

Social Information Processing Mediates the Relationship between Effortful Control and Peer

Success in First Graders

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Abstract

Some children have greater peer success than others. Effortful control is a biologically-based temperament component that has been linked to peer success. To explore why this relationship exists, a mediation analysis can be used to look for the mediating variables or mechanisms by which effortful control influences peer success. One possible mediating variable is social information processing or SIP, which allows children to cognitively interpret and respond to social situations. In the present study, it was hypothesized that SIP would partially mediate the relationship between effortful control and peer success. To test this hypothesis, pre-existing data on children from the NICHD study was used. The results of a mediation analysis supported the study's hypothesis. This suggests that biologically-based effortful control provides a lens through which children cognitively process social situations, which in turn has an impact on their peer success. Future studies could continue to explore this relationship.

Social Information Processing Mediates the Relationship between Effortful Control and Peer Success in First Graders

When children enter school, peer relationships start to become a more significant part of their lives. Before school begins, parent relationships are many children's major source of social interactions, and as Raikes, Virmani, Thompson, and Hatton (2013) explained, early parent relationships can help shape how children interact with others later in life. However, when children enter school, they are away from their parents and surrounded by peers for hours each day. Gifford-Smith and Brownell (2003) pointed out that around the time children are in the first grade, interactions with peers can make up about 30% of their total social interactions.

Even as peer relationships become a major source of social interaction in children's lives, it is important to note that children can have varying levels of success with their peers. Whereas one child might be very popular and able to get along well with their peers, another child might struggle to form strong peer relationships and constantly get involved in conflicts. Whether or not a child is able to form good peer relationships can be associated with their level of success in many life domains. For example, Ladd (1990) determined that children in kindergarten who were able to form many new friendships made greater gains in their level of classroom performance throughout the school year than children who were unable to make new friends. Furthermore, Hymel, Rubin, Rowden, and LeMare (1990) found that children with greater peer difficulties were more likely to have higher levels of externalizing problems, such as aggression, and internalizing problems, such as anxiety. With many children seemingly having difficulties with their peer relationships and with peer relationships being related to success or problems in many life domains, it is important to reach an understanding of why some children have more success with their peers than others.

Researchers have already examined a number of factors that may be related to a child's greater or lesser success with peers. For example, Becker and Luthar (2007) explained that aggression, delinquency, academic performance, and attractiveness are some of the variables that have been regularly associated with children's level of social status among peers. One area of particular interest to researchers is how the concept of temperament relates to children's ability to have successful peer relationships (Rothbart, Ahadi, & Hershey, 1994).

According to Rothbart (2007), temperament can be understood as the biologically-grounded variations in how children tend to react to stimuli and self-regulate or control these reactions. She added that children's temperaments usually stabilize in the first few years of their lives and that temperament can be divided into three components: surgency, negative affectivity, and effortful control. Rothbart explained that surgency is linked with extraversion and the tendency to experience positive emotional states, and negative affectivity is linked with the tendency to experience adverse emotional states.

Effortful control, the final temperament component, has been of particular interest to researchers examining the relationship between temperament and peer success. Rothbart (2007) explained that effortful control "describes children's ability to choose a course of action under conditions of conflict, to plan for the future, and to detect errors" (p. 207). She went on to explain that effortful control can be measured by assessing a child's ability to focus and shift attention, inhibit poor or impulsive responses, and perceive and take pleasure from low-intensity stimuli. Furthermore, she pointed out that effortful control has a biological basis, but its development can be shaped by a child's social experiences. Effortful control has also been found to be associated with a variety of socially-related variables ranging from empathy to externalizing problems, such as aggression (for a review see Rothbart, 2007, p. 209).

Based on Rothbart's (2007) description, it seems possible that many areas of a child's peer relationships could be impacted by their effortful control. For example, a child who is better able to inhibit negative impulsive responses in social situations may then be able to choose more socially appropriate actions. Furthermore, peers may be more likely to perceive children with higher effortful control as "good citizens," which could lead to more successful peer interactions (for a review see Liew, 2012, p. 106). Along these lines, many researchers have performed studies to examine the relationship between effortful control and peer-related variables. Eisenberg et al. (2003) assessed elementary-age children's effortful control and social competence as measured by teacher-rated popularity, social status, and use of socially appropriate behaviors. They found greater effortful control predicted greater social competence up to four years after effortful control was initially assessed. Similarly, Spinrad et al. (2006) had parents and teachers complete measures to assess children's effortful control, use of socially appropriate behaviors, and popularity around the time the children were six-years-old, as well as two years later. They found greater effortful control to be predictive of greater popularity and a higher use of socially appropriate behaviors. Liew, Eisenberg, and Reiser (2004) looked at even younger children by assessing preschoolers' effortful control and social competence as measured by teacher, parent, and peer ratings of the children's use of socially appropriate behaviors and level of popularity. They found that children with greater effortful control were more likely to be viewed as socially competent.

