

## Role of emotional and social information processing factors in social behavior: a developmental perspective

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### Abstract

This study examines the structural relations between social behavior, social information processing (SIP), emotionality and emotional regulation among children from Córdoba (Argentina). Six hundred and twenty-three children aged 3, 5 and 7 years, as well as their parents and teachers, participated in the study. A reduced model offered the best fit to the data, which excluded the emotional variables of positive valence. Overall, a better social performance was predicted by lower levels of negative emotionality, a better ability to regulate negative emotions, and a better ability to process social information. The different steps of SIP proved to be significant mediators. Additionally, it was observed that the structural configuration of the variables showed noticeable peculiarities according to the period of development considered.

**Keywords:** social adjustment; cognition; emotions; child development.

### Resumo

*Papel de fatores emocionais e processamento da informação social no comportamento social: uma perspectiva do desenvolvimento.* Este estudo examina as relações estruturais entre o comportamento social, o processamento da informação social (SIP), a emocionalidade e regulação emocional em crianças de Córdoba (Argentina). Participaram no estudo 623 crianças de 3, 5 e 7 anos, seus pais e professoras. Um modelo reduzido ofereceu o melhor ajuste dos dados, o que excluiu as variáveis emocionais de valência positiva. Em geral, um melhor desempenho social foi predito por níveis mais baixos de emocionalidade negativa, uma melhor habilidade de regular emoções negativas e uma habilidade melhor para processar a informação social. Os diferentes passos do SIP mostraram ser mediadores significativos. Além disso, observou-se que a configuração estrutural das variáveis apresentou peculiaridades notáveis de acordo com o período evolutivo considerado.

**Palavras-chave:** ajustamento social; cognição; emoções; desenvolvimento infantil.

### Resumen

*Rol de factores emocionales y procesamiento de la información social en el comportamiento social: una perspectiva del desarrollo.* Este estudio examina las relaciones estructurales entre el comportamiento social, el procesamiento de la información social (SIP), la emocionalidad y regulación emocional en niños de Córdoba (Argentina). Participaron 623 niños de 3, 5 y 7 años, sus padres y maestras. Un modelo reducido ofreció el mejor ajuste de los datos, el cual excluía las variables emocionales de valencia positiva. En general, un mejor desempeño social fue predicho por niveles más bajos de emocionalidad negativa, una mejor habilidad para regular emociones negativas y una mejor habilidad para procesar información social. Los distintos pasos del SIP mostraron ser mediadores significativos. Además, se observó que la configuración estructural de las variables mostraba notables particularidades según el período evolutivo considerado.

**Palabras clave:** ajuste social; cognición; emociones; desarrollo infantil.

Several theories offer explanations about why children have difficulties when interacting with peers or why they have behavioral problems. Particularly, theories of social cognition in childhood emphasize complex relationships between cognitive and interpersonal functioning. Within that framework, the models of social information processing (SIP) offer explanations about the relationship between cognition and behavior throughout development (Crick & Dodge, 1994; Lemerise & Arsenio, 2000). The idea behind those models is that people understand and interpret social situations differentially, and that those differences, along with past experiences and biological factors, influence current behavior. The SIP model allows us to decompose complex processes into specific types of cognitions which are easier to assess. As noted by Coccaro, Noblett and McCloskey (2009), it is valuable for the integration of social, cognitive and behavioral domains to explain patterns of responses, and the feasibility of empirical analysis. Overall, it is assumed that skillful processing in the different steps of SIP results in a competent social performance, while a non-skillful, or biased processing leads to problem behavior (Crick & Dodge, 1996).

Based on the model of Crick and Dodge (1994), Lemerise and Arsenio (2000) proposed an integrative model of SIP which emphasizes both emotional and cognitive aspects. They hypothesize that individual differences in emotionality and emotion regulation can influence each step of SIP, and assume that the manipulation of emotional signals might affect the different stages of SIP, with singular effects of different discrete emotions. Several studies show that individuals differ in the intensity of the experience and the expression of their emotions, and those differences are, in turn, related to social competence (Burks, Laird, Dodge, Pettit, & Bates, 1999). Children face social situations with certain mood, which may or may not be related to the situation. At the same time, they differ in the way they regulate their emotions, those who regulate their emotions inadequately are at high risk of manifesting problems of social maladjustment (Eisenberg et al., 1996). From this model it is hypothesized that those who poorly regulate their emotions will have SIP patterns associated with more aggressive behaviors. Studies addressing the relationship between emotional and cognitive processes from an integrative framework are scarce. Thus, this study aims at advancing the understanding of structural relationships between such processes, based on the model proposed by Lemerise and Arsenio (2000, see the original paper for a full explanation of the model).

Numerous studies give an account of the relationship between SIP patterns and social maladjustment; especially aggressive behavior problems have received more attention (Dodge, 2010). Aggressive children seem to stick to fewer social standards, showing hostile signals bias (Dodge, 1993; Dodge, Pettit, McClaskey, & Brown, 1986). A comprehensive meta-analytic review has shown that the relationship between hostile attribution bias and aggressive behavior is observed at different ages, and demographic and cultural backgrounds (Orobio de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002). In addition, some studies suggest that children who report feeling anger toward a provocateur tend to attribute hostile intention, and will respond aggressively, or at least more negatively, than peers who do not feel anger toward the provocateur (Orobio de Castro, Bosch, Veerman, & Koops, 2003). Another association with strong empirical support is the one between the generation of aggressive responses and aggressive behavior, which has been observed since the age of four years (Dodge, 2010). Aggressive children generate few responses, which are mainly aggressive responses and, to a lesser extent, socially competent responses (Schultz, Ambike, et al., 2010). Although the association between poor SIP skills and aggressive behavior seems unquestionable, much research leads to moderate such a claim (Fontaine, Yang, Dodge, Pettit, & Bates, 2009). For instance, according to Godleski and Ostrov (2010) that relationship seems to vary depending on the type of aggression examined. In fact, a recent meta-analytic review has revealed that the relation between hostile intent attribution and aggression depends on the level of emotional engagement, highlighting the relevance of considering specific moderators (Verhoef, Alsem, Verhulp, & Orobio de Castro, 2019).

