlson, 2020). A broad consensus exists in the literature regarding three core EFs components that underpin behavioural, cognitive, and emotional self-regulation: inhibition (including inhibitory control and resistance to interference), working memory (and its updating), and cognitive flexibility (Diamond, 2013; Gandolfi et al., 2014; Gärtner & Strobel, 2021; Miyake et al., 2000).

Developmental studies indicate that working memory and inhibition emerge early in infancy, show substantial progress between the ages of 3 and 5, and continue to develop until late adolescence (18–20 years). Cognitive flexibility appears slightly later, around ages 3–4, undergoes refinement between 7 and 9 years, and reaches adult-like levels between 12 and 15 years (Ferguson et al., 2021).

The relationship between EFs and language development has been widely examined, though its direction remains debated. While some scholars argue that EFs facilitates language growth, others propose the reverse; current evidence, however, suggests that EFs and language should be

considered distinct but interrelated domains (Gooch et al., 2016; Slot & von Suchodoletz, 2018). For instance, Romeo et al. (2022) reported a bidirectional relationship between EFs and language in children aged 4–5, with neither direction prevailing over the other. Far less is known about how EFs interacts specifically with PL across development. A longitudinal study by Currie and Muijselaar (2019), which investigated inference-making in relation to vocabulary and verbal working memory in typically developing children (ages 4–9), revealed that vocabulary rather than working memory predicted advances in inference-making. However, because this study did not take into account other EFs components, further research is needed to clarify the developmental interplay between EFs and PL.

Cross-sectional findings point to a more consistent directional association from EFs to PL, both in typically developing children and in those with developmental disorders (Filipe et al., 2020; Nilsen et al., 2021; Ouerchefani et al., 2024; Razavi et al., 2019). This influence can be understood through the specific demands of communicative interaction, where EFs supports the inhibition of speech to maintain conversational turn-taking, the pre-planning of utterances, the organisation of information for coherent narrative construction, the cognitive flexibility required to negotiate arguments, and the ongoing updating of both linguistic and contextual information (Matthews et al., 2018). Evidence from clinical populations provides additional support: studies with patients with prefrontal cortex damage have demonstrated that EFs deficits predict impairments in the comprehension of non-literal language (Ouerchefani et al., 2024). Similarly, research on children with autism spectrum disorder (ASD) has found strong associations between EFs and PL. Razavi et al. (2019), for example, identified a significant negative correlation, suggesting that higher EFs performance is linked to fewer pragmatic difficulties in social communication. Filipe et al. (2020) further reported that EFs mediated group differences in PL between ASD and typically developing children, indicating that pragmatic difficulties in ASD may be explained, at least in part, by executive dysfunction. Complementary findings were provided by Nilsen et al. (2021), who showed that EFs moderates the relationship between shyness and PL. Collectively, these results converge in

highlighting EFs as a central determinant of pragmatic competence, with implications for both typical and atypical developmental trajectories.

3.1.3. The role of socioeconomic status in executive function and language development

It is well established that SES exerts a significant influence on multiple neurocognitive domains, including language, memory, executive function, and socio-emotional processing (Lawson et al., 2018; Pace et al., 2017; Ursache & Noble, 2016). The mechanisms underlying these effects are complex and multifactorial, encompassing both the quantity and quality of linguistic input provided by caregivers—such as the diversity and sophistication of vocabulary and grammar—as well as access to learning resources like books. Children from low-SES backgrounds are often exposed to fewer opportunities for language enrichment and cognitive stimulation (Pace et al., 2017; Ursache & Noble, 2016).

Empirical evidence indicates that children growing up in socioeconomically disadvantaged environments tend to underperform on a variety of EFs tasks, including those assessing working memory, inhibitory control, and attentional shifting (Farah et al., 2006; Noble et al., 2007; Sarsour et al., 2011). Similarly, SES disparities have been consistently linked to differences in language abilities, with lower SES associated with poorer performance in vocabulary, phonological awareness, word decoding, reading comprehension, and grammar (see Letourneau et al., 2013; Pace et al., 2017, for reviews and meta-analyses). Research further suggests that family-related factors—such as the richness of linguistic input in the home and exposure to chronic stress—may act as mediators between socioeconomic disadvantage and the brain regions supporting EFs and language (Merz et al., 2019). In line with this, Romeo et al. (2022) found that language mediated the relationship between SES and EFs at age three, and this model provided a better fit than the reverse mediation. However, as the study did not extend its analyses to later developmental stages, the possibility remains that the direction of mediation may shift over time, with EFs potentially mediating the impact of SES on language in older children. This underscores the importance of

examining multiple developmental pathways to fully understand the interplay between SES, EF, and language across childhood.

By contrast, the influence of SES on PL has been less thoroughly investigated, and findings are inconsistent. Bosco et al. (2013) reported a moderate SES effect, with children from higher SES families outperforming their peers in pragmatic tasks. More recent studies, however, have suggested that SES exerts only a partial—or even negligible—impact on PL (Bosco & Gabbatore, 2017; Qasem et al., 2022; Schulze & Saalbach, 2022). The interpretation of these findings is further complicated by the frequent overlap between SES and multilingual background (MB). Families from lower SES are often migrant households in which a minority language is spoken at home (Bellocchi & Bonifacci, 2023). Although a growing body of research—independent of SES—has documented effects of multilingual exposure on PL abilities (van Wonderen et al., 2023), it is unclear whether such effects should be attributed to multilingualism per se or to socioeconomic factors intertwined with it (Bellocchi & Bonifacci, 2023). Disentangling the specific contributions of SES and MB therefore requires careful attention to variables such as proficiency levels, type and quantity of language exposure, and age of acquisition, ideally within samples where bilingualism and multilingualism occur across the full socioeconomic spectrum.

In the present study, we address this issue by focusing on the relationship between SES and PL within a socioeconomically heterogeneous context, in which children facing greater economic disadvantage frequently also come from multilingual backgrounds.

3.1.4. Aims and hypotheses of the present study

The present study aimed to test direct and indirect links among socioeconomic status, grammar comprehension, executive functioning, and pragmatic language. Our first hypothesis (H1) was that both GC and EF directly predict PL, consistent with evidence that core linguistic abilities such as grammar are essential for pragmatic understanding (Ariel, 2010; Matthews et al., 2018; Wilson & Bishop, 2021) and with findings highlighting the pivotal role of EF in supporting PL (Filipe et al.,

2020; Nilsen et al., 2021; Ouerchefani et al., 2024; Razavi et al., 2019). Our second hypothesis (H2) was that SES influences both GC and EF, in line with research on SES-related differences in cognitive and linguistic skills (Farah et al., 2006; Merz et al., 2019; Noble et al., 2005, 2007; Pace et al., 2017). In contrast, we hypothesized that SES does not exert a direct effect on PL (H3), consistent with studies reporting minimal or null associations between SES and pragmatic abilities (Bosco & Gabbatore, 2017; Qasem et al., 2022; Schulze & Saalbach, 2022). Finally, we aim to examine whether EF and GC mediate the SES–PL relationship, hypothesizing (H4) that both act as mediators given their proposed role in PL (H1) and their sensitivity to SES (H2).

3.2. Materials and methods

3.2.1. Participants

The initial sample, consistent with Study 1 (Chapter 2), comprised 150 children. Of these, 18 were excluded due to a confirmed or suspected neurodevelopmental disorder or because they had an individualized educational plan (Piano Didattico Personalizzato) within regular classes related to extreme social circumstances, and 4 were excluded for insufficient proficiency in Italian. The final sample included 128 children aged 8–11 years (69 girls; $M_{\text{age}} = 9;7$, $SD = 0;6$). Participants were recruited from a school in Genoa characterized by a large immigrant population and heterogeneous SES. Within the sample, 60 children had an immigrant background (MB) and represented the most socioeconomically disadvantaged subgroup, reflecting the demographic profile of the area.

3.2.2. Materials

APL Medea. Pragmatic language was assessed using the APL Medea, an Italian standardized battery designed for children aged 5–14 years (Lorusso, 2009). In this study, we administered the Metaphors test—comprising the subtests Verbal Metaphors and Figurative Metaphors—and the Understanding of Implicit Meaning test, which measures the ability to infer non-explicit content. The author reports excellent internal consistency (Cronbach's $\alpha = .92$).

Verbal metaphors. This subtest consists of four metaphorical expressions (e.g., Marco oggi si sente un leone [“Marco feels like a lion today”]). Children are asked to explain each sentence, with responses scored as 0 (unclear), 1 (partially correct), or 2 (fully correct), for a maximum of 8 points.

Figurative metaphors. This subtest also includes four metaphorical expressions, read aloud by the examiner. For each, children select the corresponding image from four alternatives. Correct responses receive 2 points, incorrect responses 0 points, yielding a maximum of 8 points.

Understanding of implicit meaning. This subtest comprises three short stories with implicit meanings, presented orally and also provided in written form to reduce working memory demands. After each story, children answer comprehension questions (five for the first two stories and four for the third). Responses are scored as 0 (incorrect), 0.5 (partially correct), or 1 (fully correct), with a maximum total of 14 points.

TROG-2. To assess grammatical comprehension, we used the Test for Reception of Grammar – Version 2 (TROG-2; Bishop, 2009), standardized in Italy for children aged 4–16 years. The test consists of 80 multiple-choice items with four options each, employing simple vocabulary (nouns, verbs, and adjectives). Comprehension is evaluated by asking participants to select the figure corresponding to the target sentence. Items are grouped into grammatical contrasts of four; a set is passed only if all four responses are correct. The total score corresponds to the number of sets successfully completed, with a maximum of 20. The authors report good reliability (Cronbach’s $\alpha = .88$).

TeleFE. To assess EF, we used TeleFE (Rivella et al., 2023), a tele-assessment tool standardized in Italy for children aged 6–13 years. The platform includes tasks tapping inhibition, interference suppression, working memory, cognitive flexibility, interference control, and planning. In the present study, only inhibition, interference suppression, working memory, cognitive flexibility, and interference control were assessed using the Go/No-Go, Flanker, and N-Back subtests.

Go/No-Go. In this task, children viewed a sequence of geometric figures (e.g., coloured triangles and circles) and were instructed to respond to target stimuli by pressing the spacebar while withholding responses to non-targets. The inhibition score was based on accuracy in “no-go” trials. Reported reliability is acceptable (Cronbach’s $\alpha = .68$; Rivella et al., 2023).

Flanker. The Flanker task assessed interference control and cognitive flexibility. It consisted of three blocks: (1) blue arrows—identify the central arrow’s direction; (2) orange arrows—identify the direction of the outer arrows; (3) mixed rules—apply the central-arrow rule for blue arrows and the outer-arrow rule for orange arrows. Each block included 50% congruent and 50% incongruent trials. Interference control was scored based on accuracy in incongruent trials of the single-rule blocks; cognitive flexibility was scored based on accuracy in incongruent trials of the mixed-rules block. Reported reliability was excellent (Cronbach’s $\alpha = .92-.93$ for single-rule blocks; $.91-.86$ for mixed-rule blocks; Rivella et al., 2023).

N-Back. The N-Back task included two conditions (colours and shapes) with two levels each (1-Back, 2-Back), for a total of four blocks. In the 1-Back, children pressed the spacebar when a stimulus matched the immediately preceding one; in the 2-Back, when it matched the one presented two trials earlier. Working memory scores reflected accuracy in detecting targets in each block. Reliability was good (Cronbach’s $\alpha = .91$ for 1-Back; $.75$ for 2-Back; Rivella et al., 2023).

Socioeconomic Status. Socioeconomic status was calculated following the same procedure as in Study 1 (Chapter 2).

Multilingual background. Information on multilingual background (MB) was obtained through teachers, who indicated which children were exposed to a language other than Italian at home, given their close contact with families. No additional data were collected regarding the specific home languages or children’s proficiency in them.

3.2.3. Procedure

The experimental protocol was approved by the Ethics Committee of the University of Genoa (approval no. 20230518). Data were collected through both group and individual assessment sessions. Each class participated in two group sessions of approximately 45 minutes. For each session, the class was divided alphabetically into two subgroups (maximum 10 children). One subgroup completed the TeleFE battery in the school computer room under supervision (ratio 1–3), with all computers standardized in hardware, operating system, and Ethernet connection. Simultaneously, the other subgroup completed the APL Medea subtests (Verbal Metaphors, Figurative Metaphors, and Understanding of Implicit Meaning) in the classroom. For group administration, children recorded their answers in individual protocols, which were later coded according to the manual. Stimuli for Figurative Metaphors were presented via projector, while those for Verbal Metaphors and Understanding of Implicit Meaning were read aloud by the experimenters.

The order of administration was counterbalanced across classes: in some, the first subgroup began with TeleFE and in others with APL Medea. Group sessions were scheduled in collaboration with the school to accommodate organizational needs. In addition, each child took part in an individual 25-minute session to assess grammatical comprehension using the TROG-2 (Bishop, 2009).

Assessments were conducted by master's students in psychology, assisted by bachelor's students. Verbal assent was obtained from children prior to each session.

3.2.4. Data analyses

Analyses were conducted in R version 4.3.2 for macOS (R Core Team, 2024). The socioeconomic index was derived following the same procedure as in Study 1 (Chapter 2). Multilingual background (MB) was coded dichotomously based on teacher reports (1 = exposed to another language at home; 0 = not exposed). Scores from the TROG-2 (Bishop, 2009), TeleFE, and APL Medea (Lorusso, 2009) subtests were standardized (*z*-scores). *Z*-scores were then averaged to

compute overall EF and PL scores. To control for age effects, residuals of EF, PL, and GC were obtained through linear regressions.

Associations among SES, MB, EF, GC, and PL were first examined using Pearson’s correlations (“corr.test” function of the “psych” package; Revelle, 2023). Structural equation modelling (SEM) was then performed with the “sem” function from “lavaan” package (Rosseel, 2012), accounting for clustering by class. Model fit was evaluated using normed chi-squared (χ^2/df), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), and standardized root mean square residual (SRMR). Good fit was defined as CFI and TLI $\geq .95$ and SRMR $\leq .08$ (Kline, 2015). Models were bootstrapped with 5,000 replications.

To further examine the latent structure of EF, an exploratory factor analysis (EFA) was conducted, revealing a two-factor solution consistent with the literature (Lee et al., 2013). Nevertheless, the single-factor EF model showed superior fit indices, including the lowest AIC and BIC values, supporting the use of an overall EF score as the most parsimonious and explanatory representation. Full details of the EFA and alternative SEM models are reported in Appendix 2.

3.3. Results

Descriptive statistics of the variables are presented in Table 3.1. Correlations between variables are presented in Table 3.2. Pragmatic language is significantly correlated with all the examined variables.

Table 3.1. Descriptive statistics of the raw scores.

	M	SD	Skewness	Kurtosis
1-Back	28.35	4.99	-2.29	5.11
2-Back	20.30	6.12	.14	-.87
Flexibility	20.59	5.95	-.68	.17
Interference Control	30.62	9.58	-1.34	1.01
Inhibition	43.16	7.67	-.93	1.77
Verbal Metaphors	3.76	1.59	-.20	-.12
Figurative Metaphors	3.69	2.31	-.09	-1.07
Implicit Meaning	8.67	2.51	-.41	-.71
TROG-2	14.06	3.28	-.45	-.58
SES	.07	2.75	.69	.46

Note. N=128. M=Mean. SD= Standard Deviation. (a) 1-Back, (b) 2-Back, (c) Flexibility, (d) Interference Control, (e) Inhibition= subtests of the TeleFE battery. (a) Verbal Metaphors, (b) Figurative Metaphors, (c) Implicit Meaning= subtests of the APL Medea battery. SES = Socio-Economic Status index.

Table 3.2. Correlation matrix among the pragmatic language, executive function, grammar comprehension, multilingual background and index of socio-economic status.

Variable	1	2	3	4	5
1.PL	-				
2.EF	.42***	-			
3.GC	.55***	.48***	-		
4.MB	-.28**	-.11	-.22*	-	
5.SES	.27**	.18.	.21*	-.50***	-

Note. N= 128. PL= Pragmatic Language; EF= Executive Function; GC= Grammar Comprehension; MB=Multilingual Background; SES = Socio-Economic Status index.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Structural Equation Modeling. Table 3.3 reports the direct and indirect effects estimated through SEM. The model demonstrated satisfactory fit indices: $\chi^2/df = 1.85$, CFI = .98, TLI = .92, SRMR = .04. Direct paths from both GC and EF to PL were statistically significant, whereas the direct path from SES to PL was not. SES exerted a statistically significant indirect effect on PL through GC, but not through EF. Moreover, the sequential indirect effect of SES on PL via both EF and GC was non statistically significant. Based on theoretical grounds, SES and MB were allowed to correlate in the model; this correlation did not affect the overall model structure. The final model is illustrated in Figure 3.1.

Table 3.3. Direct and indirect effects of the SEM.

Paths					95% CIs	
					LL	UL
GC	on	PL			.37***	.21 .53
EF	on	PL			.17*	.01 .32
SES	on	PL			.14	-.01 .29
SES	on	GC			.21**	.06 .36
SES	on	EF			.18*	.01 .34
SES	with	MB			-.50***	-.62 -.38
EF	with	GC			.46***	.33 .58
EF	with	GC	on	PL	.17**	.08 .26
SES	on	PL	through	GC	.08*	.01 .14
SES	on	PL	through	EF	.03	-.01 .07
SES	on	PL	through	EF with GC	.03	-.00 .06

Note. N= 128. PL= Pragmatic Language; EF= Executive Function; GC= Grammar Comprehension; MB=Multilingual Background; SES = Socio-Economic Status index.

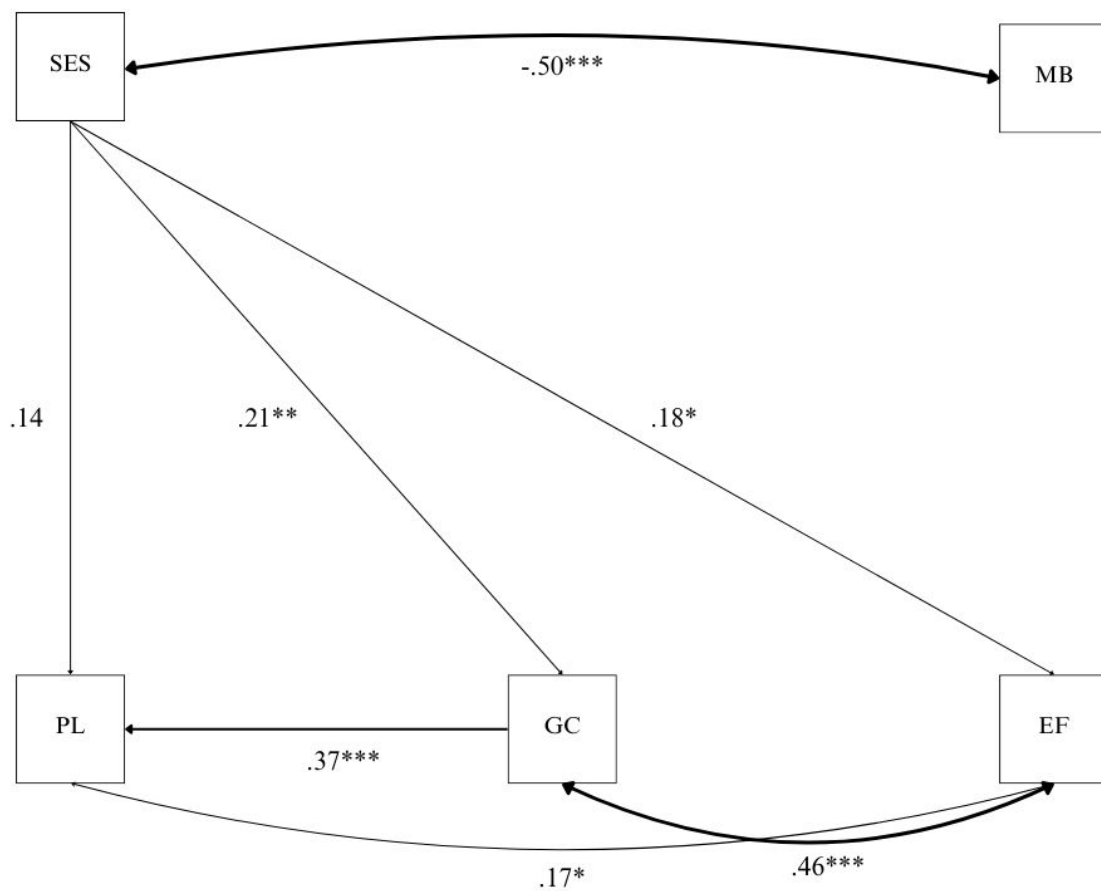
on= direct effect; through=indirect effect; with= correlation.