With such a large body of studies supporting the existence of a positive relationship between effortful control and peer success, research now needs to focus on examining why these two variables are related. Determining why this relationship exists is important for reaching a better understanding of the factors that contribute to a child's level of peer success and could

potentially help researchers who are in the process of searching for possible ways to aid children struggling with peer relationships.

In the present study, the nature of the relationship between effortful control and peer success was examined through a mediation analysis, which is a statistical method researchers can use when exploring why a predictor or independent variable has an effect on an outcome or dependent variable (Hayes, 2013). According to Hayes (2013), a mediation analysis helps researchers look for a mediating variable or “the mechanism, be it emotional, cognitive, biological, or otherwise, by which” a predictor or independent variable influences an outcome or dependent variable (p. 86). Although it is unlikely that a relationship between two variables will be fully explained by a single mediating variable, a mediation analysis can examine one or multiple potential mediating variables.

In the relationship between effortful control and peer success, a mediation model could propose that effortful control causes variation in a mediating variable, which in turn leads to variation in peer success. In such a model, effortful control would need to be related to both the mediating variable and peer success. Furthermore, the mediating variable would need to be related to peer success. One possible mediating variable that could fit into this model is social information processing (SIP; Crick & Dodge, 1994).

Crick and Dodge (1994) described SIP as the steps children go through to interpret and decide how to respond in social situations. In a model outlining the steps of SIP, Crick and Dodge proposed that when children are in social situations they encode cues, interpret the cues, clarify or choose a goal for the situation, access or create possible responses to the situation, choose a response based on an evaluation of the possibilities, and act based on the chosen response. They further explained that the steps in this process are meant to be viewed as

occurring in parallel with one another and are influenced by children's memories of previous social experiences and the emotions they are feeling.

Two components of SIP include children's hostile attributions and social problem-solving skills. According to Raikes et al. (2013), hostile attributions occur when children interpret social situations in a negative way and can be made even when the situation is actually ambiguous or benign. Raikes et al. further explained that social problem-solving skills are what provide children with the ability to come up with potential solutions in difficult social situations. In many studies exploring SIP, hostile attributions, social problem-solving skills, or both are used as measures of children's SIP skills.

Previous research has focused on looking for a relationship between children's SIP skills and their ability to have successful peer relationships. In one study, Lansford, Malone, Dodge, Pettit, and Bates (2010) assessed elementary-age children's SIP skills, including their hostile attributions and social problem-solving skills, and how well-liked they were by their peers over the course of four years. They found that better SIP skills predicted that a child would be more well-liked by their peers. In another study, Raikes et al. (2013) used both hostile attributions and social problem-solving skills to assess preschool-age children's SIP. The children's level of peer conflict was also measured in preschool, kindergarten, and the first grade. The researchers found that a lower level of hostile attributions was related to a lower level of peer conflict and that better social problem-solving skills were related to a faster decline in peer conflicts between preschool and the first grade. Related to this, Katsurada and Sugawara (1998) used preschool-age children's hostile attributions as a measure of SIP and assessed how the children's tendency to make hostile attributions related to their use of aggressive behaviors. They found that children

who made fewer hostile attributions were less likely to use aggressive behaviors during social interactions.

Overall, the results from these previous studies seem to suggest that, like effortful control, a relationship exists between children's SIP skills and peer success. The research supporting the existence of this relationship also provides evidence to suggest that SIP could be a potential mediating variable in the relationship between effortful control and peer success since a mediating variable in this relationship would need to be related to peer success.

In the present study, I explored how peer success relates to both effortful control and SIP by taking a first step toward examining why the relationship between effortful control and peer success exists. To do this, I examined SIP as a potential mediating variable in the relationship between effortful control and peer success. I proposed that children's SIP partially mediates the relationship between their effortful control and peer success.