Regarding SIP and social competence, one of the earliest studies was conducted by Dodge et al. (1986), who observed that different steps of SIP predicted social competence and success with peers in children from kindergarten through fourth grade. In a subsequent study with children of first, second and third grade, Dodge and Price (1994) found that patterns of SIP correlated with social competence assessed by teachers and peers, the SIP patterns of older children being more sophisticated. In the same vein, Teague (2005) found that preschool children who showed better SIP skills were also characterized by greater social competence and fewer behavioral problems.

Child development researchers admit the essential role of temperament and emotional processes in

the emergence of adaptive and non-adaptive behaviors. In this context, the contributions of Eisenberg and her workgroup are highlighted; those studies have led to progress in understanding the interaction between emotionality and regulatory capacity and their effects on social performance in preschool and school children, at both transversal and longitudinal levels (Eisenberg, Fabes, Guthrie, & Reiser, 2000). Generally, children who are characterized by high levels of emotionality (especially negative emotions) and, in turn, employ less constructive regulation strategies are evaluated as less skilled in social terms; however, if they have good regulatory strategies are evaluated as socially skilled (Eisenberg, Spinrad, & Eggum, 2010). Another prominent group of researchers is led by Susanne Denham, who has provided evidence about the relationship between different aspects of emotional competence and social behavior. For example, Denham et al. (2003) found that emotional competence at three and four years old not only contributed to the explanation of social competence concurrently, but also predicted the social competence at five years old.

The study of positive emotions in predicting social behavior has increased during last years. Rydell, Berlin and Bohlin (2003) observed that a propensity toward anger was associated with externalizing behavior problems and poor regulation of fear and with internalizing behavior problems in children aged 5 to 8 years; and that poor regulation of positive emotions was associated with low levels of prosocial behavior and high levels of externalization of behavior problems. Similar findings were observed in later studies with children of 8 and 9 years (Rydell, Thorell, & Bohlin, 2007).

Studies addressing the relationship between emotion, cognition and behavior deserve special mention, which generally rely on the model of Lemerise and Arsenio (2000). Lemerise, Gregory and Fredstrom (2005) evaluated the impact of emotion exhibited by an individual on the SIP in school age children with different levels of social adjustment, observing a negative relationship between SIP and age. Moreover, those who had a worse social adjustment showed a poorer ability of SIP. At the same time, Orobio de Castro, Merk, Koops, Veerman and Bosch (2005) found that aggressive children from 7 to 13 years attributed more happiness and hostile intentions, and less guilt than non-aggressive children, in turn, they reported more anger, mentioned less adaptive emotion regulation strategies, generated more aggressive responses and evaluated aggressive responses less negatively than the comparison group.

Helmsen, Koglin and Petermann (2012) reported that preschool children with non-adaptive emotional regulation skills generated more aggressive responses, and they assessed aggression as positive in a SIP task. Moreover, aggressive behavior was associated with non-adaptive emotional regulation and also with biases in some steps of SIP, but there were no associations between hostile attribution of intention and aggressive behavior. However, mediation analysis showed that the association between non-adaptive regulation and aggressive behavior was direct and it was not mediated by biases in the SIP. As the authors point out, it may indicate that strong emotions can derail cognitive processing, which is recognized as preemptive processing. Nevertheless, it is stressed that the measure of emotional regulation consists in a traditional measure of temperament, a strategy used by other researchers.

As it has been noted, emotional and cognitive processes have been particularly related to social competence and behavior problems. Although different studies indicate strong and inverse relationships between those components of social behavior three possible directions have been identified: a) Social competence influences behavior problems: those who lack social skills generally have fewer positive interactions and show more problems of internalization and externalization (e.g., Cole, Martin, Powers, & Truglio, 1996; Rubin et al., 2006). This option is the one that has received more support, including longitudinal studies with cascade models of development (Bornstein, Hahn, & Haynes, 2010; Obradović, Burt, & Masten, 2010). b) Behavior problems affecting the development of social competence (Masten, Burt, & Coatsworth, 2006): results have been inconsistent in this respect over the years, and according to gender and the social competence indicator considered (Cole et al., 1996). c) Social competence acts as a connector between internalizing and externalizing problems: it is the least strong option (Kiesner, 2002).

Even though at early ages the association between SIP and social behavior is questionable, further studies are required to examine the relations between emotional, cognitive and social processes due to the importance of early intervention to prevent future undesirable behavior. In that sense, this study was undertaken to examine structural relations between emotional, cognitive and social behavior variables in a development framework.

