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The development of ability emotional intelligence during adolescence

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ABSTRACT

This study aimed to examine the development of ability emotional intelligence (EI) in the adolescent population with a Spanish performance-based instrument of EI: Botín Foundation's Emotional Intelligence Test for Adolescents (TIEFBA), which assesses the respondent's ability to solve emotional problems for each of the four emotional skills of the Mayer and Salovey EI model. With a large cross-sectional sample of Spanish adolescents ($N = 5377$; girls, 50.9 %) aged from 10 to 17 years ($M = 13.57$), the authors examined the progression of ability EI across the adolescent period, as well as the effects of gender. The results revealed that girls scored higher than boys on both the total EI and its four branches. Moreover, total EI increased throughout adolescence, but only in girls. Regarding EI branches, while using and understanding emotions increased with age in both girls and boys, managing emotions increased only in girls and perceiving emotions decreased in boys. These findings represent a significant advance that helps us define the evolution of emotional skills in adolescence, providing empirical support for using this performance measure of ability EI.

1. Introduction

Adolescence is a dynamic period characterized by rapid changes at the physiological, emotional, and social levels (Özdemir et al., 2016). Understanding the trajectory of these changes is crucial for comprehending adolescence and developing strategies to navigate the challenges of this stage effectively. Of particular importance is the advancement in research on strategies to manage the emotional domain (Michalska & Davis, 2019; Silvers, 2022). In this study, we specifically focus on examining the development of emotional intelligence abilities during adolescence.

Emotional intelligence (EI) is defined by Mayer and Salovey as “the ability to perceive accurately, appraise, and express emotion; the ability to access and/or generate feelings when they facilitate thought; the ability to understand emotion and emotional knowledge; and the ability to regulate emotions to promote emotional and intellectual growth” (Mayer & Salovey, 1997, p. 10). Following this conceptualization, EI is composed of four branches: perceiving emotions, using emotions, understanding emotions, and managing emotions.

In addition to the Mayer and Salovey definition, various approaches to EI can be found in the literature. Joseph and Newman (2010)

categorize the EI models according to the theoretical conceptualization of the construct and the measurement method used. These are the self-report ability model, performance-based ability model, and self-report mixed model. The self-report and performance-based ability models are based on Mayer and Salovey's (1997) conceptualization and understand EI as a set of emotion-related abilities. The difference between them is that the self-report ability model employs self-report measurements, and the performance-based ability model uses more objective measures based on performance tests. On the other hand, the self-report mixed model understands EI as a broader construct which includes both emotion abilities and personality factors assessed through self-report measurements.

While three models assess EI, they are only moderately correlated with each other (Brackett & Mayer, 2003). Thus, depending on the model chosen, this can result in discrepant findings. Comparisons across the literature suggest that instruments based on performance-based ability model are more objective, as they are less susceptible to social desirability bias (Brackett et al., 2006; Webb et al., 2013). Moreover, these instruments are more consistent in predicting adaptive behavior (Gutiérrez-Cobo et al., 2016; Mayer et al., 2016). Mixed models are also frequently criticized for their redundancy since it is argued that they

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overlap with other personality traits already extensively studied in the literature (Locke, 2005).

The previous literature has consistently demonstrated the positive implications of EI for adolescents and adults, as measured through the performance-based ability model. Specifically, higher levels of EI have been associated with better mental health (Davis & Humphrey, 2012), subjective well-being (Llamas-Díaz et al., 2023), academic performance (MacCann et al., 2020), adjustment both in academic and personal domains (Fernández-Berrocal et al., 2018), and reduced instances of suicidal (Domínguez-García & Fernández-Berrocal, 2018) and aggressive behavior (García-Sancho et al., 2014; Vega et al., 2022) and substance abuse (Kun & Demetrovics, 2010). Understanding the developmental trajectory of performance-based ability EI during adolescence, along with potential gender differences, will help to gain valuable insights into the development of this protective factor. Specifically, this knowledge would help us to determine the developmental stage at which EI interventions might be most effective and necessary, enabling the development of more tailored intervention programs.

