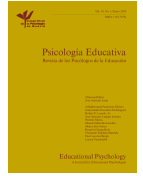




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From Bonds to Brains: Understanding the Impact of Attachment on Executive Functions in Adolescents

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ABSTRACT

Introduction: This study explores the critical relationship between attachment styles and executive functions in adolescents, focusing on how secure, ambivalent, and avoidant attachment styles affect core cognitive functions such as emotional regulation, planning, and cognitive flexibility. **Method:** This study used a cross-sectional design to assess 283 adolescents aged 13-17 from various schools in Spain. Attachment styles were evaluated using the CaMir-R questionnaire, while executive functions were measured through the BRIEF-SR. Statistical analyses, including Mann-Whitney U and Student's t -tests, were used to compare cognitive performance across secure and insecure attachment groups. **Results:** The analysis revealed that adolescents with secure attachment demonstrated significantly better overall cognitive performance compared to those with insecure attachment ($U = 7569.5, p < .01$), as well as in most of the subcomponents, which included cognitive flexibility, emotional regulation, and planning/organization. However, no significant differences were found in inhibitory control between the groups. Insecure-avoidant individuals exhibited greater difficulties overall than insecure-ambivalent individuals in all subcomponents studied. **Conclusion:** The results reinforce the link established between secure attachment and superior cognitive performance, aligning with previous research on emotional regulation and cognitive development in adolescence. However, the absence of significant differences in inhibitory control suggests that this executive function may be influenced by additional factors beyond attachment, such as environmental or contextual variables. Furthermore, the finding that insecure-avoidant individuals exhibit greater executive function difficulties than insecure-ambivalent individuals highlights the need to further investigate how different insecure attachment patterns impact cognitive processes. These insights have important implications for educational practices, suggesting the need for targeted interventions to support adolescents with insecure attachment, particularly those with avoidant tendencies.

De los vínculos al cerebro: comprender el efecto del apego en las funciones ejecutivas de los adolescentes

RESUMEN

Introducción: El estudio explora la relación crítica entre los estilos de apego y las funciones ejecutivas en adolescentes, centrándose en cómo afectan los estilos de apego seguro, ambivalente y evitativo a funciones cognitivas fundamentales como la regulación emocional, la planificación y la flexibilidad cognitiva. **Método:** El estudio utilizó un diseño transversal para evaluar a 283 adolescentes de 13 a 17 años de varios colegios en España. Los estilos de apego se evaluaron utilizando el cuestionario CaMir-R, mientras que las funciones ejecutivas se midieron a través del BRIEF-SR. Se realizaron análisis estadísticos, como la prueba U de Mann-Whitney o la t de Student, para comparar el rendimiento de las funciones ejecutivas entre los grupos de apego seguro e inseguro. **Resultados:** El análisis mostró que los adolescentes con apego seguro demostraron un rendimiento significativamente mejor en las funciones ejecutivas en general que los que tenían apego inseguro ($U = 7569.5, p < .01$), así como en la mayoría de los subcomponentes, que incluían flexibilidad cognitiva, regulación emocional y planificación y organización. Sin embargo, no se encontraron diferencias significativas en el control inhibitorio entre los grupos. Los participantes con apego evitativo mostraron mayores dificultades en las funciones ejecutivas en comparación con los individuos con apego ambivalente, tanto en general como en todos los subcomponentes estudiados. **Conclusión:** Los resultados refuerzan el vínculo ya establecido entre el apego seguro y un mejor rendimiento en las funciones ejecutivas, en la línea de investigaciones previas sobre regulación emocional y desarrollo cognitivo en la adolescencia. No obstante, la ausencia de diferencias significativas en el control inhibitorio sugiere que esta función ejecutiva podría estar

Palabras clave:

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influenciada por otros factores distintos del apego, como variables contextuales o ambientales. Además, el hecho de que las personas con apego evitativo presenten mayores dificultades en las funciones ejecutivas que aquellas con apego ambivalente pone de manifiesto la necesidad de investigar más a fondo cómo influyen en los procesos cognitivos los diferentes patrones de apego inseguro. Estas ideas tienen importantes implicaciones para las prácticas educativas, indicando la necesidad de intervenciones específicas de apoyo a los adolescentes con apego inseguro, particularmente aquellos con tendencias evitativas.