### **Hypotheses**

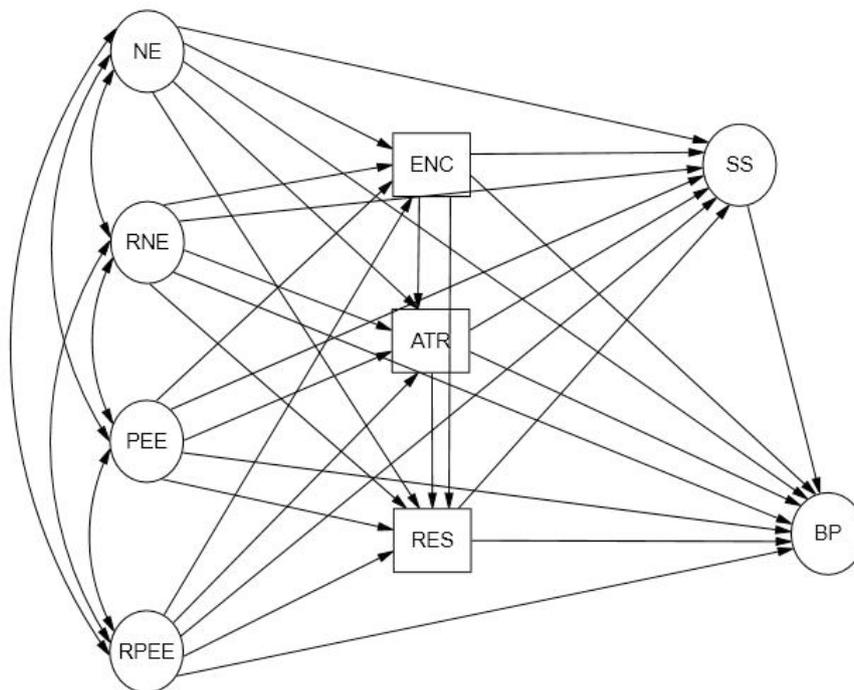
Starting from the theoretical model of Lemerise and Arsenio (2000), and considering the above

precedents, we assessed the relationship between emotionality, regulation of emotion, SIP and social behavior in children from 3 to 7 years old. Considering changes in the analyzed processes that occur at early stages of development, it was expected that relationships between variables are expressed in a particular way at different age periods.

First, a model A comprising emotional variables, different steps of SIP and social behavior was proposed (Figure 1). It was hypothesized that high levels of negative emotionality have a negative impact on different steps of SIP (Hypothesis 1) and social skills (Hypothesis 2), and it is positively related to behavior problems (Hypothesis 3) (Eisenberg, Liew, & Pidada, 2004; Rydell et al., 2003). Findings on positive emotionality are scarce, its effects on social behavior not being clear yet (Daugherty & Klein, 2010; Rydell et al., 2003, 2007). Therefore, although the effects of positive emotionality on the SIP and social behavior were explored, the directionality was not hypothesized. Furthermore, it was hypothesized that high levels of emotional regulation (with respect to positive and negative emotions) have a positive impact on different steps of SIP (Hypothesis 4) and social skills (Hypothesis 5), and they negatively

affect behavior problems (Hypothesis 6) (Denham et al., 2003; Rydell et al., 2003, 2007). It was also assumed that a better performance in different steps of SIP is positively related to social skills (Hypothesis 7) (Schultz, Ambike, et al., 2010; Teague, 2005), and negatively to behavior problems (Hypothesis 8) (Dodge, 2010; Orobio de Castro et al., 2002; Schultz, Izard, Sapleton, Buckingham-Howes, & Bear, 2010). Likewise, considering the proposal of Lemerise and Arsenio (2000), a mediating role of SIP (Hypothesis 9) was hypothesized with respect to relations between emotionality and emotion regulation with social skills and behavior problems, SIP being adversely affected by negative emotionality, and positively for emotional regulation.

Regarding relations between different dimensions of social behavior, a negative effect of social skills on problem behaviors was hypothesized (Hypothesis 10) (Bornstein et al., 2010, Cole et al., 1996; Rubin et al., 2006). Also an inverse directionality between them was considered, as noted by some researchers (Masten et al., 2006). Additionally, taking into account the scarce knowledge revealed by literature about positive emotions in relation to cognitive and social performance, a model B was proposed excluding such variables.



**Figure 1.** A-Model (Age Variable Which Affects Endogenous Variables and Covaries with Exogenous Variables Is Not Shown). SS = Social Skills; BP = Behavioral Problems; ENC = Encoding of Social and Emotional Cues; ATR = Attribution Of Intention; RES = Problem Solving; NE = Negative Emotionality; RNE = Regulation Of Negative Emotions; PEE = Positive Emotions/Exuberance; RPEE = Regulation Of Positive Emotions/Exuberance.

## Method

### Participants

Participants were 623 children aged 3 (33.39%), 5 (33.87%) and 7 years (32.74%), from public and private educational institutions from Cordoba (Argentina), who were non-randomly selected due to feasibility; also, their parents (95% mothers) and teachers. The children attended public and private institutions, being seven primary schools (five public) and six kindergartens (four public). The sample included children from different socio-economic status (SES): 38.52% marginal and low, 18.78% lower middle, 29.37% middle and upper middle, and 13.32% high.

### Measures

*Socio-economic background.* Through a structured questionnaire applied to parents it was collected information on different aspects: proportion of household contributors, education level, occupation and health coverage (Comisión de Enlace Institucional, AAM-SAIMO-CEIM, 2006).

*Social behavior.* It was used an abbreviated version of the Preschool and Kindergarten Behavior Scales developed by Merrell (2003) and previously adapted to the local context (Authors). This instrument allows evaluating social skills (SS) and behavior problems (BP) in children from 3 to 7 year olds through the report of teachers and parents. The evaluation of child's behavior is done based on a 4-point Likert scale. Items are added to obtain a raw score for each subscale and total scale. Higher scores on the total scale or subscales of SS indicate a better social performance; on the contrary, a higher score in BP indicates negative social behaviors. Internal consistency (Cronbach's  $\alpha$ ) in this study was: .93 total scale SS, .86 Cooperation, .86 Interaction, .84 Independence; .95 total scale BP, .95 Externalizing, .86 Internalizing.