CIs= confidence intervals; LL=lower limit; UL= upper limit.

^astandardized estimates.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 3.1. Interrelationships among variables derived from the path analyses.



Note. N= 128. PL= Pragmatic Language; EF= Executive Function; GC= Grammar Comprehension; MB=Multilingual Background; SES = Socio-Economic Status index.

Standardized estimates are presented in the figure.

3.4. Discussion

This study sheds light on the complex interplay between socioeconomic status, grammatical competence, executive functions, and pragmatic language. While some studies suggest a significant role of SES in shaping pragmatic abilities, others point to minimal or no direct effects, highlighting

the need to clarify the mechanisms underlying this relationship. Our results help address this gap by showing that SES influences PL indirectly through GC, but not directly, and that EF also plays a role in explaining individual differences in PL.

Specifically, we found that both EF and GC exert a direct effect on PL, confirming our first hypothesis (H1). This finding is consistent with prior evidence that EF supports children's ability to use language appropriately in social contexts (Filipe et al., 2020; Nilsen et al., 2021; Ouerchefani et al., 2024; Razavi et al., 2019) and with studies showing that core language skills, such as grammar, are crucial for pragmatic development (Wilson & Bishop, 2021). At the same time, SES was found to influence both EF and GC (H2), in line with studies suggesting that socioeconomic conditions play a central role in cognitive and linguistic development (Farah et al., 2006; Letourneau et al., 2013; Noble et al., 2005, 2007; Pace et al., 2017). Children from higher SES families are more likely to be exposed to richer linguistic and cognitive stimulation, whereas those from lower SES contexts may encounter stress and limited resources that hinder development in both domains. This highlights the need to foster enriched learning environments at school to help mitigate disparities. Our results also confirmed that SES does not exert a direct effect on PL (H3), aligning with recent evidence suggesting that SES has little or no direct influence on pragmatic abilities (Bosco & Gabbatore, 2017; Schulze & Saalbach, 2022). Regarding mediation, we hypothesized (H4) that both GC and EF would mediate the link between SES and PL; however, only GC emerged as a significant mediator. This suggests that the quality of children's linguistic exposure, closely linked to their socioeconomic background, may be more directly tied to PL development than broader cognitive skills.

This finding also gains further complexity when considering that many children in our sample had a multilingual background, meaning they were exposed to a language other than Italian at home. Their GC may therefore be influenced not only by SES—through parental education and occupation—but also by the fact that Italian is not always the primary language spoken by their parents. This may result in less linguistically stimulating input in Italian, which in turn affects their

development of GC. These results underscore the multifaceted ways in which SES and multilingualism may interact in shaping PL and call for more nuanced approaches in intervention. Enhancing both EF and GC remains important, but our data particularly emphasize strengthening GC as a key route for supporting PL and, consequently, improving children's social communication skills.

Nevertheless, this study has several limitations. The cross-sectional design prevents causal interpretations, making longitudinal research necessary to better clarify developmental trajectories. Moreover, the sample was recruited from a single school, which may limit generalizability, and we were unable to fully disentangle the effects of SES from those of multilingualism. Prior research has shown that SES and bilingualism can have distinct effects on language development: Bellocchi and Bonifacci (2023), for example, found that bilingual children performed more poorly than monolingual peers on verbal knowledge and morphosyntactic comprehension, while lower SES was associated with weaker performance in verbal knowledge, morphosyntactic comprehension, and phonological short-term memory. Although they did not investigate pragmatic abilities, their findings suggest that SES and exposure to multiple languages may also affect PL in different ways. Our lack of detailed information on the type and amount of home language exposure, children's proficiency, or the specific languages spoken represents an important limitation that future studies should address. Methodological considerations should also be noted; while TeleFE (Rivella et al., 2023) and APL Medea (Lorusso, 2009) were administered in group sessions, the TROG-2 (Bishop, 2009) was delivered individually, introducing a possible source of variability. Furthermore, Theory of Mind, which plays an important role in the EF–PL relationship (Cardillo et al., 2021), was not assessed. Finally, supplementary analyses showed minor variations across models using factor scores from exploratory factor analysis versus the overall EF score; however, the latter provided the best fit indices, supporting the use of a global EF measure as a parsimonious and reliable representation of EF contributions to PL.

In conclusion, this study extends existing research by providing novel evidence that SES influences PL indirectly through GC, while EF, although important for PL, does not mediate this pathway. These results have both theoretical and practical implications. Theoretically, they highlight the importance of distinguishing between cognitive and linguistic mediators in the SES–PL relationship. Practically, they suggest that interventions aimed at fostering GC, particularly in disadvantaged contexts, may represent an effective strategy to strengthen PL and, in turn, support children’s social integration and educational success. At the same time, promoting enriched environments that stimulate both EF and language skills remains essential to ensure equitable opportunities for children from diverse socioeconomic and linguistic backgrounds.

Chapter 4

Study 3: A short game-based intervention for enhancing executive functions at school: a pilot study

Abstract

This pilot study, published in the *Journal of Cognitive Enhancement* (Cravet & Usai, 2024), examined the feasibility of a short, teacher-led intervention designed to enhance executive functions in a heterogeneous socioeconomic and sociocultural school context. The intervention combined a board game, a token economy to promote behaviour regulation, and a narrative framework enriched with metacognitive prompts to foster children's engagement and reflection. Teachers implemented the program and contributed to the development of both the protocol and the narrative materials. A total of 24 children participated, with 12 assigned to the intervention group and 12 to the control group. Results indicated improvements in EFs among the intervention group, particularly in low load working memory, underscoring the potential of this approach to positively influence children's executive functions. The originality of the study lies in situating the intervention within the school setting and relying on teacher implementation, thereby utilizing existing educational resources. Findings support the feasibility and ecological validity of game-based interventions in schools and highlight their potential for broader application. In the following paragraphs, the article will be summarized in its main sections.

4.1. Introduction

As already extensively discussed in the previous chapters, EFs are a set of higher-order cognitive abilities that enable deliberate, top-down regulation of thoughts, behaviors, and emotions (Friedman & Miyake, 2017; Zelazo & Carlson, 2020). These functions are of particular importance in educational contexts, as they contribute both to social adjustment and prosocial behaviors (Traverso et al., 2020; Zelazo & Carlson, 2020), and to the ability to pursue goals, plan, and organize information—skills that are crucial for successful academic performance (Blair & Raver, 2015).

Furthermore, EFs have been shown to partly account for disparities in academic outcomes among children from different socioeconomic backgrounds (Hackman et al., 2010; Sirin, 2005; Waters et al., 2021). Several approaches have been investigated to foster EFs development in school-aged children, including computerized training as well as physical and mindfulness-based activities such as aerobics, martial arts, yoga, and meditation, all of which have demonstrated beneficial effects (Diamond & Lee, 2011, 2016).

In recent years, a growing line of research has begun to examine the role of board games in supporting cognitive development. A systematic review by Noda et al. (2019) pointed to their potential as effective interventions for children, with evidence suggesting benefits for educational learning, cognitive enhancement, and reductions in anxiety and ADHD-related symptoms. Similarly, Mackey et al. (2011) found that just eight weeks of engagement with commercially available games—both digital and non-digital—was sufficient to produce notable improvements in fluid reasoning and processing speed in 7- to 9-year-old children. More recently, Estrada-Plana et al. (2019) showed, through a randomized controlled trial, that a cognitive training program based on board games was effective in strengthening EFs and reducing clinical symptoms in children with ADHD. Taken together, these findings highlight the promise of board games as low-cost, engaging, and easily accessible tools to promote EFs development (Benzing et al., 2019; Gashaj et al., 2021). Unlike digital games, they do not include automated adaptation features, but teachers can act as mediators to tailor the experience. To date, however, only Korzeniowski et al. (2017) have proposed a comprehensive cognitive intervention targeting all three EF components through paper-and-pencil tasks and games embedded within the school curriculum in children at social risk such as children from socioeconomic disadvantaged backgrounds, underscoring the need for further studies. The present work contributes to this line of inquiry by investigating the feasibility of a teacher-led board game intervention that integrates a narrative framework designed to foster metacognition and engagement (Traverso et al., 2015) and a token economy related to the narrative framework to maintain engagement and promote behavioural regulation (Kim et al., 2021). We hypothesize that

such an intervention can be readily implemented in the classroom and holds potential for enhancing children's executive functions.

4.2. Materials and methods

4.2.1. Participants

A total of 37 children initially took part in this pilot study, with 18 assigned to the intervention group (IG) and 19 to the control group (CG). However, since the activities were carried out during the summer period, following the end of regular classes, several participants dropped out, and not all were available for the post-test assessment. The final sample therefore comprised 24 children: 12 in the IG (6 girls; M age = 112 months, SD = 6.96) and 12 in the CG (7 girls; M age = 109 months, SD = 7.07). None of the participants had a diagnosis of neurodevelopmental disorder. Parents were contacted by the first author and provided written informed consent for their child's participation. All children attended the same school in Genoa, situated in an area characterized by heterogeneous socioeconomic backgrounds.

4.2.2. Procedure

Intervention group. The intervention was organized as an extracurricular activity, open to a maximum of 20 students from third and fourth grade. Participation was voluntary, and those who enrolled were also recruited for the study. The program lasted 12 consecutive days, with daily sessions of approximately 2 and a half hours. Ten board games were selected according to the criterion that each involved at least one executive function. Although every game primarily engaged a specific EF, in practice most activities required the simultaneous activation of multiple components at different levels. To foster metacognition and increase engagement (Traverso et al., 2015), together with the teachers we developed a narrative framework articulated into episodes, one for each session. This narrative aimed to help children become aware of the skills they were practicing through the games and to reflect on how these skills could be transferred to everyday contexts.

In addition, a token economy, integrated with the narrative, was implemented to promote behaviour regulation (Kim et al., 2021). A detailed description of the board games, the narrative framework, and the token economy is provided in Appendix 3. Both the story and the token economy progressed throughout the 12 days of the intervention, with game sessions conducted between days 2 and 11. The first day was dedicated to group building, presentation of the narrative, and introduction of the token economy, while the final day focused on concluding the story and awarding the participants for their effort.

Each session followed a structured format: it began with storytelling, continued with approximately one hour of board game activities in small groups of four to five children, and ended with a metacognitive reflection followed by the distribution of rewards associated with the token economy.

Control group. Children in the control group were recruited from other extracurricular activities taking place in the same school during the intervention period (e.g., painting workshops and chess clubs). These activities were not specifically designed to target executive functions and did not include narrative-based components or a token economy. Participants were matched to the intervention group on age and gender.

4.2.3. Measures

Children's EFs were assessed through three subtests of the TeleFE battery (Rivella et al., 2023): the Go/No-Go, the Flanker, and the N-Back tasks. The assessment was administered by the first author, who was blind to group allocation, in the school's computer room, with a child-to-supervisor ratio of 3:1.

Go/No-Go. The Go/No-Go subtest was used to assess children's inhibitory control. This task was broadly described in Chapter 3; however, in this study, the number of correct No-Go responses was used as an index of inhibition (Rivella et al., 2023).

Flanker. Cognitive flexibility was assessed using the Flanker task, which was also described in Chapter 3. Performance on the incongruent trials of the mixed-rule block was used as a measure of cognitive flexibility (Rivella et al., 2023).

N-Back. Finally, working memory was assessed with the N-Back subtest (see Chapter 3). Accuracy in the 1-Back was taken as an index of updating under low load, whereas accuracy in the 2-Back reflected updating under high load (Rivella et al., 2023).

4.3. Data analysis

Data were analysed using R (Version 4.3.1). A series of ANCOVAs were performed on the EF scores, with post-intervention performance as the dependent variable, group as the fixed factor, and both pre-intervention performance and number of sessions attended as covariates.

Effect sizes were reported using partial eta squared (η^2_p), which represents the proportion of variance explained by the effect and is calculated by dividing the between-groups sum of squares by the total sum of squares. Values below .06 were interpreted as small effects, values between .06 and .14 as moderate effects, and values above .14 as large effects. In addition, Cohen's U_3 overlap index was computed for each effect size. This index indicates the percentage of scores in one group—in this case, the intervention group—that exceed the mean score of the comparison group (Cohen, 1988). Accuracy scores were considered the primary outcome measure, as the intervention did not directly target reaction times.

4.4. Results

Descriptive statistics are provided in Table 4.1.

Table 4.1. Descriptive statistics.

Variable	Group	N	Mean	SD	Skewness	Kurtosis
Flexibility pre	CG	12	44.6	8.67	-1.921	5.008
	IG	12	50.1	4.62	-0.548	-0.461

Flexibility post	CG	12	48.9	10.46	-1.881	4.331
	IG	12	51.9	4.98	-0.433	-0.964
Inhibition pre	CG	12	36.8	8.99	-0.550	0.527
	IG	12	43.2	6.06	0.812	-0.648
Inhibition post	CG	12	40.0	9.55	-0.140	-1.154
	IG	12	47.6	9.64	-0.249	2.464
Low load WM pre	CG	12	89.2	21.39	-1.674	1.351
	IG	12	96.5	7.03	-3.020	9.885
Low load WM post	CG	12	87.8	21.70	-1.921	2.618
	IG	12	94.4	8.53	-1.858	4.065
High load WM pre	CG	12	75.3	14.63	-1.578	2.158
	IG	12	78.8	8.75	-0.337	0.888
High load WM post	CG	12	75.7	18.76	-1.416	0.745
	IG	12	81.7	8.95	-0.492	-0.145

Note. CG=control group, IG=intervention group.

We performed a series of ANCOVAs. In the model with post-intervention flexibility as the dependent variable, no significant effects emerged for group, $F(1, 20) = .398, p = .535, \eta^2_p = .020$, number of sessions attended, $F(1, 20) = .602, p = .447, \eta^2_p = .029$, or pre-test performance, $F(1, 20) = 2.207, p = .153, \eta^2_p = .099$. The U_3 index was .64.

In the ANCOVA with inhibition as the dependent variable, the effects of group, $F(1, 20) = 1.58, p = .223, \eta^2_p = .073$, and number of sessions attended, $F(1, 20) = 2.99, p = .099, \eta^2_p = .130$, did not reach statistical significance. However, pre-intervention performance was significant, $F(1, 20) = 5.67, p = .027, \eta^2_p = .221$. The U_3 index was .79.

For low load WM performance at post-test, significant effects were found for group, $F(1, 20) = 11.7, p = .003, \eta^2_p = .370$, number of sessions attended, $F(1, 20) = 13.2, p = .002, \eta^2_p = .397$, and pre-intervention performance, $F(1, 20) = 102.1, p < .001, \eta^2_p = .836$. The U_3 index was .66. In contrast, for high load WM performance, neither group, $F(1, 20) = .390, p = .539, \eta^2_p = .019$, nor number of sessions attended, $F(1, 20) = .800, p = .382, \eta^2_p = .038$, were significant, whereas pre-intervention performance was, $F(1, 20) = 26.595, p < .001, \eta^2_p = .571$. The U_3 index was .66. Finally, a post hoc power analysis was conducted using GPower 3.1. The analysis yielded a power ($1 - \beta$ error probability) of .84, based on an effect size of .77 (corresponding to the largest observed η^2_p of .370 for group comparisons), an alpha level adjusted with Bonferroni correction for four tests ($\alpha = .0125$), a total sample size of 24, and a model with two groups and two covariates.

4.5. Discussion

Executive functions contribute substantially to school readiness and later academic achievement by providing the cognitive foundation that enables children to engage effectively in learning activities, regulate behaviours, and adapt to the demands of the school context (Blair & Razza, 2007; Best et al., 2011; Cortés Pascual et al., 2019; Gandolfi et al., 2021; Traverso et al., 2022; Viterbori et al., 2015; Viterbori et al., 2017). Interventions aimed at supporting EFs are particularly valuable for children who experience difficulties in this domain, such as those with socioeconomic disadvantage (Hackman et al., 2010; Sirin, 2005; Waters et al., 2021). The present study, conducted with children from diverse socioeconomic and cultural backgrounds, was designed to evaluate the feasibility of a brief, teacher-led intervention combining board games, a narrative framework, and a token economy. The intervention proved feasible in terms of implementation and showed encouraging results, particularly with respect to low load WM. Although no significant effects were found for cognitive flexibility, inhibition, or high load WM, the moderate effect sizes observed for low load WM point to potential benefits that deserve further investigation. Moreover, these results are consistent with previous research by Korzeniowski et al. (2017) and Benzing et al. (2019), who also

employed game-based interventions in school settings. While Korzeniowski et al. (2017) found improvements in cognitive flexibility, planning, metacognition and inhibitory control, Benzing et al. (2019), who used similar board games, found improvements in updating of WM.

Board games appear to be a promising tool for supporting EFs in classrooms. They are cost-effective, simple to implement by teachers, adaptable in difficulty, and inherently engaging and motivating for children. In addition, since they are typically played in groups, they also promote social interaction. Interestingly, the number of sessions attended had a significant effect on low load WM, suggesting that greater exposure to the intervention or higher levels of participation may enhance outcomes in this domain (Diamond & Ling, 2016).

The limited effects observed on the other EFs components may be attributable to several factors, including the specific board games chosen, the relatively small sample size, and the complexity of the targeted skills. These considerations suggest that more intensive or prolonged interventions may be required to achieve significant improvements in more demanding EFs domains. Overall, the findings of this pilot study support the feasibility of such interventions, particularly for strengthening low load WM, while underscoring the need for further research to evaluate their broader effectiveness. The moderate, though non-significant, Cohen's U_3 index observed for inhibition suggests a potential positive impact of the intervention on inhibitory processes. It is plausible that improvements in inhibition may have contributed to the gains in working memory, given the close relationship between inhibitory control and updating processes (Borella et al., 2008; Marton et al., 2007).

Several limitations must be acknowledged. These include the relatively short duration of the intervention, the small sample size, the possibility of test-retest effects, and the absence of follow-up data. Moreover, since the control group did not receive either the narrative framework or the token economy, it is difficult to disentangle the specific contributions of these components. In addition, the small sample increases the likelihood of initial, albeit non-significant, differences between groups. A further limitation of the present study concerns the lack of direct measures of

SES. Given the pilot nature of the study and the relatively small sample size, SES information was not collected, as the expected variability would not have been sufficient to support meaningful analyses or group comparisons. Finally, the primary aim of this pilot study was to assess the feasibility of the selected tools and board games in a school-related context. Participation was voluntary and occurred outside regular school hours, which may have resulted in a self-selected sample of more motivated students. Consequently, findings related to engagement and enjoyment may not fully generalize to a compulsory, curriculum-based implementation during regular school time.

Future research should therefore address these limitations by recruiting larger samples to ensure more balanced groups at baseline, extending the duration of the intervention, and including follow-up assessments. To strengthen the validity of the findings, subsequent studies should also incorporate measures of socioeconomic status, cognitive functioning, and academic performance as additional variables of interest.

Chapter 5

Study 4: A board games intervention in the school context: effects on cognitive, social, emotional, behavioural outcomes, and learning

Abstract

This study builds upon the pilot study described in the previous chapter. In this phase, the intervention protocol was refined, the sample size was increased, and additional outcome measures were introduced to provide a more comprehensive evaluation of the effects. The aim was to examine whether a 10-week, teacher-led board game intervention, enriched with metacognitive activities, could enhance executive functioning, Social-Emotional and Behavioural (SEB) skills, broadly known as soft skills, and academic achievement in primary school children.