Adolescence is a critical developmental period marked by deep changes in cognitive, emotional, and social functioning. During this stage, higher-order cognitive processes—like working memory, inhibitory control, planning, and cognitive flexibility—become increasingly important for managing complex tasks, both in academic settings and social interactions (Miyake et al., 2000; Diamond, 2013). The development of these abilities is closely tied to the maturation of the prefrontal cortex, which continues to develop during adolescence and is responsible for higher-order cognitive processes like decision-making, emotional regulation, and goal-directed behavior (Blakemore & Choudhury, 2006; Casey et al., 2019).

Although traditionally studied from a cognitive perspective, recent research highlights that these capacities are deeply influenced by emotional and relational factors, particularly attachment (Dykas & Cassidy, 2011; Zimmermann & Iwanski, 2014). The attachment theory, initially developed by John Bowlby (Bowlby, 1969) and expanded by Mary Ainsworth (Ainsworth, 1978), posits that the early emotional bond between a child and their caregiver shapes emotional regulation strategies that persist into adolescence and adulthood. Secure attachment, characterized by caregivers who are consistently responsive to a child's needs, fosters trust and emotional security, which in turn supports the development of adaptive cognitive and emotional regulation strategies (Ainsworth, 1978; Sroufe, 2005).

In contrast, insecure attachment—either avoidant or ambivalent—can lead to difficulties in emotional regulation, which may disrupt the development of executive functions (Mikulincer & Shaver, 2016). Adolescents with insecure attachment often experience challenges in managing emotions and impulses, which are essential components of executive functioning. For example, individuals with insecure-ambivalent attachment may exhibit heightened emotional reactivity and difficulty regulating impulses, potentially leading to poorer performance in planning and inhibitory control (Fonagy et al., 2002; Dykas & Cassidy, 2011). In contrast, people with insecure-avoidant attachment may exhibit greater cognitive rigidity and difficulty in adapting to new or changing situations, as their emotional suppression can limit flexibility in problem-solving and decision-making (Grossmann et al., 2006).

The interplay between attachment and cognitive functioning is particularly salient during adolescence, a time when individuals are required to manage increasingly complex cognitive tasks while also navigating the emotional challenges of this developmental stage. Securely attached adolescents tend to demonstrate better emotional regulation, allowing them to excel in tasks requiring inhibitory control, planning, and cognitive flexibility (Zimmermann & Iwanski, 2014). Their ability to regulate stress and manage emotions effectively provides them with a strong foundation for successful executive function development (Shaver & Mikulincer, 2007).

At the neurobiological level, secure attachment has been linked to more effective functioning of the prefrontal cortex, particularly in its role in regulating emotions and facilitating cognitive processes like planning and decision-making (Casey et al., 2017; Diamond, 2013). Adolescents with secure attachment are better able to balance emotional impulses with thoughtful, goal-directed behavior, contributing to superior executive functioning

(Blakemore & Choudhury, 2006). In contrast, adolescents with insecure attachment may struggle with emotional regulation, leading to deficits in cognitive performance. Insecure-avoidant adolescents tend to suppress their emotions, which may lead to better performance in tasks requiring focus and planning but impair their cognitive flexibility and adaptability to new situations (Dykas & Cassidy, 2011). On the other hand, insecure-ambivalent adolescents are often hyper-focused on emotional stimuli, which can disrupt their ability to plan and inhibit impulsive behaviors, although they may exhibit greater cognitive flexibility in social contexts due to their heightened emotional awareness (Mikulincer & Shaver, 2016).