*Emotional Processes.* The Emotional Questionnaire proposed by Rydell et al. (2003) was used. It assesses emotionality and emotion regulation regarding four emotions: anger, fear, sadness and positive emotions/exuberance. Emotionality is assessed with respect to frequency and intensity of the reactions, whereas emotional regulation is assessed in relation to the self-regulatory capacity of child and with help from others. Items are scored on a 5-point Likert scale. In this study only anger, sadness and positive emotions/exuberance scales were used. The questionnaire

was submitted to a back translation thereof. Then, a pilot study was carried out in order to check cultural adequacy, semantic clarity and grammatical issues. Thirty-five parents of children aged 3 to 7 years participated. After that, a final version was defined with minor changes. Exploratory analysis of emotionality and emotional regulation scales indicated bi-dimensional structures (these results are available upon request). Internal consistency assessed by Cronbach's  $\alpha$  index was .86 Negative Emotionality (NE), and .73 Positive Emotionality/Exuberance (PEE); and .95 Regulation of Negative Emotions (RNE), .96 Regulation of Positive Emotions/Exuberance (RPEE). Items in each scale were aggregated to obtain a raw total score; a higher value indicates a higher level of the attribute measured.

*Social Information Processing.* a) Elaboration. Vignettes were constructed based on traditional tests for evaluating SIP incorporating emotional components (Lemerise et al., 2005). A pilot study with 40 children aged 3 to 7 years was developed with the aim of evaluating cultural adequacy of the stories, and the response of young children through additional graphic support. Vignettes showed situations of social interaction between children with different emotional expression of the provocateur: anger, joy and sadness. In addition, vignettes were created to assess the evaluation by the child of aggressive, passive and competent answers. The 25.68% of the protocols were assessed by two evaluators; Cohen's  $\kappa$  was .94 to 1 for the different aspects evaluated. For all questions, a verbal response as pointing a face on a graphic support was considered valid. b) Evaluated aspects. The following steps were evaluated: encoding of social cues, encoding of emotional cues of the provocateur, attribution of intention of the provocateur and problem solving. In groups of 5- and 7-year-olds was also examined the evaluation of responses. Due to the statistical method used and to facilitate comparisons among groups it was decided not include this step in this study. c) Overall score. It was computed a score for each step of SIP but without discriminating on the story. A higher score in each step denotes a better performance. Questions and scores can be found in the supplemental file.

*Design and procedure.* It was employed a cross-sectional design. Parents completed questionnaires on socio-demographic and emotional processes of children during school hours in small groups. Prior to the evaluation of SIP skills, there was a period of familiarization with the principal investigator or research assistants.

The child assessment comprised an individual session which took place at school or kindergarten. Teachers filled out questionnaires about social behavior of children.

**Ethical issues.** We followed the ethical guidelines of the American Psychological Association (APA, 2002). Participation was voluntary, objectives of the study and the anonymity and confidentiality of information provided were previously communicated. Only children with parental consent were invited to participate.

### Data Analysis

Structural equation modeling (SEM) partially latent (Kline, 2010) were developed as steps of SIP were conceived as observed variables. Models were analyzed following steps proposed by Kline (2010). The inspection of data showed the existence of outliers, which were removed after an analysis of their influence, so the sample consisted of 577 cases. All models were estimated using the maximum likelihood method. SEM were developed in two stages. First, confirmatory factor analysis (CFA) were conducted for each one of the latent variables. Then, item parceling was applied with the goal of optimizing the measurement model. Following Little, Cunningham, Shahar and Widaman (2002), a domain representation approach for the parceling was chosen. Second, structural relationships were examined using several criteria to assess the fit of the data to the model:  $\chi^2$ ,  $\chi^2/df$  ( $< 3$  indicates a good fit), Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) ( $> .90$  indicate an acceptable fit), and root mean square error of approximation (RMSEA) ( $< .05$  indicates a good fit). In the presence of non-significant paths the model was re-specified. Total, direct and indirect effects were analyzed using a bootstrapping method. Since the requirement of normality was accomplished, it was used a parametric sampling: 1000 random samples were generated to estimate confidence intervals (CI corrected to 95%) and associated probability values. Specific indirect effects were examined using the phantom model method proposed by Macho and Ledermann (2011). Additionally, it was evaluated a B-model which excluded variables of positive emotions. That exclusion has its correlate in the limited knowledge revealed by the literature on positive emotions in relation to cognitive and social performance. That model was employed to examine structural relations in the different age groups. Structural models were markedly different depending on the age of children; hence it was not possible to assess the moderating role of age directly through multi-group comparisons.

## Results

### Confirmatory Factor Analysis and Item Parceling

In general, the structure of latent variables in the model was confirmed. However, mainly for behavioral variables, the  $\chi^2$  statistic was significant. Upon inspection of standardized residuals, modification indices and expected parameter change values, the covariances between errors of observed variables were allowed, but it was not enough to reduce the discrepancy. However, other indicators pointed to a proper fit. In addition, standardized regression coefficients were evaluated. Positive Emotionality/Exuberance showed lower values, probably due to the reduced number of indicators. Results can be consulted at the supplemental file.

### Structural Equation Modeling

Table 1 shows the fit indicators for all measurement and structural models. Table 2 presents the total standardized effects and Figures 2A to 2D show the direct standardized effects. In all cases, non-significant paths were eliminated. The model A for the full sample explained 64% of variation in Behavioral Problems (BP), 69% of Social Skills (SS), 52% of encoding of social and emotional cues, 21% of attribution of intention, and 34% problem resolution. As an additional step, it was evaluated an alternative model involving an opposite directionality between SS and BP, model named Equivalent model A. The final adjustment of the Equivalent model A was acceptable, with overall indices very similar to model A, but with fewer significant paths. The model A presented a lower value of AIC (511.238) compared to the Equivalent model A (527.673). Based on that, but mainly due to the increased theoretical and empirical support for the directionality manifested in the model A (Hypothesis 10), it was chosen analyzes only the direction SS→BP in the following models.