To examine this proposal, SIP was measured in terms of children's tendency to give aggressive solutions to ambiguous social situations, and peer success was measured in terms of children's peer status or how well they are accepted by their peers. Based on these measures, I hypothesized that children's tendency to respond aggressively to ambiguous scenarios would significantly partially mediate the relationship between their effortful control and level of peer status. If this hypothesis is supported, the results of the present study will be able to provide evidence to indicate that children's level of effortful control impacts their SIP skills, which in turn influences their level of peer success. In other words, the present study could be a first step toward providing evidence to indicate that children's SIP is one factor that can help explain the existence of the relationship between effortful control and peer success.

For the present study's hypothesis to be supported, greater effortful control will need to be related to greater peer success. As described earlier, a large body of evidence exists in support of the existence of this relationship (Eisenberg et al., 2003; Liew et al., 2004; Spinrad et al., 2006). Furthermore, greater SIP skills in terms of offering fewer aggressive responses to ambiguous social scenarios will need to be related to greater peer success, which also seems reasonable based on the evidence I previously described (Katsurada & Sugawara, 1998; Lansford et al., 2010; Raikes et al., 2013). Finally, greater effortful control will need to be related to SIP in terms of a tendency to give fewer aggressive responses in ambiguous social scenarios. Little research has been done to examine the nature of this relationship. However, some researchers have offered their speculation on why this relationship might exist. For example, Choe, Lane, Grabell, and Olson (2013) discussed the hostile attribution component of SIP and suggested that better effortful control could possibly help children avoid impulsively assigning hostile intent to peers in ambiguous social situations. This, in turn, could lead children to make fewer aggressive responses in such situations.

To test my hypothesis, I used previously collected data on children who participated in the NICHD Study of Child Care and Youth Development. From this study, the Children's Behavior Questionnaire or CBQ was used as a measure of the children's negative affectivity, surgency, and effortful control when they were 54-months-old (Rothbart, Ahadi, Hershey, & Fisher, 2001). The Attribution Bias Questionnaire, which assesses hostile attributions and can be used to determine children's tendency to give aggressive responses to ambiguous social scenarios, was used as a measure of the children's SIP skills in the first grade (Dodge, Pettit, McClaskey, & Brown, 1986). Finally, children's level of peer success in terms of their peer status was also evaluated in the first grade using the Friends or Foes Questionnaire (Ladd, 1983).

Method

Participants

For the present study, I used previously collected data on participants from the NICHD Study of Child Care and Youth Development. Raikes et al. (2013) explained that this study began collecting data in 1991 on 1,364 children and their families from 10 locations across the United States. Children included in the study came from a variety of cultural, ethnic, and economic backgrounds. Mintz, Hamre, and Hatfield (2011) further explained that data collection for the study occurred in four phases, following the children from birth to the tenth grade (for more information on the sample see NICHD, 2001).

The current study only focused on Phase II of the NICHD study, which collected data on children from age three to the first grade (United States Department of Health and Human Services, 1996-1999). I used temperament data collected at 54 months, which was available from 1,061 of the original 1,364 children involved in the study. Males and females each made up about half of this temperament sample. In terms of race, this sample was made up of 79% Caucasians, 12 % African Americans, and 6% Hispanics. Due to attrition and partial completion of the SIP-related and peer success-related questionnaires, the first grade sample size dropped and ranged from 958 to 986 participants.

Procedure

At the time the children in the NICHD study were 54-months-old, their mothers completed a questionnaire, which assessed the children's negative affectivity, surgency, and effortful control. Then, when the children were in the first grade, the children completed a measure which assessed their tendency to make hostile attributions. The children's level of peer success was also evaluated in the first grade through a teacher-completed questionnaire.

Measures

Temperament at 54 months. Children's negative affectivity, surgency, and effortful control were assessed at 54 months using the Children's Behavior Questionnaire or CBQ, which is a measure of temperament that was completed by the children's mothers (Rothbart et al., 2001). The mothers answered each question about their children on a 7-point Likert scale ranging from "extremely untrue" to "extremely true." Although the original CBQ includes 196 items and 15 subscales, the NICHD version of the CBQ was modified. The mothers only responded to 80 items divided into 8 subscales: approach/anticipation with a Cronbach's alpha of .67, activity level with a Cronbach's alpha of .69, shyness with a Cronbach's alpha of .85, fear with a Cronbach's alpha of .64, anger/frustration with a Cronbach's alpha of .76, sadness with a Cronbach's alpha of .60, inhibitory control with a Cronbach's alpha of .75, and attentional focusing with a Cronbach's alpha of .74. As the Cronbach's alphas show, the subscales' internal consistencies ranged from marginal to high (see Table 1 for a summary of Cronbach's alpha values).