These dynamics highlight the importance of understanding the relationship between attachment styles and executive function development during adolescence. Although extensive research has been conducted in other parts of the world (Dykas & Cassidy, 2011; Mikulincer & Shaver, 2016), there is a notable gap in the literature concerning this topic in Spain, particularly in the adolescent population. Most studies in Spain have focused on emotional development and psychosocial adjustment (Mónaco et al., 2019; Viejo et al., 2019), but few have explored how attachment patterns influence the development of key cognitive functions, such as inhibitory control, emotional regulation, planning, and cognitive flexibility (Mancinelli et al., 2021). These cognitive functions are essential for adolescents as they navigate the increasing demands of academic, social, and personal contexts (Casey et al., 2019).

Moreover, this research holds significant global relevance. Even though some studies have established general connections between secure attachment and better cognitive control (Shaver & Mikulincer, 2007), the specific effects of insecure-ambivalent and insecure-avoidant attachment styles on different cognitive areas, such as cognitive flexibility and inhibitory control, remain largely unexplored. By examining how attachment styles shape executive function development, this study not only fills a critical gap in the Spanish context but also contributes to the broader understanding of how emotional and cognitive development interact during adolescence (Dykas & Cassidy, 2011; Zimmermann & Iwanski, 2014).

Understanding these relationships is also essential for designing effective educational and psychological interventions. Schools are increasingly focused on the importance of social and emotional learning (SEL), recognizing that emotional regulation and cognitive control are critical for academic success and overall well-being (Diamond, 2013; Mikulincer & Shaver, 2016). By exploring the role of attachment in shaping executive function performance, this research aims to inform interventions that support adolescents in developing both cognitive and emotional competencies, fostering resilience and adaptability in academic and social contexts. Additionally, the findings could help develop more targeted support strategies for adolescents with insecure attachment patterns, improving both their emotional and cognitive development.

Objectives and Hypotheses

The primary objective of this study is to explore the relationship between attachment styles (secure, ambivalent, and avoidant) and executive functions (inhibitory control, emotional regulation,

planning, decision-making, working memory, and cognitive flexibility) in adolescents aged 13 to 17 years attending secondary education in Andalusia, Spain.

Specific Objectives

1. To analyze the differences in executive function performance between adolescents with secure attachment and those with insecure attachment styles (ambivalent and avoidant).
2. To explore how insecure-ambivalent and insecure-avoidant attachment distinctly affect inhibitory control, planning, and cognitive flexibility.
3. To identify the cognitive patterns associated with insecure attachment styles, with a particular focus on how these influence adolescents' ability to plan, regulate emotions, and adapt to changing situations.

Hypotheses

1. Adolescents with secure attachment will demonstrate superior cognitive performance (inhibitory control, emotional regulation, planning, and cognitive flexibility) compared to those with insecure attachment.
2. Adolescents with insecure-ambivalent attachment will exhibit poorer inhibitory control and planning but greater cognitive flexibility compared to those with insecure-avoidant attachment.
3. Adolescents with insecure-avoidant attachment will show better inhibitory control and planning, but lower cognitive flexibility compared to those with insecure-ambivalent attachment.

Method

Participants

The sample consisted of 283 adolescents aged between 13 and 17 years ($M = 14.81$, $SD = 0.81$), all of whom were enrolled in 3rd and 4th grade of secondary education [*Educación Secundaria Obligatoria*] in four different schools located in the Andalusian provinces of Cádiz and Seville (Spain). The sample was composed of 126 males, 153 females, and 4 individuals identifying as other gender. This gender diversity was recorded to reflect the inclusive nature of the study, acknowledging adolescents who do not conform to traditional gender categories.

Participants were selected from public and private institutions, including 71 students from the IES Azahar (a public school in San Martín del Tesorillo, Cádiz), 101 students from the IES Sierra Almenara (a public school in Pueblo Nuevo de Guadيارo, Cádiz), 47 students from the Sotogrande International School (a private institution in San Roque, Cádiz), and 64 students from the Yago School (a private, bilingual school in Castilleja de la Cuesta, Seville).

