Emotion regulation and working memory in academic performance

Regulación emocional y memoria de trabajo en el desempeño académico

Regulação emocional e memória de trabalho no desempenho acadêmico

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Abstract: The objective of this work was to analyze the relationship between emotional regulation strategies, cognitive reappraisal applied to home school tasks (CR-HST) and emotional management applied to home school tasks (EM-HST) on academic performance (AP) controlling working memory difficulties (WM-diff) in children who finished Primary Education. A self-report questionnaire to assess CR-HST and EM-HST was administered to 119 fourth, fifth and sixth grade children (9 to 11 years old) and two questionnaires to their teachers to assess their AP and WM difficulties. The results showed that EM-HST was associated with the success, academic productivity, mathematics and reading dimensions of AP, even when WM-diff was controlled. There were no significant associations between CR-HST and AP, or any of the strategies on impulse control in academic situations. The results are expected to deepen the understanding of the role of emotional regulation in AP and thus contribute to the content of programs for promoting emotional regulation designed for school contexts.

Keywords**:** emotion regulation; working memory; academic performance; children; teachers

Resumen: El objetivo de este trabajo fue analizar la relación de las estrategias de regulación emocional reevaluación cognitiva aplicada a tareas escolares para el hogar (RC-TEH) y manejo emocional aplicado a tareas escolares para el hogar (ME-TEH) sobre el desempeño académico (DA) controlando dificultades de memoria de trabajo (dif-MT) en niños que finalizaban la Educación Primaria. Se administró un cuestionario de autoinforme para evaluar la RC-TEH y el ME-TEH a 119 de niños de cuarto, quinto y sexto grado (9 a 11 años de edad) y dos cuestionarios a sus maestros para evaluar su DA y dificultades de MT. Los resultados mostraron que el ME-TEH se asoció con las dimensiones éxito, productividad académica, matemáticas y lectura del DA, incluso cuando se controlaron dif-MT. No se observaron asociaciones significativas de la RC-TEH con el DA, ni de ninguna de las estrategias sobre el control del impulso en situaciones académicas. Se espera que los resultados profundicen en el conocimiento del rol de la regulación emocional en el DA y contribuyan así al contenido de programas de promoción de la regulación emocional diseñados para contextos escolares.

Palabras clave: regulación emocional; memoria de trabajo; desempeño académico; niños; docentes

Resumo: O objetivo deste trabalho foi analisar a relação entre as estratégias de regulação emocional de reavaliação cognitiva aplicada ao dever de casa (RC-DDC) e a gestão emocional aplicada ao dever de casa (GE-DDE) sobre o desempenho acadêmico (DA) controlando as dificuldades de memória de trabalho (dif-MT) em crianças que terminam o Ensino Fundamental. Foi administrado um questionário de auto-relato para avaliar RC-DDC e GE-DDE a 119 crianças de quarto, quinto e sexto grau (9-11 anos), e dois questionários foram administrados a seus professores para avaliar suas dificuldades de DA e MT. Os resultados mostraram que a RC-DDC estava associada ao sucesso, produtividade acadêmica, matemática e leitura da DA, mesmo quando se controla a dif-MT. Não foram observadas associações significativas para RC-DDC com DA, nem para nenhuma das estratégias de controle de impulsos em situações acadêmicas. Espera-se que os resultados aprofundem a compreensão do papel da regulação emocional na DA e assim contribuam para o conteúdo de programas que promovam a regulação emocional projetada para ambientes escolares.

Palavras-chave: regulação emocional; memória de trabalho; desempenho académico; crianças; professores

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Introduction

Academic performance (AP) is defined as the achievement level of educational or knowledge goals reached in a specific area (Steinmayr, Meibner, Weidinger, & Wirthwein, 2015). AP compromises both children's future labor insertion (Parsons & Bynner, 2005) and their present psychological well-being (Bennett, Brown, Boyle, Racine & Offord, 2003). Due to their importance, sociocultural, family and individual factors that contribute to a successful AP have been analyzed (e.g., Hattie, 2009). One individual affective factor that has gained value is emotion regulation (Martin & Ochsner, 2016).