An exploratory factor analysis with varimax rotation of this modified CBQ using the data available from the NICHD study was performed following Honomichl and Donnellan (2012) in order to determine whether the temperament components of negative affectivity, surgency, and effortful control could be obtained from correlated clusters of the modified CBQ's eight subscales. Factor loadings, eigenvalues, and percent of variance explained are presented in Table 2. Lower levels of activity and higher levels of attentional focusing and inhibitory control loaded onto effortful control factor scores. Higher levels of activity, anger, and approach/anticipation loaded onto surgency factor scores. Finally, higher levels of fear, sadness, shyness, and, to a lesser degree, anger/frustration loaded onto negative affectivity factor scores. This indicates that

negative affectivity, surgency, and effortful control are the three encompassing factors which were able to be extracted from the eight subscales of the NICHD study's modified CBQ.

Social information processing in the first grade. Children's SIP in the first grade was assessed using data from the Attribution Bias Questionnaire (Dodge et al., 1986). For this questionnaire, the children were presented with eight different peer interaction scenarios illustrated with cartoon drawings. For example, a scenario might depict a child's peer knocking over some paints and ruining the child's picture. In each scenario, the peer's actual intent can be considered hostile, pro-social, ambiguous, or accidental. Children responded to each scenario by answering two questions. First, the children explained their view of why the peer acted as they did in the scenario, and their explanation was coded as either a hostile or non-hostile attribution. The internal consistency for this part of the measure was marginal with a Cronbach's alpha of .66. The children also explained what they would do to respond to the situation, which was coded on a 6-point aggressiveness scale. The internal consistency of this part of the measure was acceptable with a Cronbach's alpha of .78 (see Table 1).

From this questionnaire, the number of aggressive solutions scores were used in the present study's mediation analysis as a measure of SIP. The number of aggressive solutions scores indicate the number of negative responses children gave when explaining what they would do in the questionnaire's scenarios. Each child was given a score ranging from zero to eight. Children who received lower scores, which indicated that they were less likely to provide aggressive responses to ambiguous social scenarios, were viewed as having better SIP skills.

Peer success in the first grade. The children's level of peer success in terms of their peer status was measured using the Friends or Foes Questionnaire (Ladd, 1983). The questionnaire required teachers to respond to four questions about the children's peer status. The

first two questions asked teachers to estimate how many children like or do not like to play with the subject child on a 5-point Likert scale from “none” to “nearly all.” The question focused on how many children do not like to play with the child was reverse scored. The final two questions required teachers to rate whether the subject child is well-liked by children of the same and the opposite sex on a 5-point Likert scale ranging from “never true” to “almost always true.” A higher total score on these four questions indicated that a child was more well-liked by their peers. These four questions had a high internal consistency with a Cronbach’s alpha of .88 (see Table 1).

Results

An initial multiple regression analysis was performed to determine whether a direct predictive relationship existed between any of Rothbart’s (2007) three temperament factors and peer status. Peer status was regressed on the variables of gender, socioeconomic status, effortful control, negative affectivity, and surgency. It was found that socioeconomic status significantly predicted peer status, which indicates that children with higher socioeconomic status were more likely to have higher peer status ($\beta = .106, p < .05$). It was also found that when gender and socioeconomic status were controlled for, effortful control was the only temperament component that significantly predicted children’s level of peer status ($\beta = .120, p < .05$). In other words, children with greater effortful control at 54 months were more likely to have a higher level of peer status in the first grade.

After the multiple regression analysis was found to support the existence of a direct relationship between effortful control and peer success, the next goal was to determine whether SIP in terms of children’s aggressive solutions scores mediated this relationship. First, the aggressive solutions score variable was regressed on effortful control. Effortful control was

found to significantly predict children's aggressive solutions scores ($\beta = -.123, p < .05$). This indicates the children with higher effortful control were less likely to give aggressive solutions to ambiguous social scenarios. Then, peer status was regressed on the aggressive solutions score variable, and it was found that children's aggressive solutions scores significantly predicted their peer status ($\beta = -.117, p < .05$). Children who gave fewer aggressive solutions to ambiguous social scenarios were more likely to have a higher level of peer status (See Table 3 for a summary of the regression analyses). The unstandardized beta values and standard errors from these two regression analyses were then used to run a Sobel test to determine whether mediation had occurred (see Figure 1 for the mediation model).