Prior to data collection, 85 participants were excluded based on control scales from the Behavior Rating Inventory of Executive Function–Self-Report version (BRIEF-SR), which assessed response consistency and infrequency. Specifically, 11 participants scored high on the Inconsistency scale, 77 participants scored high on the Infrequency scale, and 7 participants scored high on both scales, leading to their exclusion from the final dataset to ensure the reliability and validity of the data collected. The final sample, after exclusions, comprised 283 participants.

Participation in the study was voluntary, and informed consent was obtained from the adolescents, as they were deemed “mature minors” capable of providing informed consent without requiring parental approval, given the non-invasive nature of the research and the absence of sensitive personal data collection.

Instruments

Questionario de Apego CaMir-R (Balluerka et al., 2011)

The CaMir-R (Pierrehumbert et al., 1996) is a shortened version of the original CaMir, adapted for the Spanish population by Balluerka et al. (2011). It is a self-report questionnaire consisting of 32 items, rated on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*), designed to assess different dimensions of attachment styles. The five key dimensions used in this study are:

- Security: perceived emotional availability and support from attachment figures.
- Family preoccupation: anxiety related to separation from loved ones.
- Parental interference: perceived overprotection or control from parents.
- Self-sufficiency and resentment towards parents: emotional independence and feelings of resentment.
- Value of parental authority: recognition or rejection of parental authority and guidance.

Based on the scores obtained from these dimensions, participants are categorized into secure and insecure attachment styles (ambivalent and avoidant). The CaMir-R has demonstrated acceptable internal consistency, with Cronbach's α values ranging from .60 to .85 in previous research, ensuring the reliability of the scale for measuring attachment-related constructs.

Behavior Rating Inventory of Executive Function – Self-Report (BRIEF-SR; Gioia et al., 2004)

The BRIEF-SR is an 80-item self-report measure assessing executive functions in adolescents aged 11 to 18. Responses are given on a 3-point scale (*never, sometimes, often*). The five dimensions used in this study are:

- Inhibition: ability to control impulses.
- Shift: cognitive flexibility and adaptability.
- Emotional regulation: regulation of emotional responses.
- Planning/organization: ability to plan and organize tasks.

The global executive composite (GEC) provides an overall score of executive function. The BRIEF-SR demonstrates high internal reliability, with Cronbach's α values typically between .80 and .95. Control scales for Inconsistency and Infrequency are included to detect unreliable responses.

Procedure

Before data collection, formal communication was established with the principals of the selected schools to obtain permission for conducting the research. The objectives and voluntary nature of the study were clearly explained. Participants were adolescents aged between 13 and 17 years, classified as “mature minors” under the Spanish Organic Law 1/1996, of Legal Protection of Minors. According to this law, minors over the age of 12 are considered capable of providing informed consent for non-invasive, low-risk research, provided they demonstrate sufficient maturity to understand the nature and purpose of the study. Given that no sensitive personal information was collected and the study involved non-clinical, psychological measures, parental consent was not required in this context.

Data collection was conducted during school hours in a designated room within each institution to minimize disruption to students' schedules. Participants were given between 60 and 90 minutes to complete the CaMir-R and BRIEF-SR questionnaires, along with a brief demographic survey. The researcher remained present throughout the process to provide instructions and clarify any questions.

To ensure data quality, the researcher closely monitored the completion of questionnaires. The Inconsistency and Infrequency control scales embedded in the BRIEF-SR were applied to exclude unreliable responses, resulting in the exclusion of 85 participants. The final sample consisted of 283 valid cases.

All responses were anonymized and data were securely stored following data protection protocols. Since the study focused on psychological and educational variables using non-invasive, self-report measures, approval from a biomedical ethics committee was not required.

Data Analysis

For data analysis and document preparation, R version 4.2.2 (R Core Team, 2022) was used.

The CaMir-R questionnaire was used to assess attachment styles. Participants scoring above 50 on the Security dimension were classified as having secure attachment. Participants with scores below 50 were classified as having insecure attachment, with further classification into insecure-avoidant and insecure-ambivalent subtypes. Insecure-avoidant attachment was identified by higher scores in the Self-sufficiency and Resentment towards Parents dimension, while insecure-ambivalent attachment was based on higher scores in the Family Preoccupation or Parental Interference dimensions.