Emotion regulation is defined as those processes by which individuals are able to influence when and how they experience and express their emotions (Gross, 2014). Several emotion regulation processes have been studied regarding its predictive capacity of AP (Andrés et al., 2017). Recently, increasing attention has been paid to emotion regulation strategies for school homework, that is, emotion regulation strategies specifically applied to emotions –which are normally unpleasant– that are usually generated by school homework assignments (Xu, Fan & Du, 2016). These tasks are defined as activities assigned by teachers to students to be carried out outside school hours with different purposes, among which are reviewing material presented in class, preparing new materials, transfering skills to other domains and/or integrating different concepts (Cooper, Robinson & Patall, 2006). Although school homework has a positive

influence on AP (Bas, Senturk, & Cigerci, 2017; Cooper et al., 2006; Maltese, Tai & Fan, 2012), it is known that they can generate unpleasant emotions that in some cases prevent their completion (Xu, 2016), therefore the ability to regulate these emotions should have an impact on AP.

One of the models of emotion regulation with greatest empirical support is the process model of Gross (2014), which highlights the importance of cognitive change as an effective component to reduce negative emotions. Cognitive change is a set of strategies that includes "early acting" strategies that are distinguished from those of "late acting", some of which have shown little effectiveness (e.g., suppression of emotional expression) (Gross, 2002). Cognitive change means changing evaluations of a situation to alter its emotional impact, either by modifying thoughts about the situation or about one's own abilities to handle its demands (Gross & Thompson, 2007). Within this component two strategies are highlighted: cognitive reappraisal involves changing the meaning of a situation to alter its emotional impact; while emotion management implies modifying thoughts about one's own abilities to impact emotion (Gross & Thompson, 2007).

Regarding the specific empirical evidence of the relationship of strategies with AP, a recent review (Andrés et al., 2017) indicated that the implementation of cognitive reappraisal improved mathematics performance (Jamieson et al., 2010; Johns, Inzlicht & Schmader 2008) and recall of educational information both in adults (Leroy, Grégoire, Magen, Gross & Mikolajczak, 2012) and primary school children (Davis & Levine, 2013). However, its implementation did not improve reading comprehension performance (Jamieson et al., 2010). Regarding cognitive reappraisal specifically applied to homework assignments (CR-H), its self-reported frequency of use was positively associated with the tendency to complete tasks in mathematics, but not with standardized tests (Xu et al., 2015, 2016). Regarding emotion management, different studies found that its implementation had a positive impact on math performance (Jamieson et al., 2010; Johns et al., 2008) and in educational material recall (Leroy et al., 2012). Regarding emotion management applied specifically to homework (EM-H), Xu et al. (2015, 2016) observed positive associations with standardized math tests.

Of the previous studies, only one included primary school children (i.e. Davis & Levine, 2013), without analyzing the role of emotion regulation of school homework. Therefore, conducting this analysis would represent a contribution. On the one hand, it would allow to expand the knowledge about emotion regulation of school homework. On the other hand, it would allow considering the importance of changes at the cognitive, emotional and academic level that occur in children who are in the final years of their primary schooling. During this period, executive functions develop and mature, social and academic demands increase; therefore, emotion regulation is highly demanded. In this sense, executive functions are at the service of socio-emotional and academic demands (Center on the Developing Child at Harvard University, 2011; Diamond, 2013; St Clair, Thompson, & Gathercole, 2006).

Based on the above, it is valuable to analyze the role of executive functions in the association of emotion regulation with AP, especially working memory. Working memory constitutes a complex system of limited capacity that allows simultaneously storing and processing information (Baddeley, 2012), which is crucial in a successful AP (Alloway, T.P. & Alloway, R.G., 2010). For example, in reading comprehension, working memory stores the sentences so they can be integrated with each other, while activating information from long-term memory, favoring the construction of a coherent representation of the text (Cain, Oakhill & Bryant, 2004). In mathematical operations, it keeps arithmetic combinations from long-term memory and counting operations in an active state, while attending to the regrouping demands that the operation requires (Bull & Lee, 2014; Raghubar, Barnes & Hecht, 2010). Various studies have highlighted the predictive role of working memory in AP (e.g., Alloway, T.P. & Alloway,

R.G., 2010). Associations have been observed even when teacher-report scales are used for its evaluation (e.g., Vernucci et al., 2020).