As hypothesized, partial mediation occurred. The results from the Sobel test indicated that children's aggressive solutions scores significantly partially mediated the relationship between effortful control and peer status ($z = 2.678, p < .05$). In other words, children's tendency to give aggressive responses to ambiguous social scenarios was found to be a mechanism by which effortful control influenced their level of peer status.

Discussion

The present study was designed to examine the proposal that children's SIP partially mediates the relationship between their effortful control and peer success. It was hypothesized that an aspect of children's SIP, which was measured in terms of their aggressive solutions scores or tendency to provide aggressive solutions to ambiguous social scenarios, would significantly partially mediate the relationship between their effortful control and level of peer success, which was assessed using a measure of peer status.

As hypothesized, the study's results indicated that children's aggressive solutions scores significantly partially mediated the relationship between effortful control and peer status. This

suggests that children with a higher level of effortful control at 54 months were less likely to provide aggressive responses to ambiguous social scenarios in the first grade, which in turn led children to have a higher level of peer status in the first grade. This is the first study to examine an aspect of SIP as a mediator between effortful control and peer success. However, this mediation relationship was still expected based on previous research that found a relationship between effortful control and different areas of peer success (Eisenberg et al., 2003; Liew et al., 2004; Spinrad et al., 2006) and a relationship between different aspects of SIP and different areas of peer success (Katsurada & Sugawara, 1998; Lansford et al., 2010; Raikes et al., 2013).

In addition to being in line with previous research, the findings from this study take a first step toward explaining why the relationship between effortful control and peer success exists and can be used to better understand the connection between biological and cognitive aspects of psychology. According to the definition provided by Rothbart (2007), temperament can be understood as having a genetic or biological basis. She explained that some differences in temperament can be measured in developing fetuses and that temperament stabilizes after only a few years. On the other hand, Crick and Dodge (1994) described SIP in relation to children's cognitive abilities, which can be molded by children's experiences. For example, Dodge, Pettit, Bates, and Valente (1995) found that children who had experienced abuse early in life were more likely to have maladaptive SIP patterns, such as a greater tendency to make hostile attributions. They suggested this could be for a variety of reasons, such as experience with abuse leading children to become overly aware of hostile cues when cognitively processing social situations.

The finding that the temperament component of effortful control was predictive of an aspect of SIP, which in turn was predictive of peer status, suggests that people's biologically-based differences may provide a lens through which the cognitive experience of social situations

is filtered. In the case of the present study, it appears that children's biologically-based effortful control influenced their cognitively-grounded SIP abilities in terms of their tendency to choose aggressive responses in ambiguous social scenarios. This could be because higher effortful control allows children to plan out more socially acceptable responses or to contain their initial impulse to provide aggressive responses in ambiguous situations where it might be possible to view a peer's intent as negative.

After the cognitive aspect of SIP is influenced by the biologically-based temperament component of effortful control, it appears that children's tendency to choose aggressive responses in ambiguous social scenarios impacted their level of peer status. This could be because children who are more likely to avoid providing aggressive responses to scenarios are also more likely to cognitively process ambiguous social situations in their everyday lives in a way that allows them to avoid choosing to enact aggressive responses when actually interacting with peers. Children in the first grade who are less likely to respond aggressively to their peers may then be more well-accepted by their peers. In summary, the results from this study appear to show that biologically-grounded effortful control provides a lens that influences children's SIP or how they cognitively perceive and respond to social situations, which then impacts their social relationships in terms of their peer status.

Although the present study's findings have interesting implications about the connection between biological, cognitive, and social aspects of psychology, it is important to keep in mind that this is the first study to explore SIP as a mediating variable between effortful control and peer success. The NICHD study attempted to be nationally representative by sampling children with diverse backgrounds from 10 locations across the United States, which makes it reasonable to hypothesize that the results from this study will be replicable in other samples of American

children. However, future research will still be needed to examine the generalizability of the present study's findings since various factors, such as children's cultural backgrounds, could have an impact on the results obtained in future studies. In order to help determine the potential reach of this study's implications, future researchers could attempt to replicate this study's findings in more specific samples, such as in samples of orphaned children or children from low-income families, and in other countries outside of the United States.