Given the non-normal distribution of the data, confirmed by the Kolmogorov-Smirnov test, non-parametric tests were applied:

- The Mann-Whitney U test was used to compare the global executive composite (GEC) scores between secure and insecure attachment groups.

- A Student's t -test was employed to analyze differences in GEC scores between ambivalent and avoidant attachment subtypes.

- The Mann-Whitney U test was also used to compare specific dimensions of executive functions, such as Inhibitory Control, Planning/Organization, Cognitive Flexibility, and Emotional Regulation, between attachment groups (secure vs. insecure, and ambivalent vs. avoidant).

All analyses were performed in R, and statistical significance was set at $p < .05$.

Results

Out of the total sample of 283 participants, 57% ($n = 161$) were classified as having secure attachment. The remaining 43% ($n = 122$) were classified as having insecure attachment. Within the insecure attachment group, 36% ($n = 44$) were identified as having insecure-avoidant attachment, while 64% ($n = 78$) were classified as having insecure-ambivalent attachment. (Table 1)

Table 1. Distribution of Attachment Styles in the Sample

	<i>N</i>	<i>M</i>	<i>SD</i>	Min	Max	Skew	Kurtosis
Inhibition	283	1.78	0.40	1	3.00	0.28	-0.24
Shift	283	1.69	0.40	1	3.00	0.39	-0.05
Emotional Regulation	283	1.82	0.50	1	3.00	0.25	-0.70
Organization/Planning	283	1.75	0.43	1	2.90	0.37	-0.51
Total	283	1.75	0.45	1	2.97	0.34	-0.42
GEC	283	90.81	18.27	52	143.0	0.28	-0.36

The descriptive statistics for the BRIEF-SR are presented in Table 2. The scale scores reflect means of raw scores, while the global executive composite (GEC) represents the sum of raw scores. As a result, values for composite scores are significantly higher than those for individual scales.

The mean scores for all dimensions were below 2 on a scale from 1 to 3, indicating a generally low level of executive function

difficulties among the participants. Lower scores suggest fewer issues in executive functioning as measured by the BRIEF-SR. The highest mean score was observed in the Emotional Regulation scale ($M = 1.82$), with the greatest variability (SD) also found in this dimension. Positive skewness across all dimensions suggests that most participants scored at the lower end of the scale, reflecting fewer executive function difficulties.

The Mann-Whitney U test (see Table 3) provided significant evidence supporting the first hypothesis, which posits that students with secure attachment demonstrate superior executive function performance compared to those with insecure attachment. Significant differences were found between the secure and insecure attachment groups in GEC scores ($U = 7569.5$, $p < .01$).

Higher scores in the insecure attachment group showed a statistically significant correlation with greater overall executive function difficulties compared to the secure attachment group, supporting the hypothesis that students with secure attachment exhibit better executive function performance.

Table 2. Descriptive Statistics for the BRIEF-SR

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Organization/Planning	283	1.75	0.43	1	2.90	0.37	-0.51
Total	283	1.75	0.45	1	2.97	0.34	-0.42
GEC	283	90.81	18.27	52	143.0	0.28	-0.36

Table 3. Mann-Whitney U test: GEC by Attachment Security

Variable	Groups	<i>Mdn</i>	<i>W</i>	<i>z</i>	<i>p</i>
GEC	Secure Attachment	86.0	7569.5	-3.3	$p < .01$
	Insecure Attachment	95.5			

In conclusion, a significant difference in executive function performance exists between students with secure and insecure attachment, suggesting that attachment style is closely linked to executive function effectiveness.

Further analysis of the individual BRIEF-SR dimensions revealed significant differences in organization/planning, cognitive flexibility, and emotional regulation, based on attachment type (see Table 4). In each of these areas, students with insecure attachment experienced greater difficulties compared to those with secure attachment, supporting the initial hypothesis.