According to the EI theory, increasing cognitive ability, together with life and social experiences, are expected to facilitate the development of EI. Therefore, from this perspective, EI levels are hypothesized to increase with age (Mayer et al., 1999; Salovey & Sluyter, 1997). Regarding age differences in the EI of adults, the overall literature tends to confirm this increase using both performance and self-report measures (Cabello et al., 2016a; Navarro-Bravo et al., 2019). However, Cabello et al. (2016a) observed a quadratic relationship where both younger and older adults showed lower performance-based ability EI scores compared to middle-aged adults. Moreover, Sánchez-López et al. (2022) found that EI increased with age, but only among women, with no age-related changes in men. Regarding age differences in adolescence, when using self-reports, EI appears to decrease, especially among girls, although other studies suggest a decline only in certain dimensions (Esnaola et al., 2017; Garaigordobil, 2020; Gómez-Baya et al., 2016). Concerning performance-based instruments, the previous literature has also yielded inconsistent results. For instance, Peters et al. (2009), with a small sample of 50 adolescents, found a positive correlation between age and the total EI score and its branches (except for perceiving). However, Fernández-Berrocal et al. (2018) reported negative correlations, while Davis and Humphrey (2012) found no significant results according to age.

Research examining gender differences in the adult population has yielded mixed results depending on the type of measuring instrument used. When using performance-based instruments, women have shown higher EI levels than men (e.g., Cabello et al., 2016a; Palmer et al., 2005). However, research using self-report instruments has shown different results depending on the study. Some studies suggest higher EI levels in either men or women, while others indicate a lack of gender differences (Goldenberg et al., 2006; Joseph & Newman, 2010; Sánchez-Núñez et al., 2008).

When examining gender differences in adolescence, similar to the findings reported in adults, inconsistent results are found when using self-reports. Some studies have found no gender differences (Nasir & Munaf, 2011; Williams et al., 2009), others have reported lower EI scores for girls (Gómez-Baya et al., 2016), and certain studies focused on specific dimensions of EI have shown higher scores for girls (Esnaola et al., 2017; Garaigordobil, 2020). When using performance-based instruments, research findings indicate that girls score higher on total EI and its branches (Davis & Humphrey, 2012; Fernández-Berrocal et al., 2018; Llamas-Díaz et al., 2023; Rivers et al., 2012), except for the understanding branch, as observed in the study conducted by Llamas-Díaz et al. (2023).

To date, we have only identified one study that examines the trajectory of performance-based ability EI alongside gender effects during a specific period of adolescence (Rivers et al., 2012). In this study, Rivers et al. (2012) found, in a sample of early adolescents (aged from 10 to 13 years), that EI increased with age for girls, but not for boys. These

authors also found that the branches of using and understanding emotions appeared to improve with age, although the understanding branch only improved in girls. Furthermore, 11-year-old participants showed the highest scores in the perceiving emotion branch.

Building upon the existing literature, the present study aimed to examine the developmental trajectory of EI throughout the whole period of adolescence (from 10 to 17 years), exploring potential gender differences in this process. While the performance-based ability model has garnered more empirical support, it is important to note that self-report models are more commonly used in adolescents. The Botín Foundation's Emotional Intelligence Test for Adolescents (TIEFBA) stands as the only validated Spanish performance instrument for assessing emotional intelligence in adolescents (Fernández-Berrocal et al., 2018). This study marks the first instance of utilizing the TIEFBA to evaluate emotional intelligence and its four branches—perceiving, using, understanding, and managing emotions—for this purpose.

The present study represents a crucial first theoretical step for developmental psychologists to understand the evolution of EI from a performance-based ability perspective throughout adolescence while analyzing its interaction with gender. This contrasts with previous literature, which primarily focused on self-report methodologies. Gaining insights into the trajectory of this protective factor has practical implications, as these can inform the design of prevention school-based programs and more tailored interventions.

In view of the literature described, we hypothesized that: H1) Girls will score higher in EI than boys; H2) EI will increase with age; H3) the increase in EI with age will be more pronounced in girls than in boys; H4) these relations could depend on the EI branch studied.

2. Material and methods

2.1. Participants

The study participants consisted of a community sample of 5377 Spanish adolescents recruited from numerous schools across various regions of Spain (during the period between 2015 and 2023). The sample was balanced for gender, 2640 of which were boys (49.1 %) while 2737 were girls (50.9 %). The ages of the participants ranged from 10 to 17 years, with a mean age of 13.57 (SD = 1.64). The distribution of age and gender in the sample is shown in Table 1. Each participant voluntarily completed the TIEFBA instrument on paper or online via the LimeSurvey platform (www.limesurvey.org). Most of the participants were part of larger studies conducted by our research group.