Finally, it was considered the model B excluding the variables related to positive emotions. The difference between the values of  $\chi^2$  of the models A and B was significant ( $\Delta\chi^2(117) = 237.716, p < .001$ ). Also, as expected due to the reduction of parameters, the AIC for the model B was considerably lower (227.522). Thus, the model B, stronger in theoretical terms, while simplest, was used to evaluate the moderating effects of age. Previously, it was examined in more detail this model with the total sample. The model B explained 64% of variation in BP, 68% of SS, 51% of encoding of social and emotional cues, 19% of attribution of intention, and 34% of problem

resolution. The results involving the variable Negative Emotionality largely supported the proposed hypotheses (Hypothesis 1, 2, 3). Higher levels of NE was associated with increased hostile attribution of intention, and less competent responses in the task of SIP, and in turn, lower levels of SS and higher BP indirectly, especially through SS and problem solving. There were no predictive effects on cues decoding. By contrast, a higher level of Regulation of Negative Emotions predicted better performance in the SIP (Hypothesis 4), particularly, better encoding of social and emotional cues, and less hostile intention attributions. Although there was not a direct effect on problem solving (Hypothesis 6), there were indirect effects on it

through initial steps of SIP (Hypothesis 9). At the same time, RNE predicted best SS and less BP directly and indirectly (Hypothesis 5, 6, 9). First steps of SIP predicted last steps, and all predicted social behavior (Hypothesis 7, 9), although each of them in particular ways. Best SS were predicted by a better performance in decoding cues, attribution of intention and problem solving, through direct and indirect effects. In contrast, higher levels of BP were directly predicted by poorer performance on attribution of intention and problem solving, and also through indirect paths; while decoding only had indirect effects (Hypothesis 8, 9). Finally, it was observed that best SS predicted lower levels of BP (Hypothesis 10).

**Table 1.** Summary of Structural Equation Models Predicting Social Behavior

Model	N	$\chi^2$	df	p	$\chi^2/df$	TLI	CFI	RMSEA (90% IC)
Full sample	577							
Measurement model		262.20	137	.001	1.91	.99	.99	.04 (.03-.05)
A-model <sup>†</sup>		363.24	202	.001	1.80	.98	.99	.04 (.03-.04)
Equivalent A-model <sup>†</sup>		387.67	206	.001	1.88	.98	.99	.04 (.03-.05)
B-model <sup>†</sup>		125.52	85	.003	1.48	.99	.99	.03 (.02-.04)
3-year-olds	195							
Measurement model		50.76	48	.365	1.06	.99	.99	.02 (.0-.05)
B-model <sup>†</sup>		43.06	45	.555	.96	1	1	.0 (.0-.05)
5-year-olds	196							
Measurement model		54.30	48	.247	1.13	.99	.99	.03 (.0-.06)
B-model <sup>†</sup>		87.43	81	.293	1.08	1	1	.02 (.0-.06)
7-year-olds	186							
Measurement model		67.89	48	.031	1.41	.99	.99	.05 (.02-.07)
B-model <sup>†</sup>		101.04	80	.056	1.26	.99	.99	.04 (.00-.06)

Note. <sup>†</sup> Fit indicators after removing non-significant paths.

The model B examined in the sample of children aged 3 years revealed some particularities (Figure 2B). Negative Emotionality covaried significantly with Regulation; however, relations with endogenous variables were not significant, so it was excluded from the model. The model B explained 47% of variance in BP, 42% of SS, 24% of encoding of social and emotional cues, 28% of attribution of intention, and 48% of problem resolution. High level of Regulation of Negative Emotions predicted a better performance in the different steps of SIP (Hypothesis 4): improved decoding cues, less hostile intention attributions, and more competent responses. At the same time, RNE was associated with better SS and less BP directly, and also by indirect ways (Hypothesis 5, 6, 9). Initial steps of SIP

predicted subsequent steps. As expected, SIP influenced both SS and BP, although not all steps of SIP maintained statistically significant relations with variables of social behavior (Hypothesis 7, 8). A better decoding cues and less hostile intention attributions were directly related with better SS and also through indirect ways, and they were only indirectly related with less BP. Whereas the increased generation of competent responses directly predicted lower levels of BP, but no influenced SS. Finally, higher levels of SS predicted fewer behavior problems (Hypothesis 10). The model B analyzed in the sample of children aged 5 years showed that the paths toward attribution of intention were not significant, but that variable served as predictor in the model, so it resulted in an exogenous variable and it was allowed