The study involved 150 fourth- and fifth-grade students from diverse socioeconomic backgrounds, with 83 children allocated to the intervention group and 67 to the control group. Outcome measures included computerized EF tasks (TeleFE), teacher ratings of children's executive functioning in the classroom (BRIEF-2), student self-reports of SEB skills (BESSI-45), and end-of-semester grades in Italian language and mathematics.

Generalized Linear Mixed Models indicated the following results: a) no statistically significant effects on computerized EFs tasks; b) significant differences over time between groups in teacher-reported EFs, particularly in behavioural and cognitive regulation, with some effects maintained at follow-up and a decline in the control group; c) a significant enhancement of children's self-reported Emotional Resilience, a core SEB domain; and d) a protective effect on academic performance, with grades remaining stable in the intervention group but decreasing in the control group.

Overall, these findings suggest that teacher-implemented board game interventions, when framed within metacognitive activities, may help support children's everyday executive functioning and

learning, and act as a protective factor against declines in behaviour and academic performance due to developmental or environmental challenges.

5.1. Introduction

5.1.1. Board games in the school context

In recent years, the use of games—both board games and video games—as educational tools has gained increasing popularity. Video games, however, present some challenges in school contexts: they are often played individually, require digital devices and internet access, and raise concerns about excessive screen time, as noted by the World Health Organization (Bull et al., 2020). Board games, on the other hand, appear more suitable for educational interventions. They are less expensive, easy for teachers to use, promote social interaction, are engaging and motivating for children, and can be adapted to different levels of difficulty (Cravet & Usai, 2024). The educational potential of board games has led to a growing number of studies on their role in learning and cognitive development (Noda et al., 2019). Playing board games is enjoyable and encourages collaboration, group interaction, and friendly competition. At the same time, board games naturally place demands on executive skills. Players must recall and follow the rules, control their impulses, and adjust their strategies as the game develops, which engages working memory, flexibility, and inhibition. These skills are important for learning because they help children focus attention, solve problems, and regulate their behaviour (Diamond, 2013; Noda et al., 2019). Some longitudinal evidence supports this link. For example, Gashaj et al. (2021) found that children's inhibition skills in second grade were positively associated with their earlier engagement in board games. This may be explained by the social nature of board games, where children usually play in small groups, take turns, respect rules, and manage impulses—for instance, avoiding giving away information like showing their cards. These dynamics create opportunities to practice self-regulation.

Given the central role of executive functions in learning, several interventions have been developed to strengthen them in schools. Benzing et al. (2019) tested a six-week board game program with 10- to 12-year-old children, delivered by teachers through two weekly 30-minute sessions. The activities targeted inhibition, working memory, and cognitive flexibility. Results showed improvements in updating and shifting. This was the first intervention to include all three main executive functions in a school setting, supported by a cover story to increase motivation and metacognitive reflection. However, the study did not examine effects on learning or include teacher and parent evaluations of executive functioning.

More recently, Vita-Barrull et al. (2024) implemented a larger-scale program with first- to sixth-grade students, using modern board games and teacher training. The intervention led to improvements in working memory updating, as well as reading and math performance.

Nevertheless, the study did not include teacher or parent reports, so it is unclear whether the benefits extended to everyday functioning. Moreover, the effects were limited to working memory, with no improvements in other executive functions, and no follow-up assessment was conducted.

The present study addresses these limitations. To our knowledge, it is the first to combine computerized EF tasks with teacher ratings to evaluate the effects of a board game intervention on executive functions. It also investigates the effects on Social, Emotional, and Behavioral (SEB) skills and far transfer effects on learning. Finally, this study includes a follow up after three months. As previously mentioned, this study builds upon the pilot study recently published (Cravet & Usai, 2024). We refined the intervention protocol, increased the sample size, and included additional outcome measures to provide a more comprehensive evaluation of the effects.

5.1.2. The importance of self-regulation and executive functions for learning outcomes

Self-regulation is a broad construct that refers to the capacity to modulate behaviour, cognition, and emotion to pursue goals and adapt to changing environmental demands. It encompasses multiple interacting domains—cognitive, emotional, and motivational—and is expressed behaviourally in

children's ability to control impulses, sustain attention, and flexibly adjust strategies in different contexts (Nigg, 2017). Within this framework, executive functions and metacognitive abilities, such as performance monitoring mechanisms, are central components of self-regulation, each contributing uniquely to children's learning and development.

While self-regulation also relies on bottom-up mechanisms that enable adaptive responses to environmental stimuli, EFs represent the cognitive foundation of self-regulation, providing the top-down control processes that guide goal-directed behaviour (Nigg, 2017). EFs encompass a set of higher-order cognitive abilities—including inhibitory control, working memory, and cognitive flexibility—that allow individuals to plan, monitor, and adapt their actions in response to situational demands (Miyake et al., 2000; Diamond, 2013). These executive abilities are essential for purposeful behaviour and problem solving in both academic and everyday contexts (Goldstein et al., 2014; Otero et al., 2014). A substantial body of research has highlighted their central role in school achievement (Best et al., 2011; Diamond, 2013; Roebbers, 2017). Children with weaker EF skills often face difficulties with typical classroom demands—staying focused, managing time, organizing priorities, or solving complex problems—and tend to struggle with adapting to novel or unexpected situations, which may result in frustration or disengagement (Otero et al., 2014). Since these difficulties undermine children's ability to learn and adapt, EF skills acquired in early childhood are strong predictors of later academic achievement (Viterbori et al., 2015; Yeniad et al., 2013). Moreover, persistent executive deficits are associated with behavioural problems, lower school engagement, and an increased risk of dropout (Blair & Diamond, 2008; Friedman et al., 2007; Vitaro et al., 2005).

Beyond EFs, metacognition is another crucial mechanism underpinning self-regulated learning. While declarative metacognition concerns the knowledge individuals have about their own cognition, procedural metacognition refers to the ability to monitor and regulate one's own cognitive processes through both metacognitive monitoring (evaluating performance, detecting errors) and metacognitive control (adapting strategies when needed), abilities that are fundamental

for learning (Roebbers, 2017). Strong metacognitive skills enable children to reflect on their problem-solving approaches, transfer strategies across contexts, and persist when faced with difficulties (Efklides, 2008). Longitudinal findings further demonstrate that early metacognitive abilities predict later achievement in domains such as reading and mathematics (He et al., 2024). While EFs provide the cognitive foundation for goal-directed behaviour, metacognition builds upon this foundation by fostering self-reflection, monitoring, and adaptive strategy use. Together, these processes are distinct yet highly interrelated, jointly supporting self-regulation and learning. A particularly illustrative phenomenon of performance monitoring within self-regulation is post-error slowing (PES)—the tendency to slow down responses following an error. PES is widely interpreted as a behavioural marker of adaptive control, reflecting the recruitment of monitoring processes aimed at optimizing subsequent performance (Botvinick et al., 2001; Braver, 2012). Developmental studies have demonstrated that PES emerges early in childhood and can be observed across the lifespan (Brewer & Smith, 1989; Ger & Roebbers, 2023a, 2023b; Jones et al., 2003; Smulders et al., 2016; Yeshua & Berger, 2024). Evidence indicates that both young children and older adults tend to show greater PES, which is typically interpreted as reflecting less efficient proactive control—that is, the ability to actively maintain and prepare task goals in anticipation of cognitively demanding situations (Brewer & Smith, 1989; Dubravac et al., 2020; Smulders et al., 2016). Importantly, PES has been linked to intelligence and academic performance, indicating that children who display more effective error monitoring and adjustment are also better equipped to sustain learning in school contexts (de Mooij et al., 2021; Jacobs et al., 2024; Varriale et al., 2021). In Cravet and Ger (2025), published in the *Journal of Experimental Child Psychology*, we investigated PES using the data of this study, with the aim of clarifying its consistency across different executive function tasks and its associations with cognitive and academic outcomes. Our objectives were fivefold: (1) to determine whether children exhibit significant PES in each task of the TeleFE battery (described below); (2) to explore whether PES correlates across task blocks; (3) to test inter-task correlations of PES; (4) to assess whether PES varies as a function of task demands

and difficulty; and (5) to examine whether PES is associated with measures of intelligence and school achievement in mathematics and Italian language. The results indicated that children showed significant PES across all tasks; however, correlations of PES were limited to certain blocks within tasks, and no consistent relationships emerged across different tasks. Moreover, task characteristics influenced the magnitude of PES, suggesting that it may reflect task-specific control adjustments rather than a stable individual trait. Finally, PES in the Flanker task showed a positive correlation with intelligence and a marginal association with language achievement, whereas no significant links were found with mathematical performance. Overall, these findings suggest that, in children, PES represents a context-dependent phenomenon with limited generalizability across tasks and modest associations with broader cognitive and academic outcomes. However, research on PES remains limited with mixed results, and further studies are required to clarify its reliability and its associations with academic performance and everyday self-regulation.

Taken together, the literature reviewed suggests that both executive and metacognitive processes play a central role in children's ability to regulate behaviour and learning.

5.1.3. The role of socioeconomic factors

Self-regulation, including its executive and metacognitive processes, is deeply shaped by children's socioeconomic environment. Children growing up in disadvantaged socioeconomic contexts generally show weaker EFs, and socioeconomic adversity is also linked to lower learning outcomes and poorer academic performance (Blair & Raver, 2016; Lawson et al., 2018; Oeri & Roebbers, 2022; Sirin, 2005; Pace et al., 2017; Ursache & Noble, 2016). These effects are partly explained by differences in linguistic input and cognitive stimulation: children from low-SES families are typically exposed to less diverse vocabulary, fewer educational resources, and more limited opportunities for enriched learning experiences (Pace et al., 2017; Ursache & Noble, 2016). Since language development provides a foundational basis for metacognitive growth, these disparities influence children's ability to monitor their thinking, evaluate their performance, and flexibly adapt

strategies. For instance, Maximino-Pinheiro et al. (2024) showed that preschoolers from higher-SES families displayed stronger metacognitive knowledge and regulatory skills, which in turn mediated the relationship between SES and their performance in language and mathematics.

Evidence also suggests that socioeconomic disadvantage may directly affect performance monitoring mechanisms such as PES. In paediatric traumatic brain injury, for example, lower SES predicted reduced PES—indicating weaker post-error adjustment—even after accounting for injury severity (Ornstein et al., 2009). Converging studies have also found SES differences in neural markers of error processing (e.g., error-related negativity, ERN) in children (Brooker, 2018).

However, research explicitly examining the relationship between SES and PES in typically developing children is still scarce, highlighting a key gap in the literature. If confirmed, such effects would suggest that socioeconomic disparities not only shape language and metacognitive development but also extend to more fundamental mechanisms of error monitoring and adaptive control.

Longitudinal studies have consistently shown that early exposure to poverty, maternal depression, or limited cognitive stimulation is associated with weaker pre-academic skills, particularly in vocabulary and mathematics (Oeri & Roebbers, 2022). These poverty-related risks have cascading effects on school trajectories, contributing to persistent academic difficulties and increased risk of dropout (Blair & Raver, 2016). Taken together, the evidence indicates that SES exerts its influence on learning outcomes through multiple pathways—language development, metacognition, executive functions, and potentially performance monitoring. This underscores the importance of interventions designed to enhance self-regulation, particularly in low-SES contexts. Practical approaches, such as structured board games, have been shown to promote EF skills and could help counterbalance SES-related disparities, not only by strengthening cognitive control but also by supporting adaptive learning behaviours in classroom contexts.

5.1.4. Soft skills and executive functions

As previously discussed in Chapter 1, Section 1.2 and Chapter 2, Sections 2.1.1–2.1.3, soft skills—conceptualized within the framework of Social, Emotional, and Behavioural (SEB) skills (Soto et al., 2021; 2022a)—represent a key dimension of children’s adaptation and learning. Evidence summarized in Chapter 2 also indicated that SEB skills are positively related to academic engagement and can be promoted through extracurricular and structured educational activities (Feraco & Meneghetti, 2023; Feraco et al., 2022). Similarly, interventions and experiences that engage cognitive control—such as sports or rule-based games—have been shown to support EF development (Diamond & Ling, 2016).

To date, however, no study has examined interventions that simultaneously target both EF and SEB skills, although this integration has been identified as a promising direction for research and educational practice (Vita-Barrull et al., 2024). Building on this framework, the present study investigates whether structured, board-game–based activities implemented in school can foster concurrent improvements in these domains. Based on this complementarity, and on evidence from Study 1 which showed that EF was the strongest predictor of SEB skills, even when controlling for intelligence, gender, and socioeconomic status, we hypothesize that training EFs through board games may also foster SEB skills. Our hypothesis is supported by evidence from the first study, where we observed a correlation between EFs and SEB skills. Furthermore, the interactive structure of board games, involving turn-taking, adherence to rules, and impulse control, is likely to promote SEB skills.

5.2. Aims and hypotheses of the present study

The aim of the present study was to examine the effects of a teacher-led board game intervention on cognitive, social, emotional, and behavioral skills and learning. The intervention was designed as a multifaceted program that integrated a narrative framework and token economy system to sustain motivation and encourage metacognitive reflection (Cravet & Usai, 2024). Importantly, the intervention was developed in close collaboration with the teachers that implemented the protocol

in the school context. Our first hypothesis (H1) was that the intervention will lead to small improvements in children's performance on EFs tasks, consistent with findings from earlier studies using comparable structures (Cravet & Usai, 2024; Benzing et al., 2019). The second hypothesis (H2) was that the intervention would lead to improvements in teacher-reported executive functioning in everyday school contexts, in line with the idea that embedding activities within a metacognitive narrative framework supports the generalization of EFs training effects (Pozuelos et al., 2019). The third hypothesis (H3) was that the intervention would foster SEB skills as reported by students, since board games naturally involve turn-taking, rule-following, and impulse control—behaviors that provide opportunities to practice self-regulation and social interaction (Gashaj et al., 2021). Additionally, we hypothesized (H4) that the intervention would produce far-transfer effects on learning outcomes, in accordance with prior research suggesting that similar interventions can positively influence academic achievement (Vita-Barrull et al., 2024). We also examined whether the intervention affected post-error slowing (PES), given that PES is widely regarded as a behavioural marker of performance monitoring and metacognitive adjustment following errors (Botvinick et al., 2001; Braver, 2012). This question is particularly pertinent because the intervention itself incorporated metacognitive and reflective components (Benzing et al., 2019; Traverso et al., 2015), which could plausibly lead to changes in PES (H5). However, due to the limited evidence available in this area, this hypothesis was formulated in an exploratory manner. Finally, we explored the potential influence of socioeconomic status (SES) on PES. Although existing literature provides only limited evidence concerning the relationship between SES and PES, prior findings in paediatric traumatic brain injury suggest that lower SES may be linked to reduced error-related adjustments (Ornstein et al., 2009). At the same time, it remains possible that lower SES could also manifest as exaggerated PES, reflecting less efficient reactive control mechanisms. Therefore, we expected some degree of association between SES and PES (H6).

5.3. Materials and methods

5.3.1. Participants

In total, 161 children were recruited for the study. Of these, 150 received parental consent and were included in the analyses. The intervention group consisted of 83 children ($M_{age} = 10$ years, $SD = 0.7$; 46 girls), while the control group comprised 67 children ($M_{age} = 10$ years, $SD = 0.8$; 27 girls). Within the overall sample, 18 were had a confirmed or suspected neurodevelopmental disorder or had an individualized educational plan (Piano Didattico Personalizzato) related to extreme social circumstances. All children attended regular classes.

The decision regarding which classes would receive the intervention was made by the teachers in collaboration with the school principal, who prioritized groups with a higher number of children presenting behavioural challenges. Ultimately, however, all fourth- and fifth-grade classes from the school were involved in the intervention. The program was embedded into the school curriculum and implemented over a period of 10 weeks with 2 sessions per week. To ensure fairness, control classes also received a shortened version of the intervention after the school year ended. Since recruitment occurred at the class level rather than at the individual level, some baseline differences between groups were unavoidable. Parental consent was obtained before participation. Of the total sample, 70 children (47%) had a multilingual background. These pupils represented the subgroup with the greatest socioeconomic disadvantage, reflecting the demographic characteristics of the community in which the study was conducted.

5.3.2. Materials

TeleFE. To assess executive functions, we employed the TeleFE battery (Rivella et al., 2023). In this study, three tasks were selected: Go/No-Go, Flanker, and N-Back. A detailed description of the tasks has been provided in Chapter 3. From these tasks, specific indices were derived. Cognitive flexibility was indexed by accuracy in congruent trials of the mixed Flanker block; interference control was assessed by averaging accuracy in incongruent trials of the first two Flanker blocks. Inhibition was measured by multiplying the percentage of correct responses in Go trials by that in

No-Go trials across all four blocks (see Howard et al., 2017). For working memory updating, we calculated separate indices for the 1-Back and 2-Back conditions by multiplying accuracy on targets and non-targets; the two values were then averaged to produce a composite score. To evaluate test–retest reliability, correlations between T1 and T2 scores in the control group were computed. Reliability was high for cognitive flexibility ($r = .74$) and working memory updating ($r = .70$), while inhibition ($r = .44$) and interference control ($r = .46$) showed moderate stability. These results are consistent with those reported by Rivella et al. (2023).

BRIEF-2 Teacher Report. Executive functioning in everyday classroom situations was evaluated with the teacher-report version of the Behavior Rating Inventory of Executive Function, Second Edition (BRIEF-2), Italian adaptation (Gioia et al., 2015). The tool was widely described in Chapter 2. In our sample, internal consistency was good, with Cronbach’s α ranging from .77 (Initiate) to .94 (Working Memory), values comparable to the Italian standardization. Questionnaires were filled out by teachers who were not involved in the intervention.

BESSI-45. Children’s socio-emotional and behavioural skills were self-reported using the 45-item short version of the Behavioral, Emotional, and Social Skills Inventory (BESSI), widely described in Chapter 2 (Soto et al., 2022). Items capture skills in five domains—Social Engagement, Cooperation, Self-Management, Emotional Resilience, and Innovation. In our data, most scales reached acceptable internal consistency (α and ω between .67 and .86). The Innovation domain, however, showed lower reliability ($\omega = .59$) and was excluded from analyses.

Fluid Reasoning. Non-verbal reasoning was measured with the Raven’s Coloured Progressive Matrices (CPM) (Raven et al., 1998; Italian adaptation by Belacchi et al., 2008). The task was widely described in Chapter 2. For analyses, raw total scores were used. Previous Italian studies reported excellent psychometric properties, including high internal consistency ($\alpha \approx .91$) and strong test–retest reliability ($r \approx .90$) (Belacchi et al., 2008). In our sample the internal consistency was acceptable (Cronbach’s $\alpha = .77$).

Italian Language and Mathematics Grades. School performance was indexed using grades in Italian and mathematics. We collected grades from the previous academic semester and from the first semester of the study year, which coincided with the end of the intervention. In Italian primary schools, grades are expressed in four levels: (a) emerging skills, (b) basic, (c) intermediate, and (d) advanced. Teachers may also use intermediate levels to provide more fine-grained evaluations. These assessments integrate written and oral tests, practical assignments, and classroom observations, and they reflect both mastery of curricular objectives and the autonomy and consistency with which children apply their skills. None of the participants in the present sample were graded at the “emerging skills” level.

Socio-economic Status. Socioeconomic background was assessed through parental reports on the consent form, including both parents’ highest level of education and occupational status. A composite SES index was then derived from these variables, widely described in Chapter 3 (see also Cravet & Usai, 2025).

5.3.3. Procedure

The intervention was carried out across the school year, from September to May. Baseline assessments (T1) were conducted in October, followed by the intervention phase, which spanned 10 weeks between November and February and included two weekly sessions of approximately one hour each. Post-test assessments (T2) took place immediately after the intervention in February, while a follow-up assessment (T3) was administered in May. The intervention took place in a specially designed room within the school and was conducted by a teacher collaborating with the authors, whereas the ratings of students’ behaviour (BRIEF-2) were completed by the regular classroom teachers, who were not involved in the project.