Participants were treated in accordance with the Declaration of Helsinki (World Medical Association, 2008). Informed consent was obtained from all parents/legal guardians. Measures were taken to ensure the confidentiality and anonymity of the collected data. The study was approved by The Research Ethics Committee of the University of Málaga (2498/CEIH/2021).

2.2. Instruments

The TIEFBA (Botín Foundation's Emotional Intelligence Test for Adolescents; Fernández-Berrocal et al., 2018) is an ability performance-

Table 1
Distribution of the number of participants by age and gender.

Age (years)	Number of Boys	Number of Girls
10	82	106
11	218	204
12	557	543
13	428	472
14	448	507
15	482	542
16	288	285
17	137	78

based instrument designed to assess EI in the adolescent population. The test provides a total score of EI and a specific score for each of the four EI branches included in the ability model (perceiving emotions, using emotions, understanding emotions, and managing emotions). Participants are presented with eight emotion-eliciting scenes which describe situations adolescents can encounter in their daily life. For example, “Gerardo and you are going to Carlos’ house because he has invited you for his birthday. However, when you arrive you realize that it’s only the two of you since the rest of your friends had to study for an exam and they have not showed up. Carlos locks himself in his room”. In each of the eight scenes, participants are required to perform four tasks, one for each EI branch. In the perceiving task, a picture is displayed showing the emotional facial expression of the main protagonist of the scene, and participants must rate the extent of surprise, anger, sadness, fear, happiness, and disgust they think that the protagonist feels. In the using task, participants must indicate the degree to which the emotional state of the protagonist can help them to perform four cognitive activities. In the understanding task, participants must rate the extent to which three thoughts or beliefs can be associated with the emotional state of the protagonist. Finally, in the managing task, participants must rate the degree to which four emotion regulation strategies are useful in achieving a certain objective related to the content of each scene. In the four tasks, the responses are given on a 5-point Likert scale ranging from 1 = “not at all” to 5 = “very much”. The total scores and those of the EI branches are computed based on an expert consensus criterion and they are reported as standard scores with mean of 100 and SD of 15. In our sample, internal consistency of the Total score was excellent (Cronbach’s $\alpha = 0.91$) and for the EI branches was acceptable ($\alpha = 0.86$ for perceiving, $\alpha = 0.75$ for using, $\alpha = 0.75$ for understanding, and $\alpha = 0.75$ for managing).

2.3. Statistical analysis

First, descriptive statistics were calculated for each of the EI scores provided by the TIEFBA (the total score and the four EI branches). Gender differences in EI scores were examined by *t*-tests. Second, the relations between age and EI scores were examined using Pearson’s correlations. Additionally, regression analysis was used to examine the possibility of a quadratic relationship between age and EI scores. Third, and as the main aim of the study, we explored the interaction between age and gender for EI scores through multiple regression analyses (an independent regression for each EI score). Age, Gender, and Age x Gender were introduced as predictors and EI scores were the dependent variables. Predictors were mean-centered. All analyses were conducted using IBM SPSS statistics Version 23.

3. Results

Descriptive statistics for the study variables, along with *t*-tests for gender differences, are shown in Table 2. Significantly higher TIEFBA scores were observed for girls in comparison with boys on the total score and the four branches (all $p < .001$; see Fig. 1 and Fig. S1).

Pearson’s correlations between age and TIEFBA scores revealed a significant positive correlation for TIEFBA total ($r = 0.06$, $p < .001$), TIEFBA using ($r = 0.14$, $p < .001$) and TIEFBA understanding ($r = 0.09$, $p < .001$), and a negative correlation for TIEFBA perceiving ($r = -0.08$, $p < .001$). The managing branch did not show a significant relationship with age ($p > .05$).