Working memory plays a key role in self-regulation (Hofmann, Schmeichel, & Baddeley, 2012), specifically in emotion regulation. It allows replacing initial evaluations of an emotional event with subsequent evaluations with lower emotional valence (Pe, Raes & Kuppens, 2013) which is a key process for cognitive reappraisal and emotional management. Evidence shows the importance of working memory in cognitive reappraisal in adults (e.g., McRae, Jacobs, Ray, John & Gross, 2012; Pe et al., 2013, 2015) and children (Andrés, Castañeircas, Stelzer, Canet Juric & Introzzi, 2016). Thus, analyzing the relationship of emotion regulation with AP controlling for working memory –particularly working memory difficulties (WM-diff) observed by teachers– would be important to identify the predictive capacity of emotion regulation more precisely. The only antecedent that can be mentioned is the study of LaFavor (2012), who found a unique explanatory contribution of distress tolerance –an emotion regulation ability that consists of resisting negative emotional states at the service of a goal– to AP when executive functions are controlled in children in situations of social vulnerability that were homeless. Analyzing these relationships in different contexts and with other emotion regulation processes linked to AP, such as the strategies for regulating emotion of homework, would be valuable to complement the available knowledge.

Therefore, the aim of this work is to analyze the relationship of emotion regulation –particularly CR-H and EM-H– on AP controlling for WM-diff, in a group of children in the last years of primary schooling. It is expected that children who report greater use of CR-H and EM-H will be evaluated by their teachers as having better AP, even when controlling for WM-diff reported by them.

Materials and Methods

Design and Participants

This was an ex post facto or correlational study according to the classification of Montero and León (2007). A non-probability convenience sample of 119 children between 9 and 11 years of age (*M*= 10.85; *SD*= 0.85) was evaluated. Children atended fourth (*n*= 37, *M* age= 9.86, *SD*= 0.31), fifth (*n*= 47, *M* age= 10.84, *SD*= 0.025), and sixth grade (*n*= 35, *M* age= 11.92, *SD*= 0.29) of Primary Education (55.5% female, 44.5% male) in a privately managed school from the city of Mar del Plata, Argentina. The children's families mostly belonged to a high and medium-high social status (68.1%) and the rest were distributed between medium and low-medium social status.

Instruments

- *Emotion regulation strategies applied to homework assignments: RC-H and EM-H.* The Homework Emotion Regulation Scale (HERS) was administered (Xu, Fan & Du, 2015). It consists of six items that are answered on a Likert scale of five options from "never" (1) to "always" (5). The CR-H subscale assesses efforts to re-signify the displeasure of homework in less emotional terms, and it presents three items: " I think that there are good sides for it as well " (item 1), " I think that I can learn something from the situation" (item 4), and "I think that it's not all bad" (item 6). The EM-H subscale assesses students' efforts to change the way they think about their own ability to handle the emotional demands of school assignments, and it presents three items: "Tell myself not to be bothered with previous mistakes" (item 2), "tell myself to calm down" (item 3), and "cheer myself up by telling myself that I can do it" (item 5). The psychometric properties reported by the authors of the original instrument are adequate.

Confirmatory factor analysis found evidence of a two-factor model according to the component items of each subscale (CFI=0.98; SRMR=0.02; RMSEA=0.06 [90% CI =0.048-0.091]). Regarding eliability, Cronbach's alpha values were adequate (α=.83 EM-H and α=.87 CR-H). Concurrent and predictive validity analyses showed associations of the subscales with mastery orientationand performance orientation, number of tasks completed, learning strategies, and performance in school homework reported by teachers. Negative associations were observed with avoidance orientation and the frequency of incomplete homework (Xu et al., 2015).

To be used in our context, the instrument was translated and adapted. A translation of the items from English to Spanish was carried out, taking care that it was functional and not literal (Hambleton, 2001). Then, psychologists who were experts in the subject and were fluent in English were asked to review these items in terms of semantic and grammatical clarity, correspondence with the domain to be measured, and adequacy to the educational and developmental level of the participants to whom it was addressed (Tornimbeni, Pérez, Olaz & Fernández, 2004). After its application to the sample under study, an exploratory factor analysis was carried out using the Principal Components method and Oblimin rotation (KMO=.723; Bartlett's sphericity test=91.23: p<.001). This indicated the conformation of two factors that explained 54.14% of the variance, and the items loaded in the factors to which they theoretically belong, except item 5 whose load was partially distributed with the CR component. The bivariate correlation matrix showed that item 2 has a negative association with all items. It is possible that it had been interpreted with a negative connotation by the children and not as a way of handling the emotional demands of the situation, which is why it was excluded from the conformation of the subscales. The reliability of the instrument was moderate to low (total α=.64; EM-H: α=.48; CR-H: α=.41).