The first and final sessions were designed as introductory and closing events rather than game-based sessions. The opening meeting introduced the cover story, the rules of the setting, and the

token economy system, while the last session concluded the narrative and delivered the final reward associated with it. The eight intermediate sessions followed a consistent structure: each began with an episode from the cover story, which was then discussed collectively. This was followed by 20 minutes of board game play in groups of four. After gameplay, children engaged in a guided group reflection on strategies and behaviours used during the session. To close, participants completed a brief self-monitoring worksheet of their behaviour, and the teacher provided individual feedback, awarding tokens within the token economy when appropriate.

The cover story revolved around a small alien who, upon arriving on Earth, experienced difficulties with self-regulation, making it challenging for him to interact and play with peers. Through the support of human friends, he gradually acquired strategies to manage his thoughts, emotions, and behaviour, and eventually shared this knowledge with other children, encouraging them to become more self-regulated as well.

The token economy was structured around a personalised rocket for each child. At the end of every session, children who displayed self-regulated behaviours following the rules of the setting—such as raising their hand before speaking, keeping an appropriate voice level, and respecting the class rules—were allowed to advance their rocket to the next galaxy. Upon completing the programme, children received a symbolic “space licence” as their final reward. To ensure that all board games were practiced an equal number of times, we developed a rotation schedule (see Appendix 4). The schedule distributed the activities so that, across the sessions, each game was played the same number of times by all children. Board games used and an extract of the cover story is provided in the appendices (Appendix 4). The board games used in the intervention were selected based on the results of the pilot study (Chapter 4), which tested the feasibility of a shorter version of the program. During the pilot phase, a preliminary screening of commercially available games was conducted, and games were selected if they required the use of at least one executive function as a core component of gameplay. Following the pilot study, feedback was collected from the teachers and students involved. On the basis of this feedback, the set of games was revised, and some games

were not retained in the final version of the intervention. In addition, at the end of each session from session 2 to session 19, children completed a self-monitoring worksheet (see Appendix 4). They rated, on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much), the extent to which they were able to raise their hand and wait for permission, regulate their own emotions, control the volume of their voice, maintain concentration, and be kind to others (e.g., sharing, helping, taking turns). Finally, teachers of the participating classes who were not directly conducting the intervention were provided with a protocol. This material included examples of activities, similar in nature to those used in the intervention. Examples included Simon Says, which could be played in the gym, and the memory game I Packed My Bag. Teachers were free to use these activities during breaks or at other times of the school day, outside of the intervention sessions. However, no systematic monitoring was conducted regarding whether, how, or to what extent these activities were implemented.

5.4. Statistical Analyses

All analyses were conducted in R version 4.5.1 (R Core Team, 2024). A composite SES index was derived from parental background information, namely mothers' and fathers' education and occupation. These four variables were entered into a Principal Component Analysis (PCA). The detailed procedure for computing the SES index has already been described in Chapter 2.

Baseline differences between intervention and control groups were examined with independent-samples *t*-tests. These analyses revealed that the intervention group initially performed worse in Italian and mathematics grades, reported greater executive functioning difficulties on the Cognitive Regulation Index (CRI) of the BRIEF-2, and scored lower on the SES index. Given these pre-existing differences, all subsequent models included SES as a covariate.

To analyse changes over time, we employed Linear Mixed Effects Models (LMEs) using the “lme4” package (Bates et al., 2015). LMEs are well-suited for our design because they accommodate non-normal data, model individual variability by including random intercepts, and

provide a robust way of testing group-by-time effects while controlling for baseline differences (see also Ger & Cravet, 2025). For each model, we reported both marginal R^2 (variance explained by fixed effects) and conditional R^2 (variance explained by fixed and random effects combined). Random effects of participants consistently accounted for additional variance, supporting the use of mixed-effects modelling. Hedges's g was calculated for treatment effects using the approach recommended by Morris (2008) and applied in Toffalini et al. (2021), which quantifies differences in pre-to-post change between groups relative to the pooled pre-test standard deviation.

A post hoc power analysis was conducted for the Emotional Resilience scale of the BESSI-45, which showed the clearest intervention effect. Using the “simr” package (Green & MacLeod, 2016), we ran 1,000 Monte Carlo simulations ($\alpha = .05$) based on the original LME structure, which preserved repeated measures across three time points, the SES covariate, and random intercepts. This simulation-based approach provided an accurate estimate of statistical power for the observed effect.

Post-error slowing was computed for each participant, task (Flanker, Go/No-Go, N-back), and time point as the difference between mean reaction time (RT) on correct trials following errors and mean RT on correct trials following correct responses (Cravet & Ger, 2025). Only commission errors were included. Trials with extremely fast responses (faster than 200 ms in the Flanker, 250 ms in the Go/No-Go and N-Back) or outliers (beyond 3 SDs of the individual mean in the Flanker and Go/No-Go, or slower than 2500 ms in the N-Back) were excluded.

Analyses proceeded in several steps. First, we tested whether PES differed significantly from zero at each time point for each task. Group differences in PES at baseline (T1) were assessed with independent-samples t -tests. We then examined associations between SES and PES using Pearson correlations. Finally, to assess longitudinal effects, LMEs were fitted with Group, Time, and their interaction as fixed factors, and a random intercept for participants.

5.6. Results

Descriptive statistics for all variables across pre-, post-, and follow-up assessments in both the intervention and control groups are reported in Table 5.1. Correlation tables for each group, including all variables at each time point are available on [OSF](#) due to their large size.

Table 5.1. *Descriptive Statistics.*

Variable	Group	N	Mean	SD	Skew	Kurt
SES	CG	67	.85	2.90	.23	-1.01
	IG	83	-.70	2.34	1.29	1.34
Fluid Reasoning	CG	67	31.21	3.99	-1.74	3.30
	IG	83	30.31	4.15	-1.02	.81
Mathematics grades T1	CG	67	2.28	.68	-.40	-.93
	IG	82	1.98	.71	.06	-1.06
Mathematics grades T2	CG	66	2.18	.55	.00	-.19
	IG	82	2.00	.67	-.03	-.87
Italian grades T1	CG	67	2.30	.73	-.54	-1.00
	IG	82	1.94	.70	.09	-1.01
Italian grades T2	CG	66	2.11	.65	-.09	-.73
	IG	80	1.91	.73	.15	-1.20
WM T1	CG	67	.65	.18	-.90	.34
	IG	82	.64	.16	-.64	-.33
WM T2	CG	66	.68	.16	-.72	.32
	IG	82	.69	.15	-1.15	1.08
WM T3	CG	65	.65	.20	-.83	.43
	IG	72	.64	.22	-.96	.19
Inhibition T1	CG	67	.67	.15	-.67	.84
	IG	81	.66	.15	-1.04	1.71
Inhibition T2	CG	66	.68	.15	-1.00	.78
	IG	82	.70	.16	-.98	.59
Inhibition T3	CG	65	.69	.17	-1.19	1.42
	IG	72	.67	.19	-.79	.03

Flexibility T1	CG	67	28.04	5.05	-2.04	4.23
	IG	82	26.38	6.60	-1.77	2.56
Flexibility T2	CG	66	28.70	5.21	-1.94	2.71
	IG	82	28.5	4.64	-2.44	6.28
Flexibility T3	CG	65	27.52	7.15	-2.29	4.50
	IG	74	27.69	6.23	-1.97	3.60
Interference Control T1	CG	67	14.81	4.79	-.98	.10
	IG	82	14.77	5.14	-1.06	-.01
Interference Control T2	CG	66	15.79	4.25	-1.52	1.45
	IG	82	16.56	3.89	-1.80	2.39
Interference Control T3	CG	65	16.04	4.29	-1.7	2.17
	IG	74	16.24	4.62	-1.77	2.56
BRI T1	CG	67	2.75	1.13	1.36	.90
	IG	80	2.76	.98	1.19	.64
BRI T2	CG	67	2.90	1.14	1.16	.44
	IG	82	2.62	.76	.74	-.93
BRI T3	CG	65	2.83	1.05	.96	-.13
	IG	77	2.75	.96	.94	-.38
ERI T1	CG	67	2.57	.86	1.36	.86
	IG	80	2.74	.85	1.00	.28
ERI T2	CG	67	2.70	.95	1.33	1.22
	IG	82	2.76	.73	.4	-1.07
ERI T3	CG	65	2.71	.93	.94	-.42
	IG	77	2.80	.78	.51	-.71
CRI T1	CG	67	6.63	2.13	1.53	1.89

	IG	80	7.42	2.36	.92	-.16
CRI T2	CG	67	7.13	2.21	1.33	1.45
	IG	82	7.44	2.10	.56	-.57
CRI T3	CG	65	7.15	2.22	.86	-.31
	IG	77	7.40	2.11	.90	.27
GEC T1	CG	67	11.94	3.82	1.49	1.76
	IG	80	12.92	3.7	.94	-.18
GEC T2	CG	67	12.73	3.95	1.32	1.52
	IG	82	12.82	2.96	.36	-.95
GEC T3	CG	65	12.69	3.95	.79	-.74
	IG	77	12.96	3.03	.47	-.82
Self-Management T1	CG	65	3.77	.69	-.22	-.57
	IG	82	3.80	.65	-1.0	2.00
Self-Management T2	CG	66	3.70	.64	-.53	.68
	IG	81	3.88	.54	.00	-.97
Self-Management T3	CG	66	3.66	.66	.00	-.54
	IG	78	3.74	.58	-.04	-.62
Cooperation T1	CG	65	3.89	.62	-.21	-.76
	IG	82	3.80	.68	-.74	1.03
Cooperation T2	CG	66	3.92	.56	-.82	.98
	IG	81	3.81	.61	.09	-.80
Cooperation T3	CG	66	3.86	.61	-.63	.34
	IG	78	3.76	.61	-.46	.28
Innovation T1	CG	65	3.84	.54	-.07	-.50
	IG	82	3.78	.61	-.52	.16

Innovation T2	CG	66	3.86	.57	-.13	-.66
	IG	81	3.88	.67	-.38	-.57
Innovation T3	CG	66	3.80	.69	-.73	1.14
	IG	78	3.78	.58	-.32	.50
Emotional Resilience T1	CG	65	3.44	.88	-.10	-.81
	IG	82	3.28	.77	-.17	-.57
Emotional Resilience T2	CG	66	3.35	.89	-.47	-.44
	IG	81	3.65	.53	.43	-.56
Emotional Resilience T3	CG	66	3.39	.93	-.41	-.70
	IG	78	3.39	.71	-.04	-.27
Social Engagement T1	CG	65	3.65	.56	-.02	-.44
	IG	82	3.59	.70	-.82	.64
Social Engagement T2	CG	66	3.72	.53	-.00	-1.00
	IG	81	3.72	.61	-.21	-.36
Social Engagement T3	CG	66	3.68	.61	.18	-.90
	IG	78	3.50	.65	-.16	-.78
PES Flanker T1	CG	67	25.20	122.00	1.00	2.34
	IG	83	32.40	145.00	1.21	2.07
PES Flanker T2	CG	66	34.40	107.00	1.00	1.36
	IG	82	66.90	123.00	1.44	3.95
PES Flanker T3	CG	64	19.00	92.70	-.52	.17
	IG	75	-1.57	108.00	-1.15	2.84
PES Go/No-Go T1	CG	67	101.00	142.00	-.13	-.41
	IG	83	118.00	135.00	.43	-.28
PES Go/No-Go T2	CG	66	76.40	125.00	-.24	-.25

	IG	82	82.70	135.00	-.21	-.37
PES Go/No-Go T3	CG	64	62.90	147.00	.61	.11
	IG	73	82.40	154.00	.83	2.14
PES N-back T1	CG	64	213.00	276.00	1.10	1.93
	IG	69	131.00	320.00	1.31	3.25
PES N-back T2	CG	61	139.00	186.00	.41	-.57
	IG	64	123.00	230.00	.19	-.68
PES N-back T3	CG	60	95.00	247.00	-.43	1.14
	IG	67	95.50	275.00	.12	1.47

Note. PES= post-error slowing.

Table 5.2 presents Hedges's *g* effect sizes for each outcome measure.

Table 5.2. *Hedges' g Effect Sizes and 95% Confidence Intervals for All Outcome Variables.*

Variable	Hedges's <i>g</i> T1 to T2	CI 95%		Hedges's <i>g</i> T1 to T3	CI 95%	
		LL	UL		LL	UL
WM	.101	-.149	.352	-.003	-.253	.248
Inhibition	.260	.007	.513	-.010	-.261	.241
Flexibility	.246	-.006	.498	.306	.053	.559
Interference Control	.161	-.090	.412	.047	-.203	.298
BRI	-.273	-.527	-.020	-.088	-.341	.164
ERI	-.135	-.387	.118	-.085	-.337	.167
CRI	-.217	-.471	.036	-.242	-.495	.011
GEC	-.238	-.491	.015	-.190	-.442	.063
Self-Management	.237	-.017	.491	.084	-.169	.336
Cooperation	-.024	-.276	.229	-.008	-.261	.244

Social Engagement	.093	-.160	.346	-.180	-.434	.073
Emotional Resilience	.559	.298	.819	.189	-.064	.443
PES Flanker	.186	-.064	.436	-.204	-.454	.047
PES Go/No-Go	-.076	-.325	.174	.019	-.230	.269
PES N-Back	.222	-.043	.486	.276	.010	.541
Mathematics grades	.17	-.080	.423			
Italian grades	.21	-.040	.463			

Note. Values in bold are statistically significant (95% CI [Confidence Interval] does not include 0).

PES= Post-Error Slowing

5.6.1. Cognitive outcomes

The results from the TeleFE battery (Rivella et al., 2023), reported in Table 5.3, showed that the interaction between time and group was not significant at any time point.

Table 5.3. *Results of the LMEs for the Cognitive Variables Measured with the TeleFE battery.*

Variable Name	β	95% <i>CI</i>		<i>F</i> (<i>df</i>)	<i>p</i>	<i>R</i> ² <i>m</i>	<i>R</i> ² <i>c</i>
		<i>LL</i>	<i>UL</i>				
WM							
Group	-.03	-.36	.31	.00 (1, 143.71)	.95	.143	.437
Time				4.40 (2, 282.57)	.01		
Post	.18	-.08	.44				
Follow up	.01	-.25	.27				
SES	.04	-.09	.18	.39 (1, 143.19)	.53		
Time * Group				.21 (2, 282.61)	.81		
Post	.10	-.25	.45				
Follow up	.00	-.35	.36				
Inhibition							
Group	-.07	-.40	.26	.00 (1, 144.29)	.98	.010	.176
Time				1.46 (2, 285.72)	.23		
Post	.07	-.25	.38				
Follow up	.11	-.21	.42				
SES	.03	-.09	.14	.20 (1, 143.20)	.65		
Time * Group				.87 (2, 285.75)	.42		
Post	.23	-.19	.65				
Follow up	-.02	-.45	.41				
Flexibility							
Group	-.30	-.63	.03	1.08 (1, 142.28)	.30	.019	.175
Time				2.63 (2, 285.22)	.07		
Post	.11	-.20	.43				
Follow up	-.08	-.40	.23				
SES	-.03	-.14	.08	.27 (1, 141.82)	.60		
Time * Group				1.09 (2, 285.25)	.34		
Post	.25	-.17	.67				
Follow up	.30	-.13	.72				
Interference Control							
Group	.04	-.29	.37	.78 (1, 139.98)	.38	.029	.364
Time				6.39 (2, 280.92)	.002		
Post	.22	-.06	.49				
Follow up	.26	-.02	.53				
SES	.09	-.04	.21	1.80 (1, 139.63)	.18		
Time * Group				.47 (2, 280.95)	.63		
Post	.18	-.19	.55				
Follow up	.04	-.33	.42				

Note. LL = Lower Limit; UL = Upper Limit. R^2m = marginal R^2 . R^2c = conditional R^2 . Values in bold are statistically significant.

* $p < .05$, ** $p < .01$, *** $p < .001$.

5.6.2. Teacher-reported behavioral outcomes

The LME results for the BRIEF-2 indices, reported in Table 5.4, revealed main effects of time, group, and SES on teacher-rated executive functioning. Significant time $\times$ group interactions

emerged for the BRI (post-test), the CRI (both post-test and follow-up), and the GEC (post-test) indices, indicating that the intervention had a beneficial effect on these domains. Importantly, the effect persisted at follow-up for the CRI index. SES also showed a significant influence on CRI and GEC scores, with children from higher-SES families consistently showing fewer executive functioning difficulties.

Table 5.4. *Results of the LMEs for the BRIEF-2 Scales and Indices.*

Variable Name	β	95% CI		$F (df)$	p	R^2m	R^2c
		LL	UL				
BRI							
Group	-.01	-.35	.33	.83 (1, 146.22)	.36	.012	.710
Time				.78 (2, 285.38)	.46		
Post	.15	-.04	.33				
Follow up	.12	-.07	.31				
SES	-.07	-.23	.08	.93 (1, 146.23)	.34		
Time * Group				2.71 (2, 285.37)	.07		
post	-.29*	-.54	-.04				
Follow up	-.10	-.35	.16				
ERI							
Group	.17	-.16	.51	.36 (1, 146.21)	.55	.016	.614
Time				1.71 (2, 286.16)	.18		
Post	.16	-.05	.37				
Follow up	.18	-.03	.40				
SES	-.09	-.24	.05	1.54 (1, 146.19)	.22		
Time * Group				.58 (2, 286.15)	.56		
post	-.16	-.45	.13				
Follow up	-.09	-.38	.20				
CRI							
Group	.29	-.04	.63	.64 (1, 146.36)	.42	.046	.747
Time				2.59 (2, 285.30)	.08		
Post	.23**	.06	.40				
Follow up	.26**	.08	.43				
SES	-.18*	-.33	-.03	5.32 (1, 146.38)	.02		
Time * Group				3.11 (2, 285.30)	.05		
post	-.27*	-.50	-.03				
Follow up	-.25*	-.49	-.01				
GEC							
Group	.22	-.11	.55	.14 (1, 146.50)	.71	.032	.727
Time				2.33 (2, 285.57)	.10		
Post	.22*	.04	.40				
Follow up	.24*	.05	.42				
SES	-.15*	-.30	.00	3.94 (1, 146.51)	.05		
Time * Group				2.80 (2, 285.56)	.06		
post	-.28*	-.53	-.04				
Follow up	-.20	-.45	.04				

Note. LL = Lower Limit; UL = Upper Limit. R^2m = marginal R^2 . R^2c = conditional R^2 . Values in bold are statistically significant.

* $p < .05$, ** $p < .01$, *** $p < .001$.

5.6.3. Social, emotional, behavioral outcomes

Table 5.5 presents the results of the LME analyses for the BESSI-45 scales. A significant time $\times$ group interaction was found for Emotional Resilience, indicating that improvements in this domain

were specific to the intervention group, particularly at the post-test assessment. In contrast, no significant time $\times$ group interactions emerged for Self-Management, Social Engagement, or Cooperation. SES did not significantly predict outcomes in any of these domains, suggesting that the observed changes in SEB skills were independent of socioeconomic background.