In addition, we examined whether the previous relations presented a better fit for a linear or quadratic model. Regression analysis revealed significant linear and quadratic relations for TIEFBA total (linear model: $R^2 = 0.01$, $p < .001$; quadratic model: $R^2 = 0.01$, $p < .001$) and the branches of TIEFBA perceiving (linear model: $R^2 = 0.01$, $p < .001$;

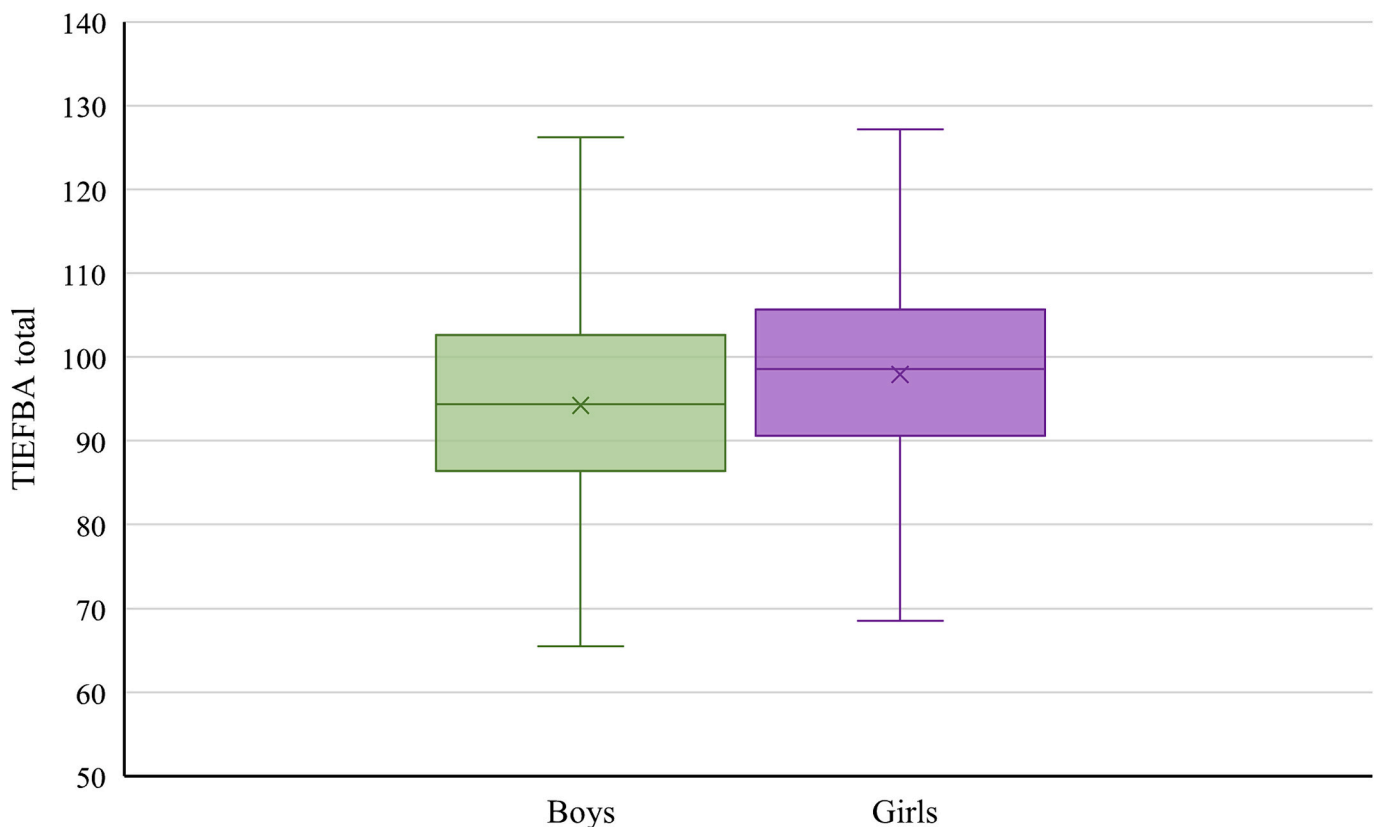


Fig. 1. Boxplot diagram of TIEFBA total score comparing boys and girls. The horizontal line in the box indicates the median, and the “x” the mean. The lower and upper limits of the boxplots represent the first and third quartiles, respectively, and the whiskers (vertical lines) show the minimum and maximum values.