- *Academic performance.* The Academic Performance Rating Scale was administered (APRS; DuPaul, Rapport & Perriello, 1991) that reflects teachers' perceptions of children's academic performance and skills in the classroom. It consists of 19 items that teachers answer using a Likert-type scale of five response options, from 1 (never or poor) to 5 (very often or excellent). These items are grouped into three subscales (some items are shared by two subscales) representing three dimensions of AP: Academic success (7 items), refers to the obtained academic achievement, such as the quality of the productions and the ability and speed to learn and retrieve new material (e.g., "How is the quality of his/her school work in general terms?"). Impulse control (3 items), refers to the regulation of behavior in class and in academic situations (e.g., "How often does this child complete tasks in a careless and hurried manner?"). Academic productivity (12 items), refers to those behaviors that are important for attaining academic success such as completing tasks, following instructions, and working independently and on time (e.g., “How often does the child follow the instructions precisely?”). Among the items that compose the subscales, some refer to specific academic skills, such as mathematics and reading (e.g., "Estimate the percentage of tasks correctly completed in math -questions, exercises, etc.-"; "What is the quality of the reading skills of this child?”). Regarding the psychometric properties of the instrument, the analyses carried out by the authors of the scale indicate that they are adequate. Exploratory factor analysis showed the conformation of three factors corresponding to the three subscales that explained 68% of the variance. The internal consistency of the scale was adequate for both the total scale (α=.95) as for each of the subscales (from α=.72 to α=.94), and the test-retest coefficient was high for both the total scale (r=.95) and the subscales (from r=.88 to r=.93). The relationships of the scale with theoretically related variables such as academic efficiency, behavioral indicators and standardized tests of academic skills were significant in most cases (24 of the 28 correlation coefficients were significant) (DuPaul et al., 1991).

To be applied to the sample under study, the same procedure was followed as that of the HERS scale (see previous description). Exploratory factor analysis using the Principal

Components method and Varimax rotation (KMO=.90; Bartlett's sphericity test=2739.49; p<.001) showed the conformation of three factors that explained 76.33% of the variance, where 13 of the 19 items loaded in the factors to which they theoretically belongThe rest loaded partially in another factor. Reliability analysis yielded adequate alpha values (α=.96 for the entire scale; α=.94 academic productivity; α=.94 academic success and α=.72 impulse control).

- *Working memory difficulties*. The Spanish versión of the Working Memory Rating Scale was applied (WMRS; Alloway, Gathercole & Kirkwood, 2008) adapted to our local context (Vernucci et al., 2020). It consists of 20 brief descriptions of behavioral problems associated with a low level of working memory functioning, and allows discerning between children with poor working memory abilities and children with average abilities. The teacher rates how typical each behavior is on a Likert-type scale with four response options from 0 (not typical at all) to 3 (very typical). Examples of items are: "The child raised his hand but when called upon, he had forgotten his response"; "The child needs regular reminders of each step in a written task"; "Depends on neighbor to remind them of the current task". Higher scores indicate greater working memory difficulties. The analysis of the psychometric properties carried out by the authors of the instrument shows good internal indicators of reliability, convergent validity with traditional measures of working memory such as the AWMA Test (Automated Working Memory Assessment; Alloway, 2007) and the WISC-IV (Weschler, 2004). The version translated into Spanish and adapted to our context applied in the present study has shown adequate psychometric properties in confirmatory factor analysis (CFI=.99; SRMR=.04; PNFI=.88), and reliability (α=.97) (Vernucci et al., 2020). In our sample it presented a high alpha value (α=.97).