These results suggest that securely attached students have better skills in task planning, adaptability to new situations, and emotional regulation. This confirms that attachment style affects not only overall executive function but also specific components like organization, flexibility, and emotional control.

However, no significant differences were found in inhibitory control between attachment groups, contrary to initial expectations of a stronger link between attachment style and impulse control.

The statistical analysis also provided significant insights into the second hypothesis, which proposed differences in executive functions between students with insecure-ambivalent and insecure-avoidant attachment styles. The hypothesis expected that students with insecure-ambivalent attachment would exhibit lower inhibitory control, greater difficulties in organization and emotional regulation, but higher cognitive flexibility compared to those with insecure-avoidant attachment. Conversely, it was hypothesized that students with avoidant attachment would display greater cognitive inflexibility but perform better in organization, planning, and inhibitory control.

The results indicated that avoidant attachment styles are

Table 4. Brief-SR Dimensions by Attachment Type

Variable	Groups	<i>Mdn</i>	<i>W</i>	<i>z</i>	<i>p</i>	Sig
Inhibition	Secure Attachment	14	8999.5	-1.21	.23	
	Insecure Attachment	14				
Organization/Planning	Secure Attachment	17	8073.5	-2.57	.01	*
	Insecure Attachment	18				
Shift	Secure Attachment	13	8165.0	-2.44	.01	*
	Insecure Attachment	14				
Emotional Regulation	Secure Attachment	10	7321.5	-3.68	$p < .01$	*
	Insecure Attachment	12				

Table 5. Student's *t*-test for GEC and Insecure Attachment Groups

Variable	Insecure-Avoidant Attachment		Insecure-Ambivalent Attachment		<i>t</i> (85)	<i>p</i>	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
GEC	101.14	18.32	91.35	17.18	$p < .01$	0	0.56

associated with greater difficulties in cognitive performance compared to ambivalent attachment styles, and this difference was statistically significant ($p < .01$). Specifically, students with avoidant attachment had a mean score of $M = 101.14$, whereas those with ambivalent attachment had a mean score of $M = 91.35$ (see Table 5).

This finding highlights the importance of attachment style in understanding individual differences in executive function performance.

Further analysis of individual BRIEF-SR dimensions revealed significant differences across all dimensions, including Inhibitory Control, Organization/Planning, Cognitive Flexibility, and Emotional Regulation, based on the type of insecure attachment. Notably, students with avoidant attachment experienced greater difficulties in these areas compared to those with ambivalent attachment. These results diverge from the initial expectations set forth in the hypothesis.

Discussion

The results of this study align with previous research that suggests that secure attachment is positively associated with better executive functioning during adolescence. Prior studies have demonstrated that securely attached adolescents benefit from stable emotional regulation and a supportive social environment, which fosters

cognitive development and adaptive problem-solving skills (Diamond, 2013). The findings from this research further confirm that students with secure attachment exhibit superior performance in executive functions compared to their insecurely attached peers, particularly in areas such as planning, emotional regulation, and cognitive flexibility. These results are consistent with the attachment theory's assertion that secure attachment promotes optimal emotional regulation, which is crucial for effective executive functioning (Bowlby, 1988; Mikulincer & Shaver, 2016).

However, contrary to our expectations, no significant differences were found in inhibitory control between secure and insecure attachment groups. This contrasts with earlier studies that found a strong relationship between attachment security and impulse control (Dykas & Cassidy, 2011). One possible explanation for this unexpected result is that inhibitory control might be influenced by a different set of mechanisms compared to other cognitive abilities, such as planning or cognitive flexibility, despite all being governed by the prefrontal cortex (Blakemore & Choudhury, 2006). Inhibitory control may be more closely tied to immediate, situational factors like peer pressure, academic demands, or environmental stressors, which could temporarily override the influence of attachment security on this function. During adolescence, when the prefrontal cortex is still maturing, inhibitory control might be particularly susceptible to external influences such as social expectations and cultural norms.