Table 2

Descriptive statistics for the total sample and separately by gender (mean and standard deviation [SD]) and t-tests for gender differences (t value and Cohen's d effect size).*

	Total sample Mean (SD)	Boys Mean (SD)	Girls Mean (SD)	Gender differences	
				t value	Cohen's d
Age	13.57 (1.74)	13.60 (1.78)	13.54 (1.71)	1.18	0.03
TIEFBA total	96.10 (11.29)	94.22 (11.47)	97.92 (10.79)	12.21**	0.33
TIEFBA perceiving	96.33 (14.82)	94.53 (15.44)	98.07 (13.99)	8.81**	0.24
TIEFBA using	96.16 (15.54)	94.45 (15.45)	97.80 (15.46)	7.94**	0.22
TIEFBA understanding	95.89 (14.54)	94.57 (14.49)	97.17 (14.47)	6.57**	0.18
TIEFBA managing	96.04 (15.54)	93.31 (15.63)	98.66 (15.00)	12.80**	0.35

* $p < .05$.

** $p < .01$.

quadratic model: $R^2 = 0.01, p < .001$), TIEFBA using (linear model: $R^2 = 0.02, p < .001$; quadratic model: $R^2 = 0.02, p < .001$) and TIEBA understanding (linear model: $R^2 = 0.01, p < .001$; quadratic model: $R^2 = 0.01, p = .001$). Based on R^2 values and visual inspection of the scatter plots, we observed that the quadratic model showed a similar fit to that of the linear model across these four relations. Thus, according to parsimony criteria, the linear model was deemed more suitable. In the case of the managing branch, the linear model was not significant ($p > .05$), but the quadratic model was ($R^2 = 0.01, p < .01$). TIEFBA managing scores increased in the early ages but decreased in the later ages of our sample (note that this quadratic relationship was not relevant when gender was included as moderator, see below).

To address the main objective of this study, multiple regression analyses were conducted to examine the Age x Gender interaction for the TIEFBA scores. The results revealed a significant interaction between age and gender for both the total score ($b = -0.85, \beta = -0.10, p < .001$; see Fig. 2) and the four branches of TIEFBA (perceiving: $b = -1.06, \beta = -0.09, p < .001$; using: $b = -0.65, \beta = -0.05, 95\% p < .01$; understanding: $b = -0.74, \beta = -0.06, p < .01$; managing: $b = -0.96, \beta = -0.08, p < .001$; see Fig. S2). Specifically, in terms of the TIEFBA total score, the interaction indicated that EI increased with Age for girls ($b = 0.82, \beta = 0.13, p < .001$), but not for boys ($p > .05$) (see Fig. 2). Analysis of the TIEFBA branches revealed that, for the perceiving branch, there was no significant relationship with age for girls ($p > .05$); however, a significant and negative relationship was observed for boys ($b = -1.16, \beta = -0.13, p < .001$). For the using branch, there was a significant positive relationship with age for both girls and boys (girls: $b = 1.61, \beta = 0.18, p < .001$; boys: $b = 0.96, \beta = 0.11, p < .001$). Similarly, for the understanding branch, a significant and positive relationship with age

was found for both girls and boys (girls $b = 1.11, \beta = 0.13, p = .001$; boys: $b = 0.37, \beta = 0.04, p = .02$). Finally, for the managing branch, the results show a significant positive relationship with age for girls ($b = 0.68, \beta = 0.07, p < .001$), but not for boys ($p > .05$). In addition, given the previously observed quadratic relationship between age and TIEFBA managing, we decided to examine the effect of gender on this relationship. The quadratic model was found to be significant for girls ($R^2 = 0.01, p = .001$), but its fit was similar to that observed in the linear model ($R^2 = 0.01, p = .001$). The quadratic model was not significant for boys ($p > .05$).

To further investigate the Age x Gender interaction, we conducted a two-way ANOVA with Age and Gender as the between-subject factors and TIEFBA total score as the dependent variable to determine at what age the differences in EI begin to emerge between girls and boys. The Age X Gender interaction was significant ($F(7, 5361) = 4.38, p < .001$). Tukey post hoc comparisons of TIEFBA scores between genders at each age revealed no gender differences in EI for participants aged 10 and 11 years ($ps > 0.05$). However, these differences became significant from the age of 12, with girls obtaining higher EI scores than boys (all $p < .05$). See Fig. 2 for a clearer representation of these differences in the case of the TIEFBA total score.