- *Social status.* A survey was administered to know the social status of the children's families. Its inquiries about the highest level of education achieved and the type of occupation of the main economic supporter of the familiy. This information is then classified using a scale based on the national educational system (Pascual, Galperín & Bornstein, 1993) and the Occupational Prestige Scale EGO70 (Sautú, 1989). Social status was calculated using the Hollingshead Index (2011), which is adequate in our context (Pascual et al., 1993).

Procedure and ethical considerations

Meetings were held with the principals of the institutions that were invited to participate in the study, to provide information on the objectives, instruments and procedures. Then, an informational document was sent to the parents, along with the informed consent form. Those children whose parents gave their consent and who gave their assent at the time of the evaluations were included in the study. Children were evaluated within the school during regular hours. The HERS scale was completed by the same children as a group in their usual classroom, the APRS and WMRS scales were completed by the child's main teacher, and the social status survey was sent to the parents through the communications notebook. This study respected the guidelines for ethical behavior in the Social Sciences and Humanities given by the National Council for Scientific and Technical Research (CONICET, 2006), as well as those included for the activities aimed at obtaining knowledge about psychological processes in human beings, recommended by the American Psychological Association (APA, 2010).

Data analysis

First, descriptive statistics (mean, standard deviation, skewness and kurtosis) of the variables were obtained. Each variable was evaluated for the presence of univariate outliers (values greater than ± 3 SD), which were eliminated. The normality of the distributions was analyzed based on the values of skewness and kurtosis (± 1 is considered acceptable). Pearson's

bivariate correlations were performed to estimate the relationship between the different variables under study. Second, differences in the variables based on gender, school grade and social status of the participants were analyzed using a factorial ANOVA. Third, multiple linear regression analyses were performed in two blocks or models to analyze the relationship of the independent variables with AP, entering as control variables those sociodemographic variables that generated differences. In the first block or model, emotion regulation strategies were entered, while in the second, WM-diff was added. In this way, it is possible to observe the change in the explanatory capacity of the strategies when WM-diff is considered. The dependent variables of AP were academic success, impulse control, and academic productivity. Additionally, the items of the APRS scale that refer to the areas of mathematics and reading were added, and the predictive capacity of the strategies and the WM-diff on them were analyzed to know if there is a specific and differential influence on these academic skills.

Results

Descriptive and correlation analysis

Descriptive statistics and Pearson correlations are presented in Table 1. In all cases, skewness and kurtosis values allow assuming a normal distribution of the data. No outliers were observed; therefore, no cases were eliminated. As Table 1 shows, EM-H was the strategy that presented significant associations with AP dimensions. WM-diff were not associated with emotion regulation strategies.

Table 1
Descriptive statistics and bivariate correlations.

	M	DE	Asimetría	Curtosis	2	3	4	5	6	7	8
1.CR-H	10.62	2.76	-.27	-.61	.41**	.04	.06	.02	.03	.03	-.01
2.EM-H	8.04	1.64	-.57	-.58		.19*	.16	.24**	.22*	.20*	-.09
3.Academic success	26.48	6.22	-.17	-.67			.75**	.93**	.90**	.97**	-77**
4.Impulse control	11.85	2.19	-.51	.01				.72**	.69**	.73**	-64**
5.Academic Production	46.56	9.69	-.58	.00					.94**	.93**	-77**
6.Math	7.45	2.14	-.62	-.29						.93**	-73**
7.Reading	11.13	3.03	-.31	-.70							-74**
8.WM-Diff	10.06	10.94	-90	-.26							-.79**

Note. *p<.05; **p<.01

Analysis of differences according to gender, school grade and social status

A factorial ANOVA was carried out, introducing gender, school grade and social status of the participants as fixed factors, and emotion regulation strategies, WM-diff and AP as dependent variables. A main effect of grade on WM-diff was observed (F(2)=6.14; p<.01) and on AP (F(2)=5.01; p<.01). No main or interaction effects were observed for the rest of the factors and none of the factors affected the emotion regulation strategies. Descriptive statistics show differences between means of each grade in WM-diff (fourth grade: M=6.70; SD=9.2; fifth

grade: *M*=8.66; *SD*=9.40; sixth grade: *M*=15.51; *SD*=12.62) and in AP (fourth grade: *M*=90.98; *SD*=15.49; fifth grade: *M*=87.11; *SD*=14.39; sixth grade: *M*=75.62; *SD*=19.43).