Table 6. Mann-Whitney U Test: Individual BRIEF-S R Dimensions by Insecure Attachment Styles

Variable	Groups	<i>Mdn</i>	<i>W</i>	<i>z</i>	<i>p</i>	Sig
Inhibition	Insecure-Avoidant Attachment	15.5	2188	2.53	0.01	*
	Insecure-Ambivalent Attachment	14.0				
Organization/Planning	Insecure-Avoidant Attachment	19	2153	2.34	0.02	*
	Insecure-Ambivalent Attachment	17				
Shift	Insecure-Avoidant Attachment	14.5	2136	2.25	0.02	*
	Insecure-Ambivalent Attachment	13.0				
Emotional Regulation	Insecure-Avoidant Attachment	13	2141.5	2.28	0.02	*
	Insecure-Ambivalent Attachment	11				

This could dampen the potential impact of attachment style, making the effect less pronounced than for other functions like planning or emotional regulation, which may be more deeply ingrained in early emotional experiences and attachment patterns (Zimmermann & Iwanski, 2014). Additionally, inhibitory control could be less sensitive to the internalized emotional regulation fostered by attachment, as it often requires real-time, situation-based decisions and reactions. In contrast, functions like cognitive flexibility and planning involve more complex, sustained processes that may more clearly reflect an adolescent's underlying emotional stability and early caregiving experiences. Future research could explore the role of situational factors and social context in moderating the relationship between attachment style and inhibitory control.

The study also revealed that insecure-avoidant attachment was associated with worse performance across all executive function domains compared to insecure-ambivalent attachment. This outcome diverges from some theoretical predictions suggesting that avoidant individuals, due to their emphasis on self-sufficiency, might exhibit stronger planning and organizational skills (Shaver & Mikulincer, 2007). However, it is plausible that the cognitive cost of constant emotional suppression in avoidant individuals negatively impacts their overall cognitive resources, leading to poorer executive functioning. Research suggests that the continuous effort to suppress emotions requires significant mental resources, potentially reducing the capacity available for complex cognitive tasks, such as planning and flexibility (Grossmann et al., 2006).

In contrast, ambivalent individuals, while emotionally preoccupied, might experience less cognitive load related to emotional suppression, allowing for better performance in certain cognitive tasks, such as cognitive flexibility. Avoidant individuals may also face additional challenges due to their reluctance to seek social support, which is a key factor in cognitive development during adolescence (Mikulincer & Shaver, 2016). By minimizing their emotional interactions and distancing themselves from others, adolescents with avoidant attachment may miss opportunities to engage in collaborative learning and problem-solving experiences, which are crucial for the development of executive skills such as emotional regulation and planning (Zimmermann & Iwanski, 2014). Ambivalent individuals, despite their emotional dependency, often engage more actively in social interactions, potentially fostering better adaptability in dynamic and complex situations that require cognitive flexibility.

An alternative explanation for the lower cognitive performance among avoidant individuals could be linked to their diminished self-awareness and lack of engagement in self-reflection. Avoidant adolescents, who prioritize independence and emotional detachment, may not invest sufficient effort in evaluating or improving their cognitive strategies, which could hinder their development of essential cognitive abilities, such as planning and emotional regulation (Diamond, 2013). Ambivalent adolescents, on the other hand, despite their emotional instability, might be more aware of their cognitive and emotional difficulties, and therefore more motivated to engage in strategies to improve their performance.

While this study provides valuable insights, it is important to acknowledge certain limitations. First, the cross-sectional design restricts our ability to infer causality between attachment styles and cognitive abilities. Future longitudinal studies are needed to better understand the temporal relationships and potential developmental trajectories. Second, the sample is limited to adolescents from specific regions in Spain, which may limit the generalizability of the findings to other cultural or demographic contexts. Third, the reliance on self-report measures brings in the possibility of response biases, which could affect the accuracy of the data. Incorporating multiple data resources, such as teacher or parent reports and observational methods, could enhance the robustness of future research. Despite these limitations, the study contributes significantly to

the understanding of how attachment styles influence cognitive development during adolescence.