4. Discussion

The present study aimed to analyze the trajectory of EI development throughout adolescence in a Spanish sample aged 10 to 17 and determine whether this process differs according to gender. For this purpose, we evaluated EI using the TIEFBA, a performance-based ability instrument that yields a score for total EI and the four branches described in

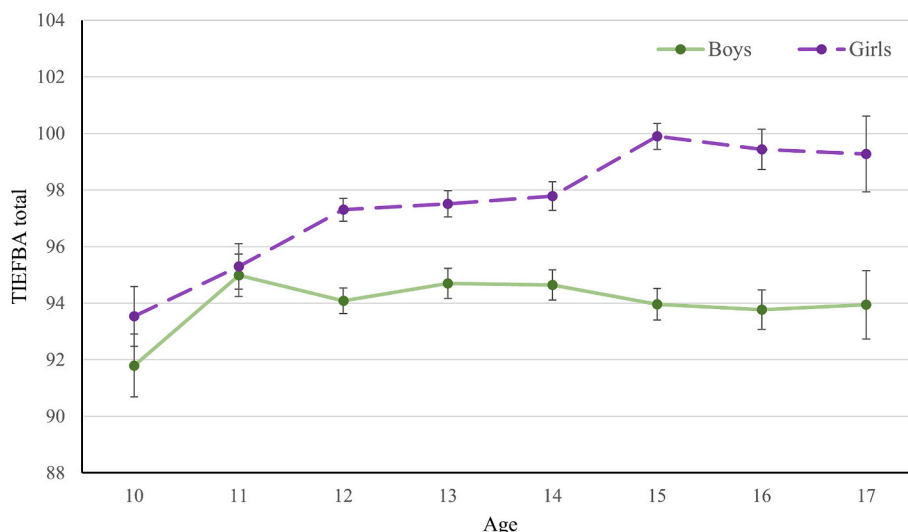


Fig. 2. Representation of the TIEFBA total scores for each age and divided according to gender.

the Mayer and Salovey (1997) model. Although different results were observed depending on the EI branch assessed, the main finding to emerge from this study is that total EI increases throughout adolescence, but only in girls.

Consistent with Hypothesis 1, the girls in our sample scored higher than boys in total EI and its four branches. This finding aligns with previous studies conducted in both adolescents and adults (Cabello et al., 2016a; Palmer et al., 2005; Peters et al., 2009; Rivers et al., 2012). When measuring EI through performance-based ability measures such as the TIEFBA, girls appear to be more emotionally intelligent than boys. This clear difference contrasts with the inconsistent results reported in previous studies using self-reports, where girls sometimes perceive themselves as more skilled, equal to, or even less skilled than their male counterparts (Esnaola et al., 2017; Garaigordobil, 2020; Goldenberg et al., 2006; Gómez-Baya et al., 2016; Joseph & Newman, 2010; Nasir & Munaf, 2011; Sánchez-Nuñez et al., 2008; Williams et al., 2009). In other words, while girls obtain higher scores than boys when EI is evaluated through performance-based ability tests, they do not acknowledge the superiority of their skills when assessed through self-reports.

Consistent with Hypothesis 2, total EI scores increased with age, and a similar trend was also observed for the using and understanding branches. However, scores on the perceiving branch appeared to decrease with age. To better interpret these findings, it is important to consider the interaction between age and gender (Hypothesis 3). Interestingly, the increase in total EI with age was found exclusively among girls, which supports both our Hypothesis 3 and the findings of a study by Rivers et al. (2012) conducted in early adolescence. These results indicate that the development of EI abilities may follow different trajectories for boys and girls during adolescence. In particular, boys may be at a disadvantage in developing these abilities and, therefore, may require more support through programs designed to enhance their EI skills.

Finally, to address Hypothesis 4, we examined the interaction between age and gender for the four branches of EI. Starting with perceiving emotions, we previously reported that this decreased with age. The interaction analysis revealed that this decline was significant only for boys, while no similar differences were found among girls in perceiving emotions. This finding is consistent with the results of a study conducted by Cabello et al. (2016a) in adults, where a decrease in this ability appeared to be more pronounced in men. In addition, Rivers et al. (2012) found that 11-year-olds scored higher in this branch than 12 and 13-year-olds, irrespective of gender. These findings highlight the importance of targeting interventions focused on the perceiving branch for both adolescents and adults. Moreover, in our sample, while both boys and girls showed an increase in using and understanding emotions, the managing branch improved only among girls. According to Mayer and Salovey's performance-based ability model of EI (Mayer et al., 2016; Mayer & Salovey, 1997), the managing branch represents a more complex ability that requires more time to develop. Our results suggest that boys may require even more time to develop this ability. This finding has important implications for future interventions, given that the ability to regulate emotions in adolescents is crucial in preventing negative consequences such as aggression (Gutiérrez-Cobo et al., 2023).