Table 5.5. *Results of the LMEs for the Social, Emotional and Behavioral Skills Measured with the BESSI-45.*

Variable Name	β	95% CI		$F (df)$	p	R^2m	R^2c
		LL	UL				
Self-Management							
Group	.04	-.30	.37	.64 (1, 146.69)	.43	.015	.682
Time				3.58 (2, 285.68)	.03*		
Post	-.06	-.26	.14				
Follow up	-.15	-.35	.05				
SES	-.04	-.19	.10	.34 (1, 146.77)	.56		
Time * Group				1.39 (2, 285.69)	.25		
Post	.21	-.05	.48				
Follow up	.04	-.22	.31				
Cooperation						.009	.587
Group	-.12	-.46	.22	1.04 (1, 146.38)	.31		
Time				1.16 (2, 286.00)	.31		
Post	.09	-.14	.31				
Follow up	-.03	-.26	.19				
SES	.02	-.13	.16	.06 (1, 146.48)	.81		
Time * Group				.06 (2, 286.01)	.94		
Post	-.05	-.35	.25				
Follow up	-.04	-.34	.26				
Social Engagement						.017	.581
Group	-.06	-.40	.27	.64 (1, 147.02)	.43		
Time				3.98 (2, 286.70)	.02*		
Post	.14	-.09	.36				
Follow up	.08	-.15	.30				
SES	.02	-.12	.16	.09 (1, 147.13)	.77		
Time * Group				1.96 (2, 286.71)	.14		
Post	.06	-.24	.37				
Follow up	-.23	-.53	.08				
Emotional Resilience						.035	.679
Group	-.26	-.59	.07	.01 (1, 147.35)	.94		
Time				5.04 (2, 286.39)	.007**		
Post	-.09	-.28	.11				
Follow up	-.06	-.26	.13				
SES	-.11	-.26	.04	2.15 (1, 147.43)	.14		
Time * Group				9.23 (2, 286.40)	<.001***		
Post	.56	.30	.83				
Follow up	.17	-.09	.44				

Note. LL = Lower Limit; UL = Upper Limit. R^2m = marginal R^2 . R^2c = conditional R^2 . Values in bold are statistically significant.

* $p < .05$, ** $p < .01$, *** $p < .001$.

The estimated power to detect the group $\times$ time (post) interaction for the Emotional Resilience variable was 98% (based on 1,000 Monte Carlo simulations, $\alpha = .05$), with an observed effect size of $\beta = .65$.

5.6.4. Learning outcomes

For mathematics grades, analyses revealed a significant main effect of SES, $\beta = .20$, $F(1, 145.80) = 6.41$, $p = .01$, with children from higher-SES backgrounds achieving better outcomes. Neither the main effect of group, $\beta = -.35$, $F(1, 145.47) = 2.54$, $p = .11$, nor of time, $\beta = -.17$, $F(1, 144.44) = 1.80$, $p = .18$, reached significance. However, the group $\times$ time interaction approached significance, $\beta = .20$, $F(1, 144.44) = 3.45$, $p = .07$, pointing to a possible protective effect of the intervention: while the control group showed a decline in performance, the intervention group maintained or slightly improved their mathematics grades. The marginal R^2 was .07 and the conditional R^2 .79, underscoring the importance of individual variability.

For Italian language grades, SES also had a robust effect, $\beta = .34$, $F(1, 144.99) = 21.63$, $p < .001$, with higher SES predicting better academic performance. A significant effect of time was observed, $\beta = -.27$, $F(1, 142.85) = 7.22$, $p = .01$, indicating an overall decline in Italian language grades across the study period. The effect of group was not significant, $\beta = -.31$, $F(1, 144.79) = 1.87$, $p = .17$. Nevertheless, the group $\times$ time interaction approached significance, $\beta = .22$, $F(1, 142.85) = 3.13$, $p = .08$, suggesting that the decline in language grades was less pronounced in the intervention group compared to the control group. The marginal R^2 was .15 and the conditional R^2 .73, again highlighting the substantial role of individual differences.

5.6.5. Post-error slowing

Preliminary Analyses. For a detailed analysis of the PES correlations across task blocks and between tasks, as well as of the variations in post-error slowing as a function of task difficulty and its specific associations with learning outcomes and intelligence, readers are referred to Cravet and Ger (2025). In the present work, only the information most relevant to the current research aims is reported and discussed. For the Flanker task, PES was significantly greater than zero at T1, $t(390) = 2.56$, $p = .011$, and at T2, $t(382) = 5.16$, $p < .001$, but not at T3, $t(352) = 1.28$, $p = .20$. For the Go/No-Go task, PES was significantly greater than zero at all three time points: T1, $t(566) = 10.75$,

$p < .001$; T2, $t(553) = 7.51, p < .001$; and T3, $t(497) = 6.27, p < .001$. For the N-Back task, PES was significantly greater than zero at all time points: T1, $t(297) = 6.22, p < .001$; T2, $t(292) = 6.60, p < .001$; and T3, $t(301) = 4.16, p < .001$. *T*-test results showed no significant group differences at T1 for any of the tasks (all $ps > .11$). Taken together, these results indicate that PES was generally present across tasks and time points and no significant difference in PES was present between the two groups at T1.

SES. Pearson's correlations did not reveal significant associations between SES and PES across tasks. For the Flanker task, the correlation was small and negative, $r = -.07, p = .41$. For the Go/No-Go task, the correlation was small and positive, $r = .08, p = .33$. For the N-Back task, the correlation was small and negative, $r = -.06, p = .48$. Overall, these results suggest that socioeconomic status is not meaningfully related to children's post-error adjustments. Nevertheless, when considering only the intervention group, which had a significantly lower SES, SES was significantly correlated with PES in the Flanker task, $r = -.22, p = .049$, and PES in the N-back, $r = -.24, p = .046$.

Flanker. The analysis of PES in the Flanker task showed no significant main effect of Group, $\beta = .03, F(1, 140.56) = 0.07, p = .79$. There was a significant main effect of Time, indicating changes in PES across assessments, $\beta = .08$ at T2 and $\beta = -.05$ at T3, $F(2, 283.98) = 4.81, p = .009$. The effect of SES was not significant, $\beta = -.05, F(1, 139.58) = 0.80, p = .37$. The Group $\times$ Time interaction was not significant, $\beta = .21$ at T2 and $\beta = -.22$ at T3, $F(2, 284.03) = 1.84, p = .16$. The marginal R^2 was .03 and the conditional R^2 was .15. Consistently, effect size estimates indicated a small, non-significant improvement from pre- to post-test (Hedges's $g = .19$), which reversed at follow-up (Hedges's $g = -.20$).

Go/No-Go. The analysis of PES in the Go/No-Go task showed no significant main effect of Group, $\beta = .16, F(1, 143.85) = 1.89, p = .17$. There was a significant main effect of Time, indicating decreases in PES across assessments, $\beta = -.18$ at T2 and $\beta = -.28$ at T3, $F(2, 287.47) = 3.09, p = .047$. The effect of SES was not significant, $\beta = .08, F(1, 142.21) = 2.12, p = .15$. The Group $\times$

Time interaction was not significant, $\beta = -.08$ at T2 and $\beta = .02$ at T3, $F(2, 287.52) = 0.10, p = .91$. The marginal R^2 was .02 and the conditional R^2 was .08. In line with this pattern, Hedges's g values were near zero at both post-test ($g = -.08$) and follow-up ($g = .02$), confirming the absence of group-related effects on PES.

N-Back. The analysis of PES in the N-Back task showed no significant main effect of Group, $\beta = -.28, F(1, 378) = .75, p = .39$. There was a marginal main effect of Time, indicating decreases in PES across assessments, $\beta = -.29$ at T2 and $\beta = -.45$ at T3, $F(2, 378) = 2.81, p = .062$. The effect of SES was not significant, $\beta = .06, F(1, 378) = 1.32, p = .25$. The Group $\times$ Time interaction was also non-significant, $\beta = .26$ at T2 and $\beta = .31$ at T3, $F(2, 378) = 0.93, p = .40$. The marginal R^2 was .03 and the conditional R^2 was .03, indicating that the inclusion of the random effect did not increase the explained variance. Nevertheless, the effect size analysis revealed a small positive change at post-test ($g = .22$) that increased at follow-up ($g = .28$), suggesting a modest and persistent modulation of post-error slowing over time.

5.7. Discussion

5.7.1. Cognitive outcomes

The intervention yielded limited, though potentially meaningful, effects on cognitive outcomes as measured with the TeleFE battery, offering only partial confirmation of our first hypothesis. LMEs analyses revealed no significant time-by-group interactions for any EFs measure at either post-test (T2) or follow-up (T3). Several factors may account for the lack of differential changes over time. First, the relatively short intervention period of ten weeks may not have been sufficient to elicit robust improvements in executive functions (Diamond & Ling, 2016). Second, the cognitive and motivational suitability of the chosen board games may have been suboptimal; some games may not have provided the level of cognitive challenge needed to effectively engage executive processes. Finally, the current study relied exclusively on a computerized battery to assess executive functions; incorporating paper-and-pencil tasks in future work could help broaden the assessment approach.

Although interaction effects were not significant, effect size estimates (Hedges's g) offer a more refined view. A small but significant improvement in inhibition emerged from pre- to post-test, and an enhancement in cognitive flexibility was observed at follow-up. These domain-specific changes suggest that certain EFs may benefit from repeated practice and may require time to consolidate. It is also plausible that the cognitive demands embedded within the selected games predominantly engaged inhibition and flexibility, while placing less emphasis on other executive domains. Interestingly, the improvement in flexibility mirrors findings by Benzing et al. (2019), who also documented post-intervention gains in shifting abilities following a school-based board game training.

In conclusion, although the overall influence on cognitive outcomes was modest, the observed improvements in inhibition and flexibility highlight the potential for targeted gains in specific executive functions, especially when activities are cognitively demanding and delivered over a longer period. Future research should consider extending the duration of interventions, diversifying assessment methods with paper-and-pencil tasks, and refining game selection to better match intended cognitive outcomes.

5.7.2. Teacher-reported behavioural outcomes

Teacher ratings on the BRIEF-2 highlighted beneficial effects of the board game program on children's classroom behaviour, offering support to our second hypothesis. Compared to the control group, children in the intervention condition showed significant improvements in the Behavior Regulation Index (BRI), the Cognitive Regulation Index (CRI), and the Global Executive Composite (GEC) consisting in lower scores (less teacher-reported problems in the EFs domain). These findings suggest that the structured, rule-based nature of the board games combined with the metacognitive activities fostered self-control, planning, and strategic reasoning—skills closely tied to executive functioning. Interestingly, while the intervention group improved, the control group declined over time, pointing to a possible protective effect of the intervention. By embedding

metacognitive prompts and opportunities for self-reflection into game play (see Cravet & Usai, 2024; Pozuelos et al., 2019), the intervention may have not only enhanced but also stabilized children's executive skills during a period when environmental or developmental pressures might otherwise have led to decline. Practicing turn-taking, rule adaptation, and planning during repeated sessions likely facilitated the transfer of these abilities to classroom contexts.

A particularly noteworthy outcome was the sustained effect on CRI at follow-up, indicating that the skills acquired during the intervention continued to support cognitive regulation even after training ended. Although not all effect sizes reached statistical significance, as shown in Table 5.2., BRI showed a reliable pre- to post-test increase, and both CRI and GEC yielded moderate effect sizes, suggesting meaningful trends. In sum, the intervention appeared to operate on two levels: enhancing executive functioning in the short term and protecting against declines observed in peers without the training. This dual role underscores the promise of structured, game-based approaches for promoting children's adaptive functioning in educational settings.

5.7.3. Social, emotional and behavioural outcomes

The intervention showed promising effects on children's Social, Emotional, and Behavioural development, with significant gains in Emotional Resilience, thus offering partial confirmation of our third hypothesis. Improvements in this domain, observed immediately after the intervention, suggest that the structured and reflective nature of the board game sessions may have provided children with strategies to manage stress, regulate emotions, and adapt more effectively to challenges—skills that are central for success in both academic and social contexts (Huang et al., 2023). The robustness of this finding is further supported by effect size estimates, with Hedges's *g* indicating a reliable pre- to post-test improvement in Emotional Resilience. However, no significant changes were detected for Self-Management, Social Engagement, or Cooperation, reflecting the limited responsiveness of such domains to short-term interventions, or the fact that the mechanisms embedded in the board games—turn-taking, strategic reasoning, and emotional regulation—were

not sufficiently aligned with the broader social and behavioral dimensions assessed. Developmental factors could also play a role: younger children may struggle to accurately self-evaluate competencies like self-management or cooperation, which could attenuate the measurable impact of the program. This study represents the first attempt to evaluate teacher-led board game activities in relation to SEB outcomes. While the observed improvements in Emotional Resilience are encouraging, the findings emphasize the importance of intervention length and design when aiming to foster a broader spectrum of social and emotional skills. Future research should examine whether extending the duration or tailoring activities more explicitly to domains such as cooperation and self-management might produce stronger and more generalized benefits. Another limitation of these results is the poor fit of the Innovation scale in this age group. Future studies should better adapt the BESSI-45 for use with children of this age in order to improve the scale's reliability and ensure that the items appropriately capture developmentally relevant expressions of innovation.

5.7.4. Learning outcomes

Findings offered partial confirmation of the fourth hypothesis regarding far-transfer effects on academic performance. Mathematics grades in the intervention group displayed a positive trend, remaining stable or slightly improving over time, whereas the control group showed a modest decline. Although the interaction between time and group did not reach significance, this pattern suggests a potential protective role of the intervention, particularly in mathematics. In contrast, Italian grades decreased across both groups, and the smaller decline observed in the intervention group was not statistically reliable. This discrepancy may reflect the nature of the skills targeted: board games tend to promote logical reasoning, structured thinking, and strategic problem-solving, which are more directly related to mathematics than to language abilities, which typically require sustained exposure to reading, writing, and rich verbal interactions.

The protective effect observed in mathematics could be linked to the cognitively engaging structure of the board game sessions. Through repeated opportunities for planning, reasoning, and applying

metacognitive strategies, children may have strengthened self-regulation skills useful for classroom learning—such as maintaining attention, managing distractions, and reflecting on problem-solving approaches. These mechanisms may have helped sustain or enhance their mathematical performance. Overall, while evidence for far-transfer to academic domains was limited, the pattern observed for mathematics aligns with prior findings that board game interventions can support school-related outcomes (e.g., Vita-Barrull et al., 2024). Future research should examine whether tailoring activities to linguistic processes or extending the duration of the intervention could produce more consistent benefits across subjects.

5.7.5. Post-error slowing

We exploratively examined whether socioeconomic status was associated with post-error slowing in our sample. When considering the entire sample, no significant correlations emerged between SES and PES in any of the tasks. However, when focusing on the intervention group—which had a significantly lower mean SES—SES was negatively correlated with PES in the Flanker and N-Back tasks. These findings suggest that lower socioeconomic status may be related to reduced post-error slowing in contexts requiring conflict monitoring and working memory updating, although the effects were small in magnitude.

Although previous studies have suggested that socioeconomic factors may play a role in error monitoring mechanisms (e.g., Ornstein et al., 2009; Brooker, 2018), this association was only partially evident in our data and limited to the lower-SES subgroup. The mixed pattern of results may reflect differences in cognitive demands across tasks, variability in SES within groups, or the developmental stage of the participants. Moreover, given the exploratory nature of this analysis, these effects should be interpreted with caution. They may indicate that behavioral markers of error monitoring, such as PES, are only modestly sensitive to socioeconomic influences, and that more sensitive neural measures (e.g., the error-related negativity, ERN) might be required to detect subtle group-level differences. Future studies with larger and more diverse samples, combined with

longitudinal and multimethod approaches, will be crucial to clarify how environmental and developmental factors jointly shape error monitoring and its role in adaptive learning.

Regarding intervention effects, no group differences or Group $\times$ Time interactions emerged, indicating that the program did not systematically influence PES. Across tasks, PES tended to decrease over time, suggesting that children became progressively faster or more efficient in adjusting their responses following errors. This pattern may reflect practice-related adaptations or increasing task familiarity rather than effects attributable to the intervention. Overall, these findings suggest that developmental changes and task-specific features exert a stronger influence on PES trajectories than experience with EF training that includes metacognitive components (Cravet & Ger, 2025; Ger & Cravet, 2025).

Descriptive data supported this interpretation. In the Flanker task, both groups showed an increase in PES from pre- to post-test, followed by a marked reduction at follow-up, particularly in the intervention group. This trend was reflected in small, non-significant effect sizes, suggesting temporary fluctuations rather than systematic training effects. In the Go/No-Go task, PES values decreased across all time points and groups, consistent with near-zero effect sizes, which indicate that changes were largely attributable to task repetition or growing familiarity. In contrast, the N-Back task showed a small and stable positive change, corresponding to a slightly slower decline in PES over time for the intervention group. Although modest, this pattern might reflect subtle differences in how children maintained post-error adjustments under higher working-memory load.

A limitation of these findings concerns class allocation. As the intervention was implemented within the school's regular curriculum, class assignment was determined by the school's internal organisation. Classes with a higher prevalence of behavioural difficulties—typically characterised by lower socioeconomic status—were prioritised for the intervention, resulting in lower SES in the intervention group compared to the control group. This imbalance should be considered when interpreting the findings.

Taken together, the results suggest that PES trajectories were mainly driven by practice effects and task demands, with limited evidence of systematic intervention-related modulation. The task-specific trends, particularly the small and persistent effects in the N-Back task, warrant further investigation in future research designed to disentangle developmental, task-related, and training-related influences on post-error adjustments.

5.7.6. Conclusion

Taken together, the findings indicate that the board game-based intervention yielded limited but promising effects across domains. Cognitive outcomes showed modest and selective improvements, particularly in inhibition and flexibility, suggesting that targeted executive processes may benefit from repeated practice but may require longer interventions to consolidate. Teacher-reported data provided stronger evidence, highlighting both short-term gains and protective effects on classroom behaviour, especially in cognitive regulation. Social-emotional outcomes also pointed to improvements in emotional resilience, underscoring the potential of structured, reflective activities to strengthen adaptive coping. Learning effects were less consistent, though a protective trend in mathematics performance was observed, aligning with the intervention's emphasis on reasoning and problem-solving. Finally, analyses of post-error slowing suggested that developmental trajectories in error monitoring are shaped more by task characteristics and practice than by short-term EFs intervention including metacognitive activities. Moreover, the absence of a correlation between SES and PES suggest that PES is less influenced by socioeconomic factors compared to other self-regulation components.

Overall, while the intervention did not produce robust or generalized gains across all outcomes, it showed the potential of structured, game-based activities to support specific aspects of executive functioning, emotional resilience, and classroom behaviour. Future research should extend the duration and refine the design of such programs to maximize their impact and clarify the mechanisms through which they foster children's cognitive and socio-emotional development.

5.7.7. Limitations and future directions

Several limitations should be acknowledged. First, the relatively short duration of the intervention (ten weeks) may have limited the scope and strength of training effects; longer programs may be necessary to produce more robust and generalized improvements. Second, the choice of the board games may not have been optimal, potentially reducing the effectiveness of the intervention. Third, outcome measures relied primarily on computerized tasks, self-reports and teacher reports; incorporating multiple assessment methods, such as paper-and-pencil tests and direct behavioural observations of SEB skills, could provide a more comprehensive evaluation. Fourth, the sample size and demographic composition limited the generalizability of findings; larger and more diverse samples are needed to clarify whether effects vary by socioeconomic background.

Future research should address these limitations by implementing longer and more intensive interventions, carefully tailoring game selection to specific executive and socio-emotional domains and broadening the assessment approach. Moreover, exploring how such interventions can be adapted to different educational contexts, cultural settings, and developmental stages will be essential for maximizing their ecological validity and impact.

Chapter 6

General Discussion

6.1. Overview and integration of findings

The overarching aim of this doctoral dissertation was to investigate how socioeconomic status shape children's development by integrating cognitive, linguistic, and socio-emotional perspectives. A second aim was to examine the associations between executive functioning and Social, Emotional, and Behavioural skills (i.e., soft skills), thereby contributing to the validation of the BESSI-45 in middle childhood. Finally, a further aim was to evaluate whether school-based, board game-based interventions can enhance children's cognitive, social, emotional, and behavioural competences, thus potentially mitigating the negative impact of socioeconomic disadvantage on developmental outcomes. Across five empirical studies, this dissertation provided converging evidence that SES acts as a contextual factor influencing children's development in domain-specific ways. SES showed a direct effect on grammar comprehension and on executive functioning. In turn, grammar comprehension mediated the relationship between SES and pragmatic language, indicating that linguistic structure serves as a pathway through which socioeconomic differences shape communicative competence. By contrast, SES did not show significant associations with SEB skills, nor with post-error slowing—a behavioural indicator of metacognitive control—, suggesting that these developmental domains are less influenced by the socioeconomic background. While we found that executive functioning was a strong predictor of SEB skills—suggesting that executive regulatory abilities may serve as a foundation for these more socially and emotionally oriented self-reported competencies—we also identified some limitations of the BESSI-45, particularly concerning the Innovation scale, although the present work nonetheless contributed to the instrument's validation in middle childhood. Finally, the intervention studies further demonstrated that even brief, teacher-led programmes based on board games can yield measurable gains in

executive functioning, emotional resilience and academic outcomes, offering a feasible approach to promoting equity in schools.