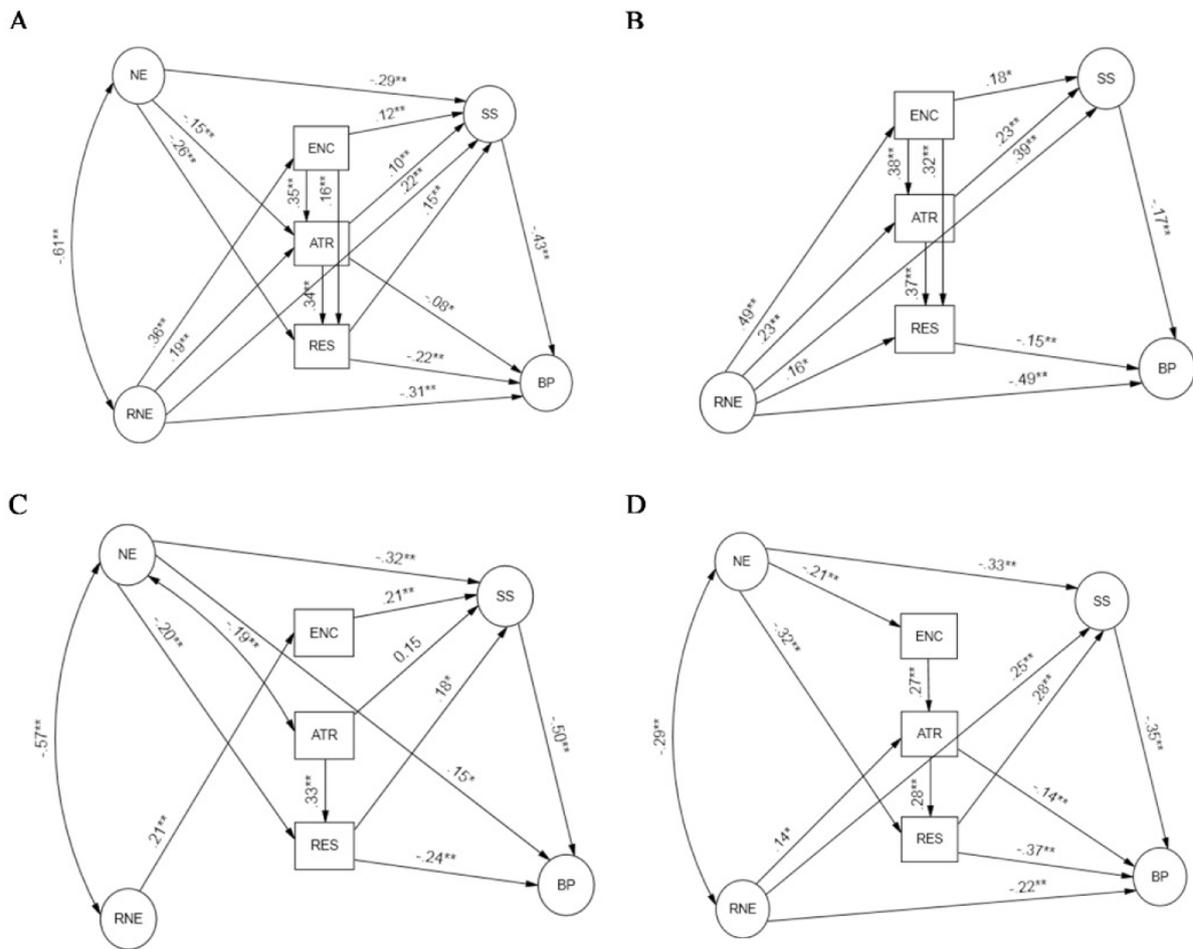
to covary with emotional variables (Figure 2C). The model B explained 50% of variance in BP, 29% of SS, 5% of encoding of social and emotional cues, and 18% of problem resolution. Higher levels of Negative Emotionality were related to less generation of competent responses (Hypothesis 1), and it was directly related with lower levels of SS (Hypothesis 2) and higher BC (Hypothesis 3), also maintaining indirect relations (Hypothesis 9). In the opposite way, a higher level of Regulation of Negative Emotions predicted better decoding cues (Hypothesis 4) and, through it, showed to be related

with better SS and less BP (Hypothesis 9). With regard to SIP steps, only the relation between attribution of intention and problem resolution resulted significant. Moreover, a better performance in decoding cues, attribution of intention and problem solving predicted better SS (Hypothesis 7); and more generation of competent responses predicted lower levels of BP (Hypothesis 8), whereas previous SIP steps made it through indirect ways (Hypothesis 9). Finally, it was observed that better SS predicted lower levels of BP (Hypothesis 10).

**Table 2.** Total Standardized Effects for the Models Predicting Social Behavior (Based on B-Model)

Effect	Total sample	3-year-olds	5-year-olds	7-year-olds
<i>Negative Emotionality</i>				
→ ENC				-.21**
→ ATR	-.15**			-.06**
→ RES	-.32**		-.20**	-.34**
→ SS	-.35**		-.35**	-.42**
→ BP	.23**		.38**	.28**
<i>Regulation of Negative Emotions</i>				
→ ENC	.36**	.49**	.21**	
→ ATR	.32**	.42**		.14*
→ RES	.17**	.47**		.04*
→ SS	.32**	.58**	.05**	.26**
→ BP	-.52**	-.65**	-.02**	-.35**
<i>SIP - Encoding of Social and Emotional Cues</i>				
→ ATR	.35**	.38**		.27**
→ RES	.28**	.46**		.08**
→ SS	.20**	.27**	.21**	.02**
→ BP	-.18**	-.11**	-.11**	-.07**
<i>SIP - Attribution of Intention</i>				
→ RES	.34**	.37**	.33**	.28**
→ SS	.15**	.23**	.21**	.08**
→ BP	-.22**	-.09**	-.19**	-.27**
<i>SIP - Problem Solving</i>				
→ SS	.15**		.18*	.28**
→ BP	-.29**	-.15*	-.33**	-.46**
<i>Social Skills</i>				
→ BP	-.43**	-.17*	-.50**	-.35**
<i>Age</i>				
→ ENC	.45**			
→ ATR	-.14**			
→ RES	.03 <sup>ns</sup>			
→ SS	.27**			
→ BP	.001 <sup>ns</sup>			

Note. SS = social skills; BP = behavioral problems; SIP = social information processing; ENC = encoding of social and emotional cues; ATR = attribution of intention; RES = problem solving. N = 577, 195, 196 and 186, total sample, 3- 5- and 7-year-olds, respectively. \*  $p < .05$ . \*\*  $p < .01$ .