Furthermore, the present study has limitations it is important to acknowledge. One limitation of the study is that it only examined one aspect of SIP as a mediator, but SIP can be measured in multiple ways. Future studies could examine whether the mediation relationship found in this study is still significant when other measures of SIP are used as mediators. For example, whereas this study examined children's SIP in terms of their aggressive solutions scores, children's social problem-solving skills could also be used in a mediation analysis as a measure of SIP. If mediation is found, these studies could provide further evidence to indicate that SIP partially mediates the relationship between effortful control and peer status. Similarly, the present study only focused on one aspect of peer success, so future studies could attempt to determine whether SIP partially mediates the relationship between effortful control and areas of peer success beyond what was explored in this study. For example, children's peer success could be measured in terms of their social skills or their ability to have successful peer interactions rather than in terms of their peer status.

Another limitation of this study is the use of the Sobel test to determine whether mediation had occurred. Kenny (2014) described the Sobel test as a conservative, low power test, and pointed out that other tests of mediation, such as bootstrapping, are being put into increasingly common use. Future researchers could take this into account by attempting to

replicate the results from this study in this sample or in other samples of children using improved tests of mediation that might be able to provide more powerful evidence to support that children's SIP partially mediates the relationship between effortful control and peer success.

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Appendix

Table 1

Cronbach's Alpha Values for Measures at 54 Months and the First Grade

Questionnaire/Subscale	Number of Items	Cronbach's Alpha
Children's Behavior Questionnaire		
Approach/Anticipation	10	.67
Activity Level	10	.69
Shyness	10	.85
Fear	10	.64
Anger/Frustration	10	.76
Sadness	10	.60
Inhibitory Control	10	.75
Attentional Focusing	9	.74
Attribution Bias Questionnaire		
Explanation of Peer's Actions	8	.66
Response to Situation	8	.78
Friends or Foes Questionnaire	4	.88

Table 2

Factor Loadings from Exploratory Factor Analysis of Temperament Variables at 54 Months

Item	Factor Loadings		
	Effortful Control	Surgency	Negative Affectivity
Activity Level	-.54	.57	-.20
Anger/Frustration	-.30	.50	.39
Approach/Anticipation	-.09	.72	.11
Attentional Focusing	.75	.00	-.06
Fear	-.04	.10	.52
Inhibitory Control	.72	-.32	-.12
Sadness	-.04	.26	.70
Shyness	-.00	-.25	.46
Eigenvalues	2.71	1.65	1.09
Percent of variance explained	33.92	20.59	13.66

Note: Bolded factor loadings indicate an absolute value of .40 or higher

Table 3

Regression Analyses to Determine Predictors of Peer Status for Mediation Analysis

Regression Variables	Beta-Value
Peer Status Regressed on Independent Variables	
Gender	.029
Socioeconomic Status	.106*
Effortful Control	.120*
Negative Affectivity	.068
Surgency	.051
Aggressive Solutions Scores Regressed on Effortful Control	-.123*
Peer Status Regressed on Aggressive Solutions Score	-.117*

Note: * $p < .05$

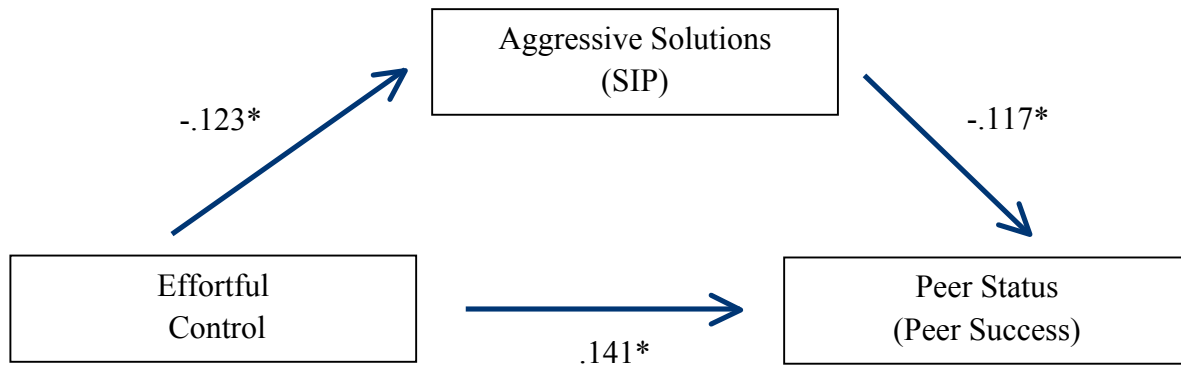


Figure 1. Mediation model between effortful control at 54 months, social information processing at first grade, and peer success at first grade.

$*p < .05$