Taken together, the findings support a multilevel model of development in which linguistic, cognitive, and socio-emotional systems interact dynamically within environmental constraints. Within this model, board game–based interventions enriched with metacognitive components emerge as effective pedagogical tools for fostering self-regulation and bridging socioeconomic gaps, illustrating that equitable development can be achieved through ecologically valid educational practices.

6.2. The role of SES across studies

Socioeconomic status influences children’s development through multiple, interrelated pathways, including environmental enrichment, cognitive stimulation, stress exposure, and access to educational opportunities (Bradley & Corwyn, 2002; Finn et al., 2017; Hackman & Farah, 2009; Noble et al., 2007). However, as demonstrated across the studies included in this dissertation, the relationship between SES and developmental outcomes is neither linear nor homogeneous across domains.

The findings from Study 2 (Chapter 3) showed that SES exerted direct effects on both grammar comprehension and executive functioning, reinforcing the view that socioeconomic context plays a pivotal role in shaping the development of linguistic and cognitive control systems. In contrast, the influence of SES on pragmatic language was found to be indirect, mediated by children’s grammatical abilities (Cravet & Usai, 2025), suggesting that linguistic structure may represent a key mechanism through which socioeconomic differences impact communicative competence.

Consistent with previous literature, Study 4 (Chapter 5) revealed a positive association between SES and academic achievement (Lawson et al., 2018), confirming that socioeconomic disparities are reflected in learning outcomes.

By contrast, SES was not significantly associated with socio-emotional and behavioural skills, i.e., soft skills, in Study 1 (Chapter 2) or with post-error slowing in Study 4, suggesting that these domains may depend more on individual and educational factors than on family background. Taken together, these findings point to a domain-specific model in which socioeconomic disparities exert stronger and more direct effects in areas where access to learning opportunities and linguistic input are most crucial—such as language and executive functioning—whereas other developmental structures, i.e., soft skills and metacognitive control, appear more resilient to socioeconomic influence. This pattern suggests that both contextual and individual factors beyond family SES, including high-quality and inclusive schooling practices, may contribute to buffering the impact of socioeconomic disadvantage on children’s broader socio-emotional development.

6.2.1. SES and cognitive and metacognitive outcomes

Overall, the present findings provide a nuanced picture of the influence of socioeconomic factors on cognitive and metacognitive outcomes, in both continuity and partial contrast with the literature reviewed in the introduction. Consistent with extensive evidence linking higher SES to better executive functioning—through differences in environmental stimulation, stress exposure, and access to educational resources (Noble et al., 2005, 2007), as well as structural and functional variations in prefrontal regions (Farah, 2017; Ursache & Noble, 2016)—we found that (a) in Study 1, SES correlated with teacher-reported executive difficulties (General Executive Composite from the BRIEF-2); and (b) in Study 2, SES correlated with EF, as measured through the composite index derived from the TeleFE computerized tasks and exerted a direct effect on it. These results are in line with previous studies showing SES-related differences in working memory, inhibition, and cognitive flexibility (Hackman et al., 2015; Lawson et al., 2018; Rakesh et al., 2025). At the same time, in Study 4, which involved the same sample and the same EF measures used in Study 1 but employed Linear Mixed Models (LMMs) to examine longitudinal changes, SES again emerged as a significant predictor in the BRIEF-2 indices (Cognitive Regulation Index and General

Executive Composite), with children from higher-SES families showing fewer executive functioning difficulties. In contrast, no significant effects of SES were detected in the TeleFE task-based measures. This pattern suggests that SES-related disparities in executive functioning may be more pronounced in ecological, behaviourally oriented assessments and in composite indices, supporting the view that SES impacts both executive processes and their everyday manifestations (Noble et al., 2005, 2007; Farah, 2017; Ursache & Noble, 2016).

Regarding metacognitive outcomes, the introduction highlighted that SES shapes early metacognitive abilities—particularly through the language domain—and that language itself forms a foundation for metacognitive development (Buehler et al., 2025; Maximino-Pinheiro et al., 2024; Pappas et al., 2003). Since SES is strongly associated with children’s language proficiency (Farah et al., 2006; Noble et al., 2005, 2007; Pace et al., 2017; Lawson et al., 2018; Ursache & Noble, 2016; Merz et al., 2019), it could indirectly influence metacognitive processes through this pathway. However, in our data, the post-error slowing—the only metacognitive indicator examined—was not significantly related to SES, nor was it influenced by the intervention (Study 4).

Although previous studies have suggested that socioeconomic factors may influence error-monitoring mechanisms (e.g., Ornstein et al., 2009; Brooker, 2018), this association was only partially evident in the present study. Specifically, when considering the intervention group—which had a significantly lower mean SES—SES was negatively correlated with PES in the Flanker and N-Back tasks, suggesting that children from lower-SES backgrounds tended to show reduced post-error slowing in these contexts. No significant associations were observed in the control group or in the Go/No-Go task. This pattern may indicate that socioeconomic influences on error monitoring are subtle and become evident primarily when socioeconomic disadvantage reaches more pronounced levels.

In sum, while our findings on executive functions converge with prior evidence linking SES to differences in executive performance (Hackman et al., 2015; Lawson et al., 2018; Rakesh et al., 2025; Noble et al., 2005, 2007; Farah, 2017; Ursache & Noble, 2016), the limited and task-specific

associations between SES and PES suggest that this metacognitive process may be only modestly sensitive to socioeconomic variation—consistent with the scarce and mixed evidence currently available (Ornstein et al., 2009; Brooker, 2018).

6.2.2. SES and language outcomes

The study presented in Chapter 3, published in the *Journal of Child Language*, investigated the linguistic pathways through which socioeconomic factors shape children's communicative competence. Our findings that SES was directly related to executive functioning and grammar comprehension, but not to pragmatic language, with grammar comprehension fully mediating the latter association, align with prior research highlighting that the quality and complexity of linguistic input in early interactions, including syntactic richness and opportunities for elaborated discourse, predict both grammatical and pragmatic development (Letourneau et al., 2013; Pace et al., 2017; Merz et al., 2019). Children from higher-SES families are typically exposed to more sophisticated syntactic forms and more varied conversational contexts, which strengthen their ability to process grammatical relations and, consequently, to use language in socially adaptive ways. Conversely, children from lower-SES backgrounds may encounter fewer opportunities for linguistically complex exchanges, limiting their grammatical knowledge and, indirectly, their pragmatic flexibility.

Importantly, the present study also underscored the role of language background as a relevant variable in interpreting SES-related effects. In the current sample, children from lower-SES families were more likely to come from multilingual households, often with at least one immigrant parent. Because both grammar and pragmatic skills were assessed in Italian—a language that was not always the primary language spoken at home—the lower performance observed among these children may partly reflect differences in linguistic exposure and proficiency rather than socioeconomic disadvantage per se. This consideration aligns with recent discussions emphasising

that linguistic diversity can modulate SES–language associations and must therefore be carefully controlled in future research (Bellocchi & Bonifacci, 2023).

From a theoretical standpoint, the findings confirm and extend prior work showing that SES primarily influences the structural aspects of language, which in turn support the development of pragmatic competence (Merz et al., 2019; Pace et al., 2017). At the same time, they diverge from studies reporting direct SES effects on pragmatic abilities (Bosco et al., 2013), instead aligning with more recent evidence that such associations tend to disappear once grammatical and cognitive factors are accounted for (Bosco & Gabbatore, 2017; Schulze & Saalbach, 2022). This suggests that SES-related differences in communication are not a direct manifestation of socioeconomic status but emerge through the unequal distribution of linguistic and cognitive resources that scaffold pragmatic understanding. Furthermore, the study demonstrated that both grammar comprehension and executive functioning directly predicted pragmatic abilities, supporting models that conceptualise pragmatics as an inherently multicomponential skill requiring both linguistic structure and cognitive regulation (Filipe et al., 2020; Nilsen et al., 2021; Razavi et al., 2019). This convergence between linguistic and cognitive contributions reinforces the view that pragmatic communication involves not only access to linguistic forms, but also the ability to flexibly monitor, infer, and adjust meaning in real time.

Taken together, these results highlight a domain-specific pattern in which SES exerts direct effects on grammar and EF but influences pragmatic abilities only indirectly through grammar. The absence of a direct SES effect on pragmatic performance also underscores the relevance of additional developmental and contextual influences, such as peer interaction, classroom discourse, and the broader quality of schooling, which may support communicative adaptation beyond the linguistic environment alone. From an applied perspective, the findings carry important implications for educational practice. They indicate that interventions designed to reduce disparities in communicative competence should jointly target grammatical development and executive regulation. Strengthening grammatical awareness provides the structural foundation for meaning-

making, while fostering executive functioning enhances children's ability to apply this knowledge flexibly across contexts. Creating linguistically and cognitively enriched school environments may thus represent a powerful means of promoting equity in communication and learning (Farah et al., 2006; Noble et al., 2007).

6.2.3. SES and socio-emotional outcomes

The findings from the present dissertation contribute to clarifying the role of socioeconomic factors in shaping children's social, emotional, and behavioural skills development, a topic that, as discussed in the introduction, has so far received limited and inconsistent attention, at least in middle childhood. Previous research has shown that SES-related differences in SEB skills tend to be smaller than those observed in cognitive domains (Lechner et al., 2021), although more recent evidence indicates that parental education and migration background can significantly predict adolescents' SEB profiles (Lechner & Urban, 2024). Our results align with and extend this mixed evidence, suggesting that SES may exert relatively modest or indirect effects on SEB skills in middle childhood.

In Study 1, SES did not significantly correlate with SEB skills, despite the sample including children from heterogeneous socioeconomic backgrounds. This finding is consistent with Lechner et al. (2021), who reported small SES-related differences in SEB skills compared to cognitive outcomes, and may reflect developmental or contextual factors. During middle childhood, SEB skills may be less directly shaped by structural inequalities, or alternatively, the restricted SES variability within a single-school sample may have attenuated detectable associations. However, when analyses focused solely on the intervention group, a positive correlation emerged between SES and Emotional Resilience, suggesting that children from higher-SES backgrounds might have benefited more from the intervention's socio-emotional components. Together, these results indicate that SEB skills, at least in this developmental window, may be relatively resilient to

socioeconomic variation, although the expression or enhancement of specific skills such as Emotional Resilience could still be modulated by socioeconomic context.

Moreover, the broader pattern of findings across studies suggests that SES may influence SEB development indirectly, through its impact on cognitive and executive processes. In Study 1, executive functioning—and not SES—emerged as the unique predictor of SEB skills, supporting the view that EFs constitute a proximal mechanism linking self-regulation and socio-emotional adaptation (Diamond, 2013; Doebel, 2020). Considering that SES was associated with EF difficulties in Study 1 (as reflected in the BRIEF-2 indices), it is plausible that socioeconomic disparities in SEB skills may become more apparent later in development, as EF and related self-regulatory processes further consolidate.

In summary, the present findings support the view that socioeconomic disparities in SEB skills are less pronounced in middle childhood than in adolescence (Lechner et al., 2021; Lechner & Urban, 2024). Although SES did not directly predict SEB outcomes in our sample, its established links to executive functioning (Noble et al., 2005, 2007; Farah, 2017; Ursache & Noble, 2016) point to possible indirect pathways through which socioeconomic conditions could influence children's social and emotional adaptation. Future longitudinal studies involving more socioeconomically diverse samples will be essential to disentangle these pathways and determine how SES-related differences in executive and regulatory processes contribute to the development of SEB skills over time.

6.2.4. SES in intervention contexts

The present findings contribute to the growing literature on interventions aimed at reducing disparities associated with socioeconomic disadvantage, particularly in the domain of executive functioning. As summarized in the introduction, school-based programs have proven especially valuable for promoting executive functions in ecologically valid contexts and for reaching children who may otherwise have limited access to cognitive enrichment opportunities (Company-Córdoba

et al., 2025; Diamond & Lee, 2016; Diamond & Ling, 2020; Katz & Shah, 2017; Poon et al., 2020).

Board games, in particular, have been highlighted as promising tools due to their social, motivational, and cognitively demanding nature (Benzing et al., 2019; Moya-Higueras et al., 2023; Vita-Barrull et al., 2024).

In Study 3, the teacher-led board game intervention proved feasible and yielded encouraging effects, particularly on low-load working memory. These findings are consistent with evidence that board game activities can engage executive functions in an intrinsically motivating context (Benzing et al., 2019; Diamond & Ling, 2016). Importantly, the number of sessions attended was related to the magnitude of gains, suggesting that quantity and engagement are key parameters for efficacy, especially for children who may experience socioeconomic disadvantages.

In Study 4, conducted with a larger sample, Linear Mixed Models revealed that SES significantly predicted EF outcomes in teacher reports (BRIEF-2 CRI and GEC), with children from higher-SES backgrounds exhibiting fewer EF difficulties across time. However, no significant SES effects emerged in the TeleFE computerized measures. These results indicate that although SES remains a relevant factor in children's executive functioning, structured and universally delivered school programs may offer a context in which disparities are attenuated. This pattern aligns with evidence suggesting that educational interventions, when embedded in naturalistic settings, can buffer SES-related disadvantages by providing shared cognitive and social experiences (Company-Córdoba et al., 2025; Diamond & Ling, 2020). Beyond executive functioning, SES also predicted academic outcomes, as children from higher-SES backgrounds obtained higher grades in mathematics and Italian. This finding is consistent with previous evidence that socioeconomic conditions strongly influence children's cognitive and language development, as well as their academic performance (Farah et al., 2006; Noble et al., 2005, 2007; Pace et al., 2017; Lawson et al., 2018), highlighting that educational disparities emerge early and tend to persist across domains closely tied to both linguistic and executive processes.

In contrast, no significant SES effects were observed for SEB skills, in line with previous findings suggesting that socioeconomic disparities in these domains are less pronounced than those observed for cognitive or academic outcomes (Lechner et al., 2021).

In sum, the current results suggest that school-based, game-based interventions may act as protective tools in contexts where related disparities exist. The overall pattern indicates that equitable, engaging, and cognitively challenging classroom experiences—such as structured board game activities—can provide meaningful opportunities for all children to strengthen their self-regulatory capacities. Future longitudinal studies including more socioeconomically diverse samples are needed to clarify whether such interventions can produce lasting compensatory effects, particularly for children at greater socioeconomic risk, and to examine the mechanisms—both cognitive and socio-emotional—through which these benefits unfold over time.

6.2.5. Summary and synthesis

Across all studies, the present work provides a comprehensive view of how SES influences executive functioning, metacognitive processes, and socio-emotional and behavioral skills (i.e., soft skills) in middle childhood, and how these processes can be supported through ecologically valid, school-based interventions. Taken together, the findings converge on three main points.

First, SES emerged as a consistent predictor of executive functioning, in line with prior evidence that children from higher-SES backgrounds tend to show more efficient cognitive control and self-regulation (Hackman et al., 2015; Lawson et al., 2018; Noble et al., 2005, 2007; Farah, 2017; Ursache & Noble, 2016). In Study 1, SES correlated with teacher-rated EF difficulties and in Study 2, SES exerted a direct effect on the EF index computed from TeleFE tasks, supporting the idea that socioeconomic conditions influence executive functioning through multiple pathways. These findings were further confirmed using Linear Mixed Models in Study 4, where SES significantly predicted teacher-reported EF outcomes. Together, these results reinforce the notion that SES

shapes executive control both at the behavioral and cognitive levels, although its impact may vary depending on the type and context of assessment.

Second, SES also influenced academic performance, with children from higher-SES families achieving better grades in mathematics and Italian. This finding aligns with well-established evidence that socioeconomic differences in cognitive and linguistic stimulation contribute to disparities in learning outcomes (Farah et al., 2006; Noble et al., 2005, 2007; Pace et al., 2017; Lawson et al., 2018). In contrast, no SES effects were observed for SEB skills, consistent with previous research suggesting that socioeconomic disparities in these domains are typically smaller than those observed for cognitive or academic outcomes (Lechner et al., 2021) and may become more pronounced only later in development (Lechner & Urban, 2024).

Third, the intervention studies (Studies 3 and 4) demonstrate that structured, school-based board game programs can be feasibly implemented by teachers and may enhance specific cognitive and socio-emotional outcomes. In Study 3, a short teacher-led intervention showed promising effects on low-load working memory, while in Study 4, children in the intervention group exhibited improvements especially in classroom behaviour (BRIEF-2 indices), as well as in emotional resilience. These results suggest that school-based programs may serve as protective contexts that provide equitable opportunities for cognitive and socio-emotional growth (Diamond & Ling, 2020; Moya-Higueras et al., 2023).

In sum, the findings across studies highlight a complex yet coherent pattern: SES influences foundational cognitive processes and academic outcomes, while interventions targeting EFs in naturalistic school contexts hold potential to mitigate these disparities. Executive functioning consistently emerged as a central mechanism linking cognitive, socio-emotional, and learning domains, underscoring its pivotal role in children's adaptation and success. By integrating evidence from correlational, mediation, and intervention studies, this thesis advances our understanding of how socioeconomic and cognitive factors jointly shape development—and how carefully designed educational interventions can promote resilience and equity from early schooling onward.

6.3. Incorporating SEB in the EF framework

The results of Study 1 provide empirical support for integrating Social, Emotional, and Behavioral skills within the broader framework of executive function. Consistent with theoretical accounts emphasizing the centrality of self-regulation in both domains (Diamond, 2013; Doebel, 2020; Soto et al., 2021, 2022a, 2022b), the present findings revealed that children with fewer EF difficulties—as rated by teachers—also reported stronger SEB skills across all domains. This convergence underscores the conceptual and functional overlap between EF and SEB skills, suggesting that SEB skills may represent the applied, self-perceived expression of executive capacities in everyday contexts. While EF encompasses core cognitive processes such as inhibition, working memory, and cognitive flexibility that enable goal-directed behaviour, SEB skills capture how these regulatory processes manifest in social and emotional functioning, including cooperation, emotional resilience, and self-management.

By situating SEB skills within the EF framework, a more comprehensive understanding of adaptive functioning in middle childhood can be achieved. In line with Diamond and Ling's (2016) view that EF supports behavioral and emotional regulation across contexts, EB skills can be conceptualized as the self-perceived expression of executive functioning in everyday life. For instance, self-management may rely on working memory and shifting to plan and adapt behaviour, whereas emotional resilience may depend on inhibitory control to regulate affective responses. The associations observed in Study 1 between EF and all SEB domains support this interpretation, highlighting EF as a potential cognitive foundation for SEB development.

At the same time, the lack of correlation between SEB skills and fluid intelligence, and the modest convergence often found between different measures of EF, point to the importance of considering methodological differences in assessment. In the present study, SEB skills were self-reported by children, whereas EF was rated by teachers. Previous research has shown that correlations between EF measures depend strongly on the method of assessment: performance-based EF tasks typically capture efficiency in controlled settings and show weak associations with informant reports, which

instead reflect the child's regulatory capacities as observed in everyday contexts (Toplak et al., 2013; Doebel, 2020). The significant links found here between teacher-reported EF and self-reported SEB skills therefore suggest that when both constructs are measured through ecologically valid, context-based reports, their conceptual alignment becomes more evident. This supports the view that SEB skills represent the behavioral and self-perceived expression of executive control in real-world settings rather than the cognitive efficiency measured by traditional EF tasks.