**Figure 2.** B-Model for the full sample and different age periods (direct standardized effects). A. Full sample (age variable which affects endogenous variables and covaries with exogenous variables is not showed). B. Children 3-years-old. C. Children 5-years-old. D. Children 7-years-old. SS = social skills; BP = behavioral problems; ENC = encoding of social and emotional cues; ATR = attribution of intention; RES = problem solving; NE = negative emotionality; RNE = regulation of negative emotions.

\*  $p < .05$ . \*\*  $p < .01$ .

The model B assessed in the sample of children aged 7 years explained 57% of variance in BP, 38% of SS, 4% of encoding of social and emotional cues, 10% of attribution of intention, and 20% of problem resolution (Figure 2D). Higher levels of Negative Emotionality directly predicted worse abilities to decode cues and fewer competent responses, and also predicted a higher level of hostile intention attributions (Hypothesis 1). At the same time, higher levels of NE predicted directly lower SS (Hypothesis 2) and higher BP by indirect ways (Hypothesis 9). Conversely, better Regulation of Negative Emotions was related to a lower level of hostile intention attributions, and through it also

predicted an increased generation of competent responses (Hypothesis 4); and also predicted better SS and less BP directly and through indirect paths (Hypothesis 5, 6, 9). Regarding SIP steps, there were direct positive effects of decoding on attribution of intention and indirect on problem resolution. In addition, attribution of intention had a positive impact on problem resolution. An increased generation of competent responses was directly related to better SS (Hypothesis 7) and less BP (Hypothesis 8), and in turn, it served as mediator between initial SIP steps and social behavior (Hypothesis 9). Lastly, it was observed that better SS predicted lower BP (Hypothesis 10). Specifications on direct, indirect

and total effects for each model can be found in the supplemental file.

## Discussion

This study aimed at considering structural relations between social behavior, social information processing (SIP), emotionality and emotion regulation, based on the integrative model proposed by Lemerise and Arsenio (2000). While this model was proposed more than 15 years ago, few studies have evaluated it empirically using structural models and, as far as we know, none has comprised Latin American samples.

The model A, which included all variables, showed a weak predictive power of Positive Emotionality/Exuberance and Regulation of Positive Emotions/Exuberance. Based on that, and considering the limited knowledge on positive emotions in relation to cognitive and social functioning (Daugherty & Klein, 2010), we decided exclude those variables in the model B, which offered a better fit to the data. Moreover, we obtained evidence about the directionality from SS to BP (Hypothesis 10), in line with previous findings (Bornstein et al., 2010; Kiesner, 2002, Rubin et al., 2006).

The model B showed, as the model A, the impact of Negative Emotionality and Regulation of Negative Emotions on the SS (Hypothesis 2, 5) and BP (Hypothesis 3, 6), as noted in previous studies (Eisenberg et al., 2004; Rydell et al., 2003). Additionally, specific predictive relationships to and from the different SIP steps were identified (Hypothesis 1, 4, 7, 8). The SIP steps acquired a dominant mediating role (Hypothesis 9) as hypothesized by Lemerise and Arsenio (2000) and reported by some researchers (Lemerise et al., 2005; Orobio de Castro et al., 2005), even so they totally mediate the commonly observed effect of Negative Emotionality on BP.

Structural models were markedly different depending on age of children, thus making it impossible to assess the group invariance in a traditional way. In the structural configuration of model B evaluated with children of 3 years old, Negative Emotionality lost predictive power and was excluded. The percentages of explained variance of BP, SS and the encoding of social and emotional cues were lower than observed within the total sample, while they were higher in attribution of intention and problem-solving. In this sample it was possible to assess the impact of the Regulation of Negative Emotions on social behavior (Hypothesis 5, 6) in the preschool period such as previous investigations

have reported (Denham et al., 2003). It also provides evidence of the predictive role of different SIP steps on SS and BP (Hypothesis 7, 8), and the mediator role (Hypothesis 9) between the regulation of negative emotions and social behaviors in these early stages of development, a period which has been poorly studied (Schultz, Ambike, et al., 2010; Teague, 2005). Such as in older children, better performance in SS predicted less BP (Hypothesis 10), although the predictive strength was lower. The structure of relationships in this sample did not involve negative emotionality, which has been reported in other studies (Liew et al., 2004). These results contradict those found by Helmsen et al. (2012), who reported bivariate relationships between emotion regulation and some SIP steps and aggressive behavior in preschoolers, although SIP steps did not act as mediators. It is difficult to draw conclusions beyond what is exposed here, mainly due to differences in methodological and analytical terms.

The model B examined with children 5 years old showed that the explained variability of SIP steps was reduced; and the variance explained of SS in relation to previous models was also smaller, but the explained variability of BP was similar to the one in other age groups. Low percentages indicate that other factors may be influencing the development of these cognitive and behavioral processes that were not incorporated into this model. In this group, Negative Emotionality had a predictive role more important than the Regulation of Negative Emotions on social behavior. Beyond that, the results were in accordance with those reported by the literature regarding the negative effect of high levels of negative emotionality (Hypothesis 2, 3) and positive effect due to its regulation (through indirect ways) on social behavior (Eisenberg et al., 2010, Rydell et al., 2003). Furthermore, the different SIP steps contributed to the explanation of social behavior (Hypothesis 7, 8), also acting as mediators (Hypothesis 9) between emotional and behavioral processes, as it was assumed by Lemerise and Arsenio (2000). However, each step of SIP was not considered in relation with each other. Specifically, decoding cues was not linked with other steps; at the same time its variability was poorly explained, but it significantly contributed to the prediction of SS, and through it, to the BP. These results highlight the importance of understanding each steps of SIP in a unique way (Fontaine, 2010). As noted by some authors, capturing the nature of the decoding cues is not an easy task, especially due to the speed of the processing

(Horsley, Orobio de Castro, & Van den Schoot, 2010), a difficulty that maybe resulted the apparent disconnection of such step. Lastly, in relation to other age periods, in this group the stronger predictive relation between better SS and lower levels of BP (Hypothesis 10) was observed.