The findings of this study hold important implications for educational practice and intervention strategies. Understanding the relationship between attachment styles and executive functions during adolescence can help educators, school counselors, and psychologists to design more tailored support systems that address the emotional and cognitive needs of students.

Since securely attached students tend to demonstrate better executive function performance—particularly in areas like planning, cognitive flexibility, and emotional regulation—schools can play a pivotal role in fostering secure attachment-like environments. Providing students with consistent support, emotional safety, and positive feedback may help mitigate the cognitive challenges faced by those with insecure attachment styles. Given that students with insecure-avoidant attachment showed greater difficulties in all executive functions, compared to those with ambivalent attachment, targeted interventions could be developed to support these students in areas such as cognitive flexibility, emotional regulation, and planning.

Training teachers on the impact of attachment styles on students' cognitive and emotional development could empower them to identify signs of insecure attachment and implement strategies that foster a supportive classroom environment. By adopting characteristics of secure attachment—such as consistency, empathy, and positive feedback—teachers can play a pivotal role in enhancing students' cognitive performance. Establishing safe, emotionally supportive classroom spaces where students feel free to express themselves without judgement could foster trust and connection.

Additionally, integrating social-emotional learning (SEL) programs into the school curriculum could provide structured opportunities for students to develop essential skills. These programs might include activities like mindfulness exercises, collaborative group projects, and role-playing scenarios that promote problem-solving, self-awareness and emotional regulation—foundational abilities for success in both academic and personal contexts.

Peer mentoring programs could also be highly beneficial, particularly for students with insecure attachment. These interactions provide emotional support, improve communication skills, and help build a sense of community and belonging, which is critical for adolescents navigating complex social and emotional challenges.

Furthermore, engaging caregivers and families in school activities focused on emotional and cognitive development could reinforce these efforts at home, creating a consistent support system across environments.

This study's findings contribute significantly to understanding the relationship between attachment styles and executive functions in adolescents, particularly within the Spanish context. The results highlight that secure attachment is positively associated with better performance in several areas of executive function, such as planning, cognitive flexibility, and emotional regulation. This aligns with prior research that emphasizes the role of secure attachment in fostering cognitive and emotional regulation skills during adolescence (Dykas & Cassidy, 2011; Zimmermann & Iwanski, 2014). However, the absence of significant differences in inhibitory control between secure and insecure attachment groups opens up new avenues for investigation, particularly around how external factors such as peer dynamics, academic pressures, or cultural norms may influence executive functions. Further research is needed to explore how environmental variables such as socio-economic status, parental involvement, and peer relationships interact with attachment styles to influence the development of executive functions. Adolescence is a period marked by complex social and cognitive demands, and understanding the broader ecological context of these students may help refine interventions designed to support cognitive development in insecurely attached adolescents. Investigating how these factors

modulate cognitive capacities could yield a more nuanced view of the cognitive processes involved, particularly in culturally diverse settings such as Spain.

One promising direction for future research is longitudinal studies that track changes in attachment styles and executive function development over time. Adolescence, particularly the transition from middle school to high school, represents a critical period for both cognitive maturation and emotional development. Longitudinal studies could provide valuable insights into how attachment security—or its lack—interacts with school environments and peer relationships over time to shape cognitive outcomes. Such a research could help identify key transition points where educational interventions might be most effective.

Another area of future research involves designing and evaluating pilot programs linking attachment-based interventions with measurable outcomes that further validate these approaches, generating valuable data for refining practices in diverse educational contexts. Research into teacher-student dynamics is also crucial, as teachers' emotional attunement to their students and their own attachment styles could buffer or exacerbate the cognitive and emotional challenges faced by insecurely attached adolescents.

In conclusion, this study lays the groundwork for both understanding and addressing the relationship between attachment styles and executive functions in adolescents. Through future research and practical applications in education, there is significant potential to develop strategies that support cognitive and emotional growth, helping students navigate academic and social challenges more effectively.

Conflict of Interest

The authors of this article declare no conflict of interest.

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