The observed increase in EI with age is consistent with EI theory, which posits that the enhancement of cognitive abilities and life experiences, including social interactions, are expected to promote its development. This finding is also congruent with the notion that a construct must evolve with age to be considered a standard intelligence (Mayer et al., 1999; Mayer & Salovey, 1997). Additionally, gender appears to play a role in determining the extent of this improvement. Prior research suggests that biological, interpersonal, and socio-cultural factors may contribute to this gender bias (Brody, 1985). For instance, hormonal changes during puberty could impact emotional and cognitive development, potentially influencing how girls and boys manage their emotions (Chaplin & Aldao, 2013). Moreover, certain brain regions,

such as the prefrontal cortex and amygdala, show differential activation based on gender when regulating specific emotions (McRae et al., 2008). Socio-cultural factors could also explain gender differences in emotional processing (Chaplin & Aldao, 2013), with societal norms often dictating that girls are more encouraged to express emotions than boys (Brody & Hall, 2008). Additionally, girls could be more motivated than boys to perform these emotional tasks (Ickes et al., 2000; Klein & Hodges, 2001).

Previous studies have pointed to EI as a protective factor in adolescence (Balluerka et al., 2013; Davis & Humphrey, 2012; Domínguez-García & Fernández-Berrocal, 2018; Fernández-Berrocal et al., 2018; Gómez-Baya et al., 2016; Gutiérrez-Cobo et al., 2023; Llamas-Díaz et al., 2022; MacCann et al., 2020; Rueda et al., 2022). In the present study, we observed gender differences in the developmental trajectory of this ability during adolescence, with boys being disadvantaged compared to girls, specifically in the total, perceiving, and managing branches of EI. Although these results highlight the importance of focusing on boys to balance the trajectory of EI development, it is recommended that all adolescents participate in EI intervention programs as they have been shown to yield benefits in the short and mid-term for both boys and girls (Brackett et al., 2019; Cabello et al., 2016b; Castillo-Gualda et al., 2018; Durlak et al., 2022). In addition, previous research has indicated that men tend to increase their EI from young adulthood to middle age (Cabello et al., 2016a). Therefore, future studies should consider expanding the age range of the sample to include early adulthood to determine whether boys also increase their EI with age, but at a later stage.

Our study is not exempt from limitations as the results prevent us from establishing the causal relationships underlying the differences found. These differences could be due to biological or cultural factors, which should be explored in future studies (Michalska & Davis, 2019; Silvers, 2022). In addition, the variance explained by the results is low, indicating that while gender and age contribute to EI levels, other variables must be considered. We recommend further exploring the impact of socioeconomic and educational levels, as previous studies have identified these variables as significant protective factors for emotional and cognitive abilities (Cabello et al., 2014; Gutiérrez-Cobo et al., 2021; Letourneau et al., 2013; Mohammad et al., 2020). Moreover, future research should adopt a longitudinal approach to examine the developmental trajectory of EI more thoroughly over time and avoid possible cohort effects due to the transversal nature of the present study. Finally, our results are based on a Spanish sample, highlighting the need to conduct transcultural studies to detect potential differences in EI development across different cultures.

In conclusion, this study is the first to utilize the TIEFBA as a performance-based ability instrument for measuring the development of EI throughout adolescence while considering gender differences. Our findings indicate that total EI scores tend to increase during adolescence, but this growth is observed only in girls. Furthermore, the development of the four branches of the performance-based ability model follows different trajectories. These results enhance our understanding of gender-related differences in the development of EI abilities during adolescence and pave the way for future research and practical applications. Consequently, our findings highlight the importance of promoting EI programs to safeguard individuals from the effects of this dynamic developmental stage.

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CRedit authorship contribution statement

Alberto Megías-Robles: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **María José Gutiérrez-Cobo:** Conceptualization, Investigation, Resources, Visualization, Writing – original draft, Writing – review & editing. **Pablo Fernández-Berrocal:** Conceptualization, Funding acquisition, Project administration, Supervision, Writing – review & editing. **Raquel Gómez-Leal:** Conceptualization, Investigation, Writing – review & editing. **Rosario Cabello:** Conceptualization, Funding acquisition, Methodology, Project administration, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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