The evaluation of the model B with children of 7 years old showed that the explained variability in SIP steps was lower than that the one observed within the total sample and younger children, but similar to the one observed in children of 5 years old. The proportion of explained variance of SS and BP was similar to the observed with the total sample and children 5 years old. In this case, it was possible to appreciate the participation of Negative Emotionality (Hypothesis 2) and Regulation of Negative Emotions (Hypothesis 5, 6) on both dimensions of social behavior, with similar results to those reported in other studies (Rydell et al., 2007). Also, as reported by Lemerise and Arsenio (2000), both emotional processes impacted on SIP steps (Hypothesis 1, 4); and SIP was associated with SS and BP (Hypothesis 7, 8), although the effect was mainly through the step of problem resolution, unlike other studies that have pointed out outcomes from each SIP steps (Dodge et al., 2003). Moreover, the mediating role of SIP (Hypothesis 9) in the relationship between emotional processes and the different spheres of social behavior was evident. In this sample also emerged that better SS predict less BP (Hypothesis 10), with an intermediate magnitude in relation to children aged 3 and 5 years.

### **Limitations**

This work included a non-probabilistic accidental sampling. While efforts were made to count with children of both genders and different SES, no specific sampling methods were used for this purpose, thus limiting the extrapolation of results to the population.

The assessment methods used generate additional limitations. Teachers reported on social behavior of children and parents reported about emotional issues through questionnaires. On one hand, several studies point out that teachers have a relevant comparative experience to observe children at school (Canivez & Rains, 2002). On the other hand, parents have been considered good informants of child temperament (Rothbart & Goldsmith, 1985). However, the use of multiple sources of information would allow consider the child's performance in different contexts and thereby achieve a clearer and complete image. Additionally, the constraints of questionnaires and advantages

associated with other methods of assessment such as natural observation are highlighted, although that was not feasible for the current study.

Another limitation relates to the measurement level of SIP indicators, which limit the comprehension of SIP referred to different basic emotions displayed by the provocateur. Also, the graphical tool did not allow capturing the differential processing of several emotions, such as has been observed by other researchers (Lemerise et al., 2005). Lastly, it is emphasized that while graphics and audio-visual media are the most used ones, it remains unknown whether SIP patterns obtained by those methods can be generalized to real world situations (Keil & Price, 2009). As noted by Lemerise, Thorn and Costello (2017), the hypothetical situation commonly used to measure SIP excludes affective ties reducing its predictive validity, particularly for young children. Hence, it would be very fruitful to measure SIP when participants are involved in real situations.

Finally, it should be remarked that the correlational nature of the study limits the conclusions reached. It will be possible to advance on the understanding of causal relationships only if experimental designs are used, involving, for instance, analysis of baseline mood (Harper, Lemerise, & Caverly, 2010) and manipulation of stimulus (Lemerise et al., 2005). At the same time, as it has been noted by many authors, longitudinal studies are required to obtain a more complete picture of social and cognitive development. In this regard, developmental cascade models are highlighted (e.g., Bornstein et al., 2010).

### **Conclusions and future directions**

This research has contributed to the field of study of socio-cognitive and emotional development in Latin American children, and it has provided empirical evidence on the relationship assumed by the integrative SIP model proposed by Lemerise and Arsenio (2000), with special focus in different age periods.

This study aimed at clarifying the predictive role of cognitive and emotional processes with respect to SS and BP in global terms. Nevertheless, it is likely that there are differences when considering the dimensions that constitute each of those broad categories (see e.g., Castro, Cooke, Halberstadt, & Garrett-Peters, 2017; Samur, 2015; Stefan & Avram, 2017). Moreover, with regard to aggressive behavior, specific SIP biases have been observed in children characterized by relational or overt aggression (Crick & Werner, 1998). Additionally,

it could be interesting to incorporate a more discrete vision of emotions. For instance, Nozadi, Spinrad, Johnson and Eisenberg (2018) observed attentional biases toward angry and sad facial expressions in preschoolers, which in turn affected the social functioning.

Lemerise and Arsenio's model (2000) proposes to take into account other factors besides those incorporated herein, for example, the affective nature of social ties and empathic sensitivity. In that sense, the progress of some researchers in favor of articulating specific attachment relationships with SIP is highlighted (Dykas & Cassidy, 2011; Stefan & Avram, 2017; Ziv & Sorongon, 2011). Likewise, the modeling of other type of relations remains for future works. The SIP model of Crick and Dodge (1994), as well as the reformulation of Lemerise and Arsenio (2000), predict reciprocal relations between cognition and emotion affecting social behaviors and include peer evaluation and response.

Furthermore, aspects related to the cultural context are highlighted, mainly due to the dominance of American and European investigations which have been compared with the results of this study. As noted by Chen and French (2008), the cultural influence on children's social competence is a dynamic process, so it is essential to examine how child characteristics and socialization practices contribute to the processes of social interaction, manifested in a specific cultural context, a context that is subject to economic, political and social changes. In that sense, it is recommendable to recover the contributions of some researchers on cultural influences on social cognition (e.g., Hannover & Kühnen, 2009) in order to understand the peculiarities and similarities in the socio-cognitive and emotional child development as the result of complex socio-cultural processes.

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