Relationship of emotion regulation and WM with AP: multiple linear regression

Compliance with assumptions was analyzed in the regression models. Durbin-Watson statistic showed in all cases values between 1.70 and 1.89 (independence). The scatterplots of the standardized residuals and the standardized predicted values did not show association patterns (homoscedasticity). Residuals were normally distributed (*M*= 0.00; *SD*= 1.00, in all models) and both the histogram and the normal probability plot showed a distribution close to normal (normality). The partial graphs showed point clouds close to the line (although in the case of the CR-H the residuals move away relatively from the line) (partial fulfillment of the linearity assumption). Finally, Tolerance values were between .80 and .99 and VIF values were between 1.01 and 1.20, no autovalues close to 0 were observed, all condition indices were less than 15 in all models and the proportion of variance explained for each dimension was large in only one coefficient per model (non-collinearity).

In the first model (see Table 2), school grade was entered as a control variable –due to the results of the factorial ANOVA– and emotion regulation strategies; and in the second, WM-diff was added as another control variable. In this way, the change in the explanatory capacity of both models can be observed. Although in the general model it increases, strategies decreases; but the association remains. The higher predictive capacity was that of WM-diff. Emotion regulation was only associated through EM-H with AP dimensions of productivity, mathematics and reading, and marginally with academic success. There were no association with impulse control.

Table 2
Multiple linear regression: relationship of emotion regulation strategies and WM-diff with AP

		Academic success ß	**Impulse control** ß	**Academic Productivity** ß	**Math** ß	**Reading** ß
Model 1		*F*(3)=7.48; *p*<.001 R^2=*.14*	*F*(3)=8.08; *p*<*.01*; R^2=.08	*F*(3)=6.61; *p*<.001 R^2=.12	*F*(3)=6.97; *p*<*.001*; R^2=.13	*F*(3)=7.09; *p*<*.001*; R^2=.13
	School grade	-.35***	-.29**	-.20**	-.31***	-.33***
	CR-H	.04	-.00	-.09	-.07	-.06
	EM-H	.17(*p*=.06)	.13	.25**	.21*	.19*
Model 2		*F*(4)=48.77, *p*<.001, R^2=.61	*F*(4)=22.48; *p*<.001, R^2=.42	*F*(4)=48.99, *p*<.001, R^2=.61	*F*(4)=38.75, *p*<.001, R^2=.55	*F*(4)=41.21, *p*<.001, R^2=.57
	School grade	-.13*	-.10	-.05	-.11	-.12*
	WM-diff	-.72***	-.60***	-.73***	-.68***	-.69***
	CR-H	-.02	.01	-.07	-.05	-.04
	EM-H	.11(*p*=.06)	.09	.20**	.16*	.14*

*Notes***p*<.05; ***p*<.01; ****p*<.001. In all cases, adjusted R^2 is reported.

Discussion

The objective of this study was to analyze the explanatory capacity of the emotion regulation strategies CR-H and EM-H on AP, controlling for WM-diff in children who are in the last years of primary schooling. The results showed that EM-H was associated with success (marginally) and academic productivity dimensions and the areas of math and reading, even when WM-diff was introduced as a control variable. No significant associations were observed between CR-H and AP, or of any of the strategies on the impulse control dimension of AP.

Regarding the association between EM-H and AP, our results are similar to those obtained by other studies. Xu et al. (2015, 2016) found relationships between EM-H and performance on standardized math tests in adolescents of 13 and 15 years old. EM-H is characterized by the ability to modify thoughts about one's own abilities to achieve an impact on emotion (Xu, 2016). It is possible that when faced with the negative emotions generated by school assignments, children who consider themselves capable of solving them and think that it is important to remain calm, are in a better position to persist and complete them. Although the associations are relatively low, it is possible that these children are perceived by their teachers as having greater academic success and productivity; that is, with higher quality productions, as well as with a repertoire of behaviors that leads to achieving such higher quality. Regarding the association with mathematics and reading, it is possible that children who regulate their emotions in assignments from these specific areas are also perceived by their teachers as having greater command of them.