6.3.1. Theoretical and practical implications

Incorporating SEB into the EF framework thus has important theoretical and practical implications. The strong EF–SEB association observed in this study suggests that interventions targeting EF—such as mindfulness, sports, or music programs (Diamond & Ling, 2016; Feraco & Meneghetti, 2022)—may also promote SEB skills. Conversely, activities designed to foster SEB competencies, including cooperation or emotional resilience training (Durlak et al., 2011; Taylor et al., 2017), could indirectly strengthen EF by providing opportunities for self-regulation in socially and emotionally meaningful contexts. Future longitudinal research is needed to clarify the directionality of these influences and to examine whether improvements in EF precede, follow, or co-develop with gains in SEB skills.

In summary, the present findings support a unified perspective in which SEB skills are conceptualized as developmentally grounded expressions of executive control across social and emotional domains. Integrating SEB and EF frameworks offers a richer, ecologically valid account of children's adaptive functioning and provides a theoretical foundation for educational interventions aimed at fostering holistic development and resilience in school-aged children.

6.4. Intervention studies: structured play as a context for self-regulation

A central applied goal of this dissertation was to test whether structured play, implemented through board game activities, could enhance children's executive and socio-emotional functioning and learning within real classroom environments. A converging body of evidence indicates that

structured play—particularly modern board games embedded in reflective classroom routines—offers an ecologically valid context for practicing self-regulation. Board games naturally recruit working memory, inhibition, and cognitive flexibility through rule following, turn taking, and strategic adjustment. When such activities are intentionally framed with metacognitive prompts and delivered by teachers, they may foster both executive functioning and Social, Emotional, and Behavioural, skills relevant to classroom learning (Benzing et al., 2019; Feraco & Meneghetti, 2022; Vita-Barrull et al., 2024).

Study 1 established robust links between teacher-reported EF and children’s self-reported SEB skills in middle childhood, positioning SEB as self-reported expressions of regulatory capacities in everyday contexts. Building on this foundation, the intervention studies (Chapters 4–5) implemented structured play in schools through teacher-led protocols that combined board games with a narrative framework and token economy to scaffold behaviour regulation and reflection (Cravet & Usai, 2024; Kim et al., 2021; Traverso et al., 2015). Across these studies, school proved to be a strategic setting for implementation, given its reach, feasibility, and potential to mitigate access inequalities (Company-Córdoba et al., 2025; Diamond & Lee, 2011; Diamond & Ling, 2016).

6.4.1. Pilot and main intervention findings

The dissertation included both a pilot feasibility study and a main intervention implemented over ten weeks. The pilot (Chapter 4) demonstrated feasibility and produced selective gains in low load working memory, with effect sizes suggesting practically meaningful benefits despite the small sample (Cravet & Usai, 2024). Although flexibility, inhibition, and high load updating did not show reliable group differences, dosage mattered: the number of sessions attended predicted stronger working-memory outcomes, consistent with accounts that EF benefits scale with practice and program length (Diamond & Ling, 2016).

The larger intervention study (Chapter 5) extended these results. On computerized EF tasks (TeleFE), group $\times$ time interactions were not significant; however, some effects emerged on teacher ratings (BRIEF-2), specifically in behavioural and cognitive regulation and in the Global Executive Composite, with the cognitive regulation effect persisting at follow-up. Importantly, students' Emotional Resilience—a core SEB domain—improved in the intervention group (BESSI-45; Soto et al., 2022), while academic grades showed a protective pattern, particularly in mathematics, with stability in the intervention group and declines in controls. Socioeconomic status predicted academic outcomes and some BRIEF-2 indices. Finally, post-error slowing analyses revealed task-related decreases over time but no intervention or SES effects, suggesting that structured board-game intervention may not meaningfully alter this monitoring marker in primary school despite metacognitive reflection activities included in it (see Chapter 5). These findings are noteworthy for several reasons. First, they demonstrate that ecologically valid, classroom-based activities can foster measurable improvements in self-regulation without the need for intensive one-to-one training or technology-dependent resources. Second, the effects were observed across socioeconomic levels, underscoring the intervention's potential to promote equity and inclusiveness within educational settings.

6.4.2. Mechanisms of change

Three mutually reinforcing mechanisms likely underpinned the observed changes. First, task demands inherent to board games require continuous updating, interference control, and set shifting as children plan moves, manage rules, and adapt to opponents' strategies (Diamond, 2013; Noda et al., 2019). Such repeated, situated practice plausibly supports near-transfer to everyday EF as captured by teacher reports.

Second, metacognitive scaffolding—the narrative framework and guided reflections—likely facilitated awareness of strategies and promoted generalization beyond game contexts (Pozuelos et al., 2019; Traverso et al., 2015). The token economy provided behavioral reinforcement for self-

regulation routines (e.g., waiting, turn taking, voice regulation), aligning motivational contingencies with the program’s regulatory goals (Kim et al., 2021). The selective improvement in Emotional Resilience may rely in the idea that structured, reflective social play can strengthen emotion regulation and coping with challenge. Third, teacher mediation and ecological delivery may have enabled transfer to classroom functioning. Co-design and teacher-led implementation bridge laboratory and classroom practices, increasing fidelity and contextual relevance (Letang et al., 2020; Zelazo et al., 2024). The observed “protective” pattern in behaviour regulation and mathematics grades is compatible with this ecological account: when everyday classroom routines embed opportunities for practice and feedback, EF-related behaviours may stabilize or improve despite developmental or environmental stressors.

6.4.3. Implications for inclusive education

The combined evidence supports structured, teacher-led play as a low-cost, scalable, and inclusive approach to fostering self-regulation in diverse classrooms. First, school-based delivery reduces access barriers common in low-SES communities and leverages existing staff and schedules. Second, the observed benefits on teacher-rated EF and Emotional Resilience and the protective effect from drops in academic performance indicate that such programs may bolster capacities that mediate SES-related disparities in learning (Blair & Raver, 2016; Lawson et al., 2018; Sirin, 2005). For implementation, findings point to several design principles: (a) quantity and continuity matter—more sessions were associated with stronger outcomes (Cravet & Usai, 2024; Diamond & Ling, 2020); (b) explicit metacognitive framing and behavioral reinforcement help translate game-based challenge into generalized self-regulatory routines (Kim et al., 2021; Pozuelos et al., 2019; Traverso et al., 2015); and (c) teacher partnership is essential for ecological validity and sustainable scale-up (Letang et al., 2020; Zelazo et al., 2024). Finally, given the mixed or nonsignificant effects on computerized EF tasks and post-error slowing, future interventions might benefit from increasing the duration or intensity of structured play, or from combining it with targeted cognitive activities

that more directly engage specific executive processes, such as working memory or inhibitory control training. Moreover, since the present findings showed a protective trend in mathematics but not in language performance, incorporating content-specific components—such as problem-solving tasks in mathematics or explicit instruction in grammar and reading comprehension—could further strengthen the link between self-regulation and academic learning. Nonetheless, such additions would likely need to be implemented in parallel with structured play, as domain-general self-regulation alone may not be sufficient to produce measurable gains in academic achievement. In sum, integrating structured play with metacognitive and motivational scaffolds offers a practical route to strengthen everyday executive functioning and socio-emotional adaptation in heterogeneous classrooms, complementing broader efforts to reduce opportunity gaps through school-based, teacher-led interventions.

6.5. Methodological considerations and limitations

Several methodological considerations should be acknowledged when interpreting the findings presented across this dissertation. First, although the studies were conceptually integrated, their designs were largely cross-sectional. This constrains the ability to draw firm causal inferences about developmental trajectories. Future longitudinal research is therefore needed to clarify the directionality of associations among socioeconomic status, executive functioning, pragmatic language, grammar comprehension, and socio-emotional development. Second, although all samples were drawn from schools characterized by socioeconomic and cultural heterogeneity, recruitment was limited to a single geographical area. While this ensured ecological consistency and reduced confounding variability across contexts, it also constrains the generalizability of findings. Future studies should include larger and more demographically diverse samples—ideally across multiple schools and regions—to capture broader variability in SES, language background, and educational environments.

Third, differences in assessment methods across studies may have influenced the strength and pattern of observed relationships. For instance, EF was assessed both through teacher reports (BRIEF-2) and computerized performance-based tasks (TeleFE), while SEB skills were self-reported by children using the BESSI-45. As widely noted in the literature (Toplak et al., 2013; Doebel, 2020), these different modalities capture distinct aspects of executive functioning—ecological versus cognitive efficiency—leading to modest convergence. The strong correlations observed between teacher-rated EF and self-reported SEB skills in Study 1 thus likely reflect shared ecological validity rather than purely construct overlap. Similarly, the lack of correlation between SEB skills and task-based EF measures underscores the importance of multimethod assessment. Moreover, although computerized EF tasks offer standardized and reliable indices of cognitive efficiency, they may insufficiently capture the behavioural and context-dependent manifestations of executive functioning that are most relevant for classroom functioning. Future studies could therefore complement computerized measures with behavioural EF tasks, naturalistic observations, or performance-based activities embedded in everyday school contexts, in order to increase ecological validity.

Fourth, despite rigorous standardization and training procedures, some limitations may stem from the group-based assessment format used for several tasks (e.g., APL Medea, TeleFE). Although this approach increased ecological validity and feasibility, it may have introduced additional variability compared to strictly individual testing. Relatedly, while the intervention studies (Chapters 4–5) were implemented and supervised by teachers—enhancing authenticity and scalability—this may have introduced differences in fidelity across classrooms involved in the intervention. Although fidelity was monitored through researcher observations, minor deviations from protocol cannot be excluded.

Fifth, although the intervention effects were generally consistent across SES levels, the available sample size in both the pilot and main studies limited the statistical power to detect small effects and to explore potential moderators such as gender, multilingualism, neurodiversity. Expanding

future trials to larger cohorts would allow for more fine-grained analyses of individual differences in responsiveness to structured board-games interventions.

Sixth, measurement timing and task specificity may have contributed to some null results. For example, post-error slowing showed no association with SES or intervention, possibly reflecting the limited sensitivity of this behavioural index in middle childhood or a limit in the tool used (TeleFE). More sensitive neural correlates, such as event-related potentials (ERN/Pe), could provide a deeper understanding of the metacognitive mechanisms underlying SES- and intervention-related effects. Similarly, the relatively short duration of the intervention may have constrained transfer to high-load EF tasks or to language-based academic outcomes.

Finally, as most measures relied on standardized instruments validated in Italian populations (e.g., TROG-2, APL Medea, TeleFE, BESSI-45), cross-cultural comparability remains an open question. The integration of multilingual participants adds ecological richness but also methodological complexity, as linguistic proficiency in Italian may influence both cognitive and language-based performance. Future research should therefore incorporate explicit measures of language dominance and proficiency to disentangle socioeconomic from linguistic influences.

In sum, while the present dissertation provides converging and ecologically valid evidence across multiple developmental domains, future research should address these methodological limitations through larger, longitudinal, and multi-informant designs. Integrating behavioural, neural, and ecological indicators within diverse school contexts will be essential for advancing a comprehensive understanding of how SES, executive functioning, and socio-emotional skills interact to shape children's adaptive development.

6.6. Implications for educational practice

The findings of this dissertation hold several implications for educational practice, particularly regarding how schools can foster self-regulation, language, and socio-emotional development in socioeconomically diverse contexts. Taken together, the results highlight the importance of

approaching learning as a multilevel process in which cognitive, linguistic, and emotional systems interact dynamically. Educational environments that intentionally integrate these domains—rather than treating them as separate targets—are more likely to support adaptive functioning and reduce developmental disparities.

A first implication concerns the promotion of self-regulation through everyday pedagogical routines. The intervention studies demonstrated that structured board-game play, when embedded in classroom life and mediated by teachers, can strengthen executive and socio-emotional skills without the need for costly or technology-based resources. This supports the feasibility of incorporating brief, game-based, or cooperative learning activities that exercise working memory, inhibition, and emotional regulation within standard curricula. Such practices can be flexibly adapted to different ages and subjects, serving both as preventive tools and as complements to existing instructional programs (Cravet & Usai, 2024). Building on this perspective, the present findings suggest that the educational potential of board-game-based interventions may be further enhanced by explicitly tailoring game selection to targeted executive and socio-emotional domains. Different games place distinct demands on executive processes: for example, games requiring the maintenance and updating of multiple rules may preferentially engage working memory, whereas games involving rapid response suppression or frequent rule changes may more strongly recruit inhibitory control and cognitive flexibility. In parallel, the social structure of games—cooperative versus competitive dynamics—can be leveraged to foster specific socio-emotional skills, such as cooperation, emotional resilience, or self-management. From an educational standpoint, aligning the cognitive and social demands of games with clearly defined developmental objectives may increase both the specificity and effectiveness of classroom interventions, while supporting teachers in selecting activities that match students' regulatory and socio-emotional needs. In school-based, teacher-led interventions, it is also important to distinguish between assessment approaches designed for research purposes and those that are meaningful and feasible for everyday educational practice. While standardized and computerized measures are essential for evaluating intervention

efficacy at the research level, teachers require assessment tools that capture children's behaviour as it unfolds in natural classroom contexts. From an educational perspective, the assessment of game-based interventions could therefore be broadened through the use of structured behavioural observation grids, teacher checklists, or simple rating scales focusing on executive and socio-emotional behaviours such as turn-taking, rule adherence, emotional regulation, persistence, and cooperation. Such tools would allow teachers to monitor changes over time, align assessment with instructional goals, and support formative decision-making, while remaining consistent with the ecological nature of board game-based activities.

Second, the observed links between grammar comprehension, executive functioning, and pragmatic language suggest that explicit work on linguistic structure can serve as a powerful tool for communicative development. However, focusing on grammar alone is not sufficient to support learning and reduce disparities. The development of communicative and academic competences also depends on children's ability to regulate attention, plan, and flexibly adapt their strategies—core executive processes that enable the effective use of linguistic knowledge. Therefore, classroom practices should combine structured language instruction with activities that stimulate executive functioning, such as reasoning about rules, reflecting on errors, or engaging in collaborative problem solving. Such an integrated approach may be particularly valuable in mitigating the effects of socioeconomic disadvantage, as it provides both the linguistic scaffolding and the self-regulatory tools needed for equitable learning.

Third, the results underline the potential of inclusive, universal interventions that are delivered at the classroom level rather than targeted only to at-risk students. By embedding regulatory practice within shared experiences, such as structured board games or cooperative challenges, schools can create conditions that benefit all learners while especially supporting those from lower-SES backgrounds. This aligns with evidence that universal, teacher-implemented approaches enhance motivation and engagement, key mediators of both EF and academic growth.

Finally, the broader theoretical integration between executive and socio-emotional skills underscores the value of whole-child education frameworks. Programs that explicitly link cognitive regulation with emotional resilience and social collaboration can foster not only academic competence but also well-being and adaptability. Teacher professional development is therefore crucial: educators need training to recognize executive and socio-emotional dimensions of learning and to use reflective dialogue, feedback, and play as tools for strengthening them.

In sum, the present findings advocate for an educational paradigm that treats self-regulation, language, and emotion as interdependent foundations of learning. By designing classrooms as contexts for both cognitive challenge and social reflection, educators can help children translate regulatory skills into enduring academic, social, and emotional success.

6.7. Contributions to theory

This dissertation makes several contributions to the theoretical understanding of how socioeconomic, cognitive, linguistic, and socio-emotional systems interact in middle childhood. First, it advances a domain-specific model of socioeconomic influence, showing that SES exerts its strongest and most direct effects on executive and linguistic domains, while social-emotional and behavioural skills and performance monitoring (PES) appear comparatively resilient. This differentiation contributes to refining developmental theories that have traditionally treated socioeconomic disadvantage as a broad, undifferentiated risk factor. Instead, the present findings indicate that SES influences are mediated by specific pathways—most notably through grammatical and executive processes that underpin both learning and communication.

Second, the research clarifies the interdependence of linguistic and cognitive regulation. The evidence that grammar comprehension mediates the relationship between SES and pragmatic competence supports an integrated account in which language structure provides the scaffolding for effective communicative. This perspective bridges psycholinguistic and executive function

frameworks, positioning grammatical reasoning as a cognitive mechanism that supports adaptive communication and learning.

Third, the associations observed between executive functioning and SEB skills offer empirical grounding for a unified model of self-regulation, in which SEB skills are conceptualized as the applied, self-perceived expressions of executive functioning in everyday contexts. This integration extends existing EF models beyond cognitive efficiency, linking them to socially and emotionally meaningful forms of regulation. Moreover, this study contributed to the validation of the BESSI-45 for assessing SEB skills in middle childhood, paving the way for future standardization on a larger and more representative sample. However, the Innovation scale may require item revision to ensure developmental appropriateness for this age group.

Finally, by embedding intervention studies within naturalistic classroom settings, this dissertation contributes to theories of ecologically grounded self-regulation. It demonstrates that structured, teacher-led play can activate and reinforce regulatory mechanisms through socially embedded experiences, providing a bridge between laboratory-based models of EF training and real-world educational practice. In doing so, it positions self-regulation not as a fixed trait or isolated cognitive construct, but as a dynamic capacity that develops through interaction, reflection, and guided participation in shared cultural activities.

Together, these contributions support a multilayered theoretical framework in which language, cognition, and emotion operate as interdependent systems shaped by both individual and contextual factors. This integrative perspective refines existing models of self-regulation and provides a foundation for future research aimed at understanding how cognitive and socio-emotional development can be jointly supported in equitable educational environments.

6.8. Future Research Directions

Building on the findings presented in this dissertation, several promising avenues for future research emerge.

First, longitudinal and multi-wave designs are needed to clarify the directionality and developmental dynamics linking socioeconomic conditions, language, executive functioning, and socio-emotional skills. Such designs would help determine how these domains mutually influence one another over time, and whether improvements in one (e.g., executive functioning) precede or follow gains in others (e.g., pragmatic competence or emotional regulation). Longitudinal approaches are also essential to trace how self-regulatory capacities and Social, Emotional, and Behavioural skills evolve from middle childhood into adolescence—a developmental window during which socioeconomic disparities tend to widen.

Moreover, future research should more precisely assess language proficiency and bilingualism or multilingualism to disentangle the effects of socioeconomic background from those of linguistic experience. Including detailed measures of language exposure, dominance, and proficiency would allow researchers to determine whether lower performance among children from disadvantaged or multilingual households reflects limited socioeconomic resources, reduced opportunities for linguistic stimulation, or the cognitive demands of managing multiple languages. Such distinctions are crucial for identifying the mechanisms through which environmental and linguistic factors jointly shape cognitive and communicative development.

Second, future intervention research should test scalable, school-based programs with longer duration, stronger fidelity monitoring, and broader outcome assessment. Comparing structured play with alternative modalities (e.g., digital games, collaborative learning, or mindfulness-based programs) would help identify the active components and mechanisms of change. Including more socioeconomically and linguistically diverse samples will be essential to evaluate the potential of such interventions to reduce inequities in learning and self-regulation.

Finally, future work should move toward integrative models of development that bridge traditionally separate research domains. Combining perspectives from developmental psychology, education, and cognitive neuroscience may yield a more comprehensive understanding of how language, cognition, and emotion interact within social and cultural contexts. Such interdisciplinary

approaches will be crucial to designing interventions that not only enhance specific skills but also foster adaptive, equitable developmental trajectories across diverse populations.

6.9. Concluding remarks

The studies presented in this dissertation collectively underscore that children's development is shaped by the dynamic interplay between cognitive, linguistic, socio-emotional, and contextual factors. Socioeconomic status emerged as a significant but domain-specific influence—strongly affecting executive and linguistic abilities, while leaving socio-emotional skills relatively resilient. Within this framework, language and executive functioning appeared as key mechanisms through which environmental conditions translate into learning and communicative outcomes, highlighting grammar comprehension and self-regulation as foundational processes for adaptation.

