

Relationships between Social Information Processing and Aggression among Adolescent Girls with and without ADHD

Amori Yee Mikami · Steve S. Lee · Stephen P. Hinshaw · Benjamin C. Mullin

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Abstract This study investigated the relationship between social information processing (SIP) and both relational and overt, physical aggression in a longitudinally-followed sample of 228 adolescent girls (ages 11–18; 140 with ADHD and 88 comparison girls). During childhood, girls participated in naturalistic summer camps where peer rejection, overt physical aggression, and relational aggression were assessed via multiple informants and methods. Approximately 4.5 years later, these girls participated in follow-up assessments during which they completed a commonly-used vignette procedure to assess SIP; overt and relational aggression were again assessed through multiple informants. Correlations between (