These associations between EM-H and different domains of AP were found even when WM-diff was incorporated; which allows the analysis of the predictive capacity of the EM-H to be more precise. In fact, in relation to the association between WM-diff and AP, results show that WM-diff are consistently associated with the different dimensions of AP. This is in line with evidence showing that working memory plays a key role in AP. Although the working memory measure used is a reporting measure, recent studies indicate that the measurement of WM-diff through questionnaires shows associations with AP tasks (e.g., Vernucci et al., 2020). Although the highest explanatory percentage of AP dimensions was achieved by WM-diff, EM-H kept having predictive power, which would indicate that emotion regulation has a unique contribution to AP beyond other theoretically related variables such as executive functions. In this sense, our results are similar to those found by LaFavor (2012).

Regarding the absence of significant associations between CR-H and AP, our results are similar to those by Xu et al. (2015, 2016), who obtained associations of EM-H with standardized math tests, but not of CR-H. Thinking positively about one’s own coping skills may have greater benefits than thinking about the situation itself in more optimistic terms. In this sense, the favorable academic self-concept -understood as the perceptions of oneself in the school domain- has positive relationships with AP (e.g., Peralta Sánchez & Sánchez Roda, 2003). In relation to CR-H, it may be posible that the reinterpretation of the “duty” to solve homework as an opportunity for learning does not have an impact on the degree of permanence and the tendency to complete them. The study by Davis and Levine (2013) found that the implementation of cognitive reappraisal improved the recall of educational material in primary school children. In this study, children were instructed and trained for its effective implementation, so it could be that the self-reported frequency of its spontaneous use does not reflect associations with AP.

Regarding the relationship between strategies and impulse control, we expected a positive association, since the ability to reinterpret one's own skills and the situation in more positive terms should favor the adherence to the task and a decrease in behaviors such as abandonment, fast realization, little detail, etc. However, we have not found an association. It is possible that other variables such as WM-diff and others that were not considered in this study explain impulse control in academic situations. It could even happen that other emotion

regulation processes have greater predictive power and that the strategies that were considered are too specific.

Among the limitations of this work it is possible to mention, on the one hand, the use of a cross-sectional design. This does not allow discarding bidirectional relationships between variables. However, other similar studies have models with the same directionality as ours, which provides greater validity to the results. On the other hand, the exclusive nature of self-report and single informant (i.e., teachers) to evaluate WM-diff and AP should also be mentioned. This methodology is vulnerable to response biases and the greater common variance between the variables (see Duckworth & Yeager, 2015). However, from 9 years of age children are highly capable of reporting their own emotional states (Rydell, Thorell & Bohlin, 2007), and it has been indicated that reports from teachers provide broad and representative information of AP, complementary to that of performance tasks (Graziano et al., 2007). In addition, although WM-diff and AP were reported by teachers, the emotion regulation strategies were reported by the children themselves, which provides greater validity to the associations that were found. Third, the reliability of the instrument for evaluating emotion regulation strategies was relatively low. However, responses given by children are usually more unstable than those offered by adults, therefore correlations of .30 can be considered with explanatory value (e.g. Mischel, Zeiss & Zeiss, 1974). Finally, the sample size is limited and its selection was intentional, which hinders the generalizability of the results. However, other studies in children and adolescents found similar relationships to ours.

Future studies could gain precision by conducting longitudinal studies, with more representative samples and including performance measures and/or multiple informants. Especially, incorporating other executive functions as control variables. For example, inhibition and cognitive flexibility have been indicated as predictors of both AP and emotion regulation (e.g., Aran-Filippetti & López, 2014; Schmeichel & Tang, 2013, 2015). The incorporation of other emotion regulation processes would allow us to know the differential contribution of each one on AP, which would expand the knowledge of the role of emotion regulation in learning.

Conclusions

Despite the limitations, these results represent a contribution by showing that the regulation of the specific emotion of school homework plays a role in the explanation of AP, in a child population that has been hardly studied. Especially, those children who perceived themselves with a higher EM-H ability were evaluated by their teachers as having greater academic success and productivity, as well as higher performance in reading and math. This association was even maintained when cognitive functions strongly involved in both variables were controlled (i.e., WM-diff). Completing school homework is an important AP predictor (Cooper et al., 2006), so regulating the negative emotions that they produce has a positive impact on it. In this sense, these results could constitute resources for the content of programs to promote emotion regulation in school contexts.

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