At the same time, the results demonstrate that development is not solely determined by background constraints. The intervention studies showed that structured, teacher-led play can strengthen children's everyday executive functioning and emotional resilience, offering a practical route to foster equity through accessible, engaging, and ecologically valid educational practices. By embedding cognitive and socio-emotional training into regular school activities, such approaches provide children—regardless of socioeconomic background—with shared opportunities to practice self-regulation, collaboration, and reflective thinking.

Theoretically, this work contributes to a more integrated understanding of self-regulation as a multi-level construct encompassing executive, linguistic, and socio-emotional dimensions. Practically, it highlights the school as a powerful context for promoting resilience and inclusion through structured play and metacognitive reflection. Together, these findings suggest that equitable development is not an abstract ideal but an achievable goal when educational environments are intentionally designed to align cognitive challenge with emotional support.

Ultimately, the present dissertation advocates for a developmental science that bridges disciplines and contexts—linking laboratory evidence with classroom practice, and individual processes with

social opportunity. By situating children's self-regulation at the intersection of cognition, language, and emotion, it offers a framework for understanding and fostering the skills that enable all children to learn, adapt, and thrive.

Appendices

Appendix 1

Supplementary Materials of Study 1

Exploring Soft Skills in Middle Childhood: The Predictive Role of Executive Function

Table A1. Fit Indices of the Measurement Models in the High School and Primary School Samples.

	Parameters*	χ^2	df	CFI	TLI	SRMR
Self-management	45.00	32.19	27.00	.99	.99	.06
Self-management HS	45.00	67.55	27.00	.99	.99	.04
Innovation	49.00	76.79	23.00	.91	.86	.11
Innovation HS	49.00	361.91	23.00	.98	.96	.10
Cooperation	49.00	20.04	23.00	1.00	1.01	.05
Cooperation HS	49.00	140.21	23.00	.98	.97	.06
Social engagement	49.00	23.36	23.00	1.00	1.00	.06
Social engagement HS	49.00	118.33	23.00	.99	.99	.06
Emotional resilience	49.00	38.97	23.00	.99	.99	.07
Emotional resilience HS	49.00	327.54	23.00	.97	.96	.08

Note. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; SRMR = Standardized Root Mean Square Residual.

* Number of parameters included in the model

Table A2. Multigroup Confirmatory Factor Analysis Results.

	Parameters*	χ^2	df	CFI	TLI	SRMR
Self-management						
Full sample	45.00	53.03	27.00	.99	.99	.03
Configural	90.00	101.76	54.00	.99	.99	.05
Scalar	56.00	176.22	88.00	.98	.98	.05
Innovation						
Full sample	49.00	610.91	23.00	.96	.94	.12
Configural	96.00	435.28	46.00	.97	.96	.10
Scalar	63.00	983.75	79.00	.94	.94	.12
Cooperation						
Full sample	49.00	116.121	23.00	.98	.97	.05
Configural	98.00	161.25	46.00	.98	.97	.06
Scalar	64.00	221.78	80.00	.98	.98	.06
Social engagement						
Full sample	49.00	158.88	23.00	.99	.98	.06
Configural	98.00	143.73	46.00	.99	.99	.06
Scalar	64.00	343.04	80.00	.98	.98	.06
Emotional resilience						
Full sample	49.00	317.05	23.00	.98	.97	.07
Configural	98.00	367.80	46.00	.98	.96	.08
Scalar	64.00	545.03	80.00	.97	.97	.08

Note. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; SRMR = Standardized Root Mean Square Residual.

* Number of parameters included in the model

Appendix 2

Supplementary Materials of Study 2

Exploring the influence of socioeconomic status on pragmatic language: do executive functions and grammar comprehension have a mediating role?

Exploratory Factor Analysis. An Exploratory Factor Analysis (EFA) aimed to determine whether a multifactorial structure better explained the data compared to a single-factor solution was conducted using all EFs scores (low load working memory, high load working memory, inhibition, interference control, flexibility). The analysis was conducted using the maximum likelihood (ML) method and a Promax rotation, which allows the factors to be correlated. This approach produced a matrix of loadings that indicates how much each observed variable contributes to each factor.

Parallel analysis suggested a two-factor solution, with eigenvalues of the observed data (Factor 1 $\lambda_1 = 1.57$, Factor 2 $\lambda_2 = .29$) exceeding those of simulated data (Factor 1 $\lambda_1 = .79$, Factor 2 $\lambda_2 = .15$) for the first two factors. Fit indices for the two-factor model indicated a satisfactory fit (RMSR = .01, $\chi^2(1) = .34$, $p = .56$, TLI = 1.08, RMSEA=.00 [90% CI, .00, .19], BIC= -4.51). The two factors explained 46% of the variance in the data, with 26% attributed to the first factor and 19% to the second. Factor 1 strongly loaded on flexibility ($\lambda = .96$) and interference control ($\lambda = .64$), while Factor 2 primarily loaded on low load ($\lambda = .92$) and high load working memory ($\lambda = .42$). Inhibition showed weak loadings on both factors ($\lambda = .12$, $\lambda = .13$). The two factors are moderately correlated ($r = .54$)

Factor scores for the two dimensions were computed using the regression method, which combines the observed variable values with the factor loadings to estimate each participant's latent factor score. This method minimizes prediction error and ensures the highest possible correlation between the factor scores and the underlying latent factors, providing a more accurate representation of the participants' positions on the constructs being measured. The calculated factor scores were added as

new variables (Factor 1 and Factor 2) to the original dataset, allowing these summaries to be used for subsequent analyses, including structural equation modelling (SEM) and comparisons.

Structural Equation Modeling. A Structural Equation Model (SEM) was conducted separately for each of the two factor-derived scores (Factor 1 and Factor 2). These models were then compared to the SEM model using the overall EF score to determine which provided the best fit to the data. Model comparisons were based on key fit indices, including the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), as well as measures of model parsimony and explanatory power. This approach allowed for a comprehensive evaluation of the performance of the factor-derived models relative to the overall EF score model. The fit indices for all three models are reported in Table A3, while the direct and indirect effects for each model are detailed in Table A4.

Table A3. Fit Indices of the Three Structural Equation Models.

Metric	Overall EF Score	Factor 1	Factor 2
χ^2/df	1.849	2.295	1.694
CFI	.978	.961	.978
TLI	.925	.869	.925
RMSEA	.081	.101	.074
SRMR	.044	.044	.044
AIC	1,639.258	1,780.283	1,752.399
BIC	1,687.743	1,828.767	1,800.884

Note. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion.

Table A4. Direct and Indirect Effects from the Structural Equation Models.

Path	β Overall EF Score	CI 95%		β Factor 1	CI 95%		β Factor 2	CI 95%	
		LL	UL		LL	UL		LL	UL
GC on PL	.372***	.215	.529	.380***	.237	.524	.408***	.265	.551
EF on PL	.166*	.011	.321	.201**	.053	.349	.142	-.007	.290
SES on PL	.143	-.009	.295	.164*	.011	.317	.142	-.012	.297
SES on GC	.211**	.062	.360	.211**	.062	.360	.211**	.062	.360
SES on EF	.178*	.014	.343	.036	-.142	.213	.162*	.001	.323
SES with MB	-.501*	-.626	-.376	-.501*	-.626	-.376	-.501*	-.626	-.376
EF with GC	.456*	.328	.583	.330*	.193	.468	.280*	.130	.430
EF with GC on PL	.170***	.081	.258	.126**	.053	.198	.114**	.041	.187
SES on PL through GC	.079*	.012	.145	.080*	.014	.146	.086*	.017	.156
SES on PL through EF	.030	-.007	.066	.007	-.028	.043	.023	-.009	.055
SES on PL through EF with GC	.030	-.004	.064	.005	-.018	.027	.019	-.004	.041

Note. GC= Grammar Comprehension; PL= Pragmatic Language; SES= Socio-Economic Status; MB= Multilingual Background; EF= Overall

Executive Function Score or Factor 1 or Factor 2 depending on the model.

The supplementary analyses revealed slight variations in the direct and indirect effects across models using Factor 1, Factor 2, and the overall EF score. Notably, SES exhibited a direct effect on pragmatic language in the Factor 1 model but not in the global EFs score or Factor 2 models. This suggests that flexibility and interference control (Factor 1) may mediate SES effects differently compared to working memory (Factor 2) or a general EFs composite. However, the overall EFs score model provided a more parsimonious fit to the data, consolidating shared variance across EF tasks and aligning with the primary focus of this study.

Appendix 3

Supplementary Materials of Study 3

A Short Game-Based Intervention for Enhancing Executive Functions at School: a Pilot Study

Description of the games used in the intervention

Inhibition:

1. Grabolo Junior: in this game, there are two dice—one with colours and the other with animals—and a deck of cards, each featuring an animal associated with a colour. All the cards are spread out on the table, and the dice are rolled. The goal is to quickly identify the card that matches the combination shown on the dice or remember who took it if it has been drawn before. If you make a mistake in grabbing the card or stating the name of the person who took it, you lose a card. It's a game that not only requires inhibition but also demands processing speed, visual search, and flexibility.
2. Halli Galli Junior: The game consists of two decks of cards featuring clowns and a bell. Two cards are revealed at a time. If the clowns on the two cards have the same colour and a happy expression, you need to ring the bell. Pressing the bell when the clowns are not the same colour and, at the same time, with a happy expression result in losing a card. It's a game that primarily demands inhibition but also involves processing speed and flexibility.
3. Zicke Zacke (Finde die Verstecke hinter Zaun und Hecke): This is a game of visual search, processing speed, and inhibition. Each player has cards in front of them depicting animals partially hidden by a fence. Additionally, each player has a "finding card" with a hand on a coloured background. In each turn, a card depicting an animal is revealed in the centre of the table. Players must quickly slap the "finding card" of the player who has the animal on the

card in the centre of the table among their “hideout cards”. The fastest player to make the correct move takes the card, but if they make a mistake, they lose a card.

Working Memory:

1. Peek-a-Mouse (Italian edition): this is a cooperative memory game. The guiding teacher randomly tosses objects into the mouse’s house. Each child observes the inside of a room through a window and must remember the objects present (or absent) in that room. The teacher asks about the placement of the objects, and the children must collaborate to agree on the response.
2. Ho una fame che...: this is a game that enhances attention and working memory. Each player has a deck of cards featuring various animals. The first player draws a card from their deck, saying, “I’m so hungry I could eat...,” followed by the name of the animal on the card. The next player draws another card and must say, “I’m so hungry I could eat...” followed by the name of the first animal drawn and then the name of the animal they drew. There are also “sound cards” where the child imitates the animal sound without saying the animal’s name. The winner of the round is the one who remembers the most cards.
3. Foxy: this is a memory game with various variations. The game includes a deck of cards depicting one or more animals of one or more species. The cards are revealed and covered one at a time, up to a maximum of 20 cards per turn. Players must remember how many animals have appeared for each species, summing up those present on the cards that have been progressively revealed and covered.
4. Zicke Zacke (Hühnerkacke): in this game, a circular path is created with covered cards. At the centre, the same cards are placed, also covered. To advance one’s chicken along the path, players must find, among the covered centre cards, the one that matches the card in front of their chicken. When positioned behind an opponent’s chicken, to overtake it, players must locate not the card in front of their chicken but the one in front of the opponent’s chicken. If

you surpass an opponent's chicken, you steal their feathers. It's a game of visual working memory.

Flexibility:

1. Photophantom (The Young Detective and the Shy Ghost): this is a game of reasoning and cognitive flexibility. The game comprises a deck of cards featuring a problem to solve, Tommy's silhouette, and the ghost Peppone's silhouette. If it's possible to solve the problem with the elements on the card, players should grab Tommy's silhouette; otherwise, they should grab the ghost Peppone's silhouette. If played correctly, you win the card; otherwise, you forfeit one card.
2. Pipolo (Italian edition): this game has been adapted to enhance cognitive flexibility and inhibition. The game includes cards from four categories: naked animals, furry animals, feathered animals, and clothed animals. In the adapted version, a card is flipped and placed on the table (e.g., a clothed cow). Subsequently, cards from the deck are flipped one by one. Players must quickly press a bell when another clothed animal appears (e.g., the clothed elephant), without being deceived by other "cow cards" or cards with animals covered in feathers or fur. The fastest player wins the card, and if a mistake is made, a card is lost.
3. Gorilla (Italian edition): this is a card game. Each card features an animal and a colour. Every player starts with 7 cards. The first card is revealed, and on their turn, each player can play a card that matches either the animal or the colour. The game also includes special cards like the one that skips the next player's turn, the one that reverses the order of play, and the jolly card that changes the colour.

Description of the story

The teachers involved in the intervention, along with the first author, created the episodic story of Angry. Angry is an alien who recently arrived on Earth. Initially, he struggles with self-regulating his behaviour and playing with other children but gradually learns useful strategies for both games

and everyday life situations. Each session features an episode from Angry's story. The early episodes focus on inhibition, followed by working memory, and then flexibility, with one dedicated to all three EFs.

In the inhibition stories, Angry finds it challenging to manage his behaviour. Thanks to his human friends, he learns the “cheetah technique”: observe, wait, and then act. This helps him not only win board games but also regulate his behaviour more generally.

In the working memory stories, the little alien learns the “network technique”: grouping similar things together to enhance memory. This technique proves useful both in games and daily life. For instance, when Angry goes grocery shopping without a list, he recalls items to buy by categorizing them. In the flexibility stories, little Angry learns the “chameleon technique” - not staying fixed on a cognitive pattern but being flexible. For example, Angry practices flexibility by inventing new uses for everyday objects.

Description of the token economy

The token economy is a behaviour modification technique based on reinforcement. In this study, a poster depicting galaxies was designed and displayed on the wall. Each child received a cardboard rocket, and every day, they progressed through one galaxy as a reward for their commitment to activities and adherence to the rules. The final destination was the planet of the little alien Angry and the final reward was the “space license”. Receiving the space license implies mastering all Angry's strategies to control one's behaviour.

Appendix 4

Supplementary Materials of Study 4

A board games intervention in the school context: effects on cognitive, social, emotional, behavioural outcomes, and learning

Table A5. *Board games used in the intervention.*

Board games	Executive function	Players	Duration in minutes	Recommended age
Halli Galli Junior (Shafir, 1998)	Inhibition	2-4	15	+4
Zicke Zacke - Finde die Verstecke hinter Zaun und Hecke (Zoschl, 2011)	Inhibition	2-5	15-20	+4
Zicke Zacke – Hühnerkacke (Zoch, 1997)	Updating of working memory	2-4	15-20	+4
Ho una fame che... (Daffi, 2017)	Updating of working memory	2-6	15	+4
Shrimp (Fraga, 2012)	Cognitive Flexibility and Interference Control	2-6	15	+7

Fantascatti – Occhio al tranello (Ben- Aroush, 2022)	Cognitive Flexibility and Interference Control	2-6	15	+7
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Table A6. *Schedule of sessions and board games.*

Session	Groups 1–2–3	Groups 4–5	EF
1	Introduction	Introduction	
2	Halli Galli Junior	Zicke Zacke – Finde die Verstecke hinter Zaun und Hecke	Inhibition
3	Zicke Zacke – Finde die Verstecke hinter Zaun und Hecke	Halli Galli Junior	Inhibition
4	Halli Galli Junior	Zicke Zacke – Finde die Verstecke hinter Zaun und Hecke	Inhibition
5	Zicke Zacke – Finde die Verstecke hinter Zaun und Hecke	Halli Galli Junior	Inhibition
6	Ho una fame che...	Zicke Zacke – Hühnerkacke	WM
7	Zicke Zacke – Hühnerkacke	Ho una fame che...	WM
8	Ho una fame che...	Zicke Zacke – Hühnerkacke	WM
9	Zicke Zacke – Hühnerkacke	Ho una fame che...	WM
10	Fantascatti – Occhio al tranello	Shrimp	Flexibility
11	Shrimp	Fantascatti – Occhio al tranello	Flexibility
12	Fantascatti – Occhio al tranello	Shrimp	Flexibility
13	Shrimp	Fantascatti – Occhio al tranello	Flexibility

Session	Groups 1–2–3	Groups 4–5	EF
14	Halli Galli Junior	Zicke Zacke – Finde die Verstecke hinter Zaun und Hecke	Inhibition
15	Zicke Zacke – Finde die Verstecke hinter Zaun und Hecke	Halli Galli Junior	Inhibition
16	Ho una fame che...	Zicke Zacke – Hühnerkacke	WM
17	Zicke Zacke – Hühnerkacke	Ho una fame che...	WM
18	Fantascatti – Occhio al tranello	Shrimp	Flexibility
19	Shrimp	Fantascatti – Occhio al tranello	Flexibility
20	Conclusion	Conclusion	

Sory Number 3

Wait, Think, Strike: Think Phase.

Abstract

After reflecting on the idea of impulsivity and focusing on what does it mean to wait before acting, we now move on to the next steps: understanding what needs to be done and thinking about how to do it.

Story

“Well done, kids! Now you’ve understood what it means to act impulsively, and you know that’s not the right way to be strong in a game like this,” said Angry, holding up the Halli Galli board-game box.

“Of course, my friends, these are speed games. But think carefully: we need to be fast at doing something precise. The goal isn’t just to ring the bell first—it’s to ring it only when the situation has very specific features.”

“That’s right, Angry! We ring the bell only if we see at least five matching fruits on the cards,” said Sara.

“Excellent, Sara, you’ve understood the goal, the instruction.”

“Instruction? Come on, Angry, this isn’t school! Don’t act like a teacher,” joked Luca.

“Actually, Luca, an instruction isn’t just about school exercises—it’s also the goal of a game. And you can only win if you reach that goal. So, before we strike, we need to be absolutely sure we understand what we’re supposed to do!”

“Come on, let’s try again!” shouted the kids, eager to play once more.

This time, they tried hard to control themselves, holding back their little hands that used to shoot forward like rockets toward the bell.

“Yes! Finally! I rang because there are two banana cards on the table!” shouted Marco, a little red-haired boy who had managed to ring first.

“No, no, Marco,” interrupted Angry. “Looks like you missed part of the instruction. We need to be sure we understand the whole situation. If our understanding is partial, our choice won’t be the right one. It’s not enough that there are two matching fruits—the number matters. There must be at least five.”

“We have to focus all our energy on listening to the explanation of the game. And if we don’t understand, we need to ask questions and ask for examples. Only then will we be ready to play,” concluded the little alien.

“Got it! Now we really understand the instruction. Let’s play!” shouted the children.

Metacognitive Group Discussion

Once again, starting from the story and the game situation, children can be guided to understand that pausing to reflect means taking a little time before acting in order to understand what is required and what they need to do. Examples of questions for starting the discussion are:

“What do Angry’s friends do? They ring the bell right away, at random. But what does ‘at random’ mean? It means without knowing the goal, without understanding what is required, without knowing the instruction. But what does ‘instruction’ really mean?”

The next step is to help children realize that their understanding must be complete. If it’s only partial, they risk making mistakes and failing to reach the goal. Finally, the discussion can be generalized to children’s own experiences: “Can you think of situations where it’s important to fully understand the instruction? Has it ever happened that you didn’t really understand what you were supposed to do? What happened then?”. These are just examples of questions to guide the discussion.

To conclude, the teachers can return to Angry’s advice on how to understand instructions properly:

“We need to focus all our energy on listening carefully to the person explaining, reading the rules, observing the situation. If we’re not sure, we ask questions, reread, or look more closely. Only then are we ready to begin.” From here, the reflection can be broadened to everyday and school situations familiar to the children: “What do I have to do when the teacher asks me to solve a math problem? What do I have to do before solving the problem? How can I be sure that I got the instructions?”. These are example of questions to invite children to reflect.

Metacognitive worksheet

Oggi sono stato/a capace di

Quanto sei stato o stata **in grado di fare** le seguenti cose **oggi**? Segna con una X per ogni affermazione:



Per niente



poco



né poco né molto



abbastanza



molto

Incontro	Alzare la mano e aspettare il permesso	Regolare da solo/a le mie emozioni	Regolare il tono della voce	Mantenere la concentrazione	Essere gentile con gli altri
2					
3					
4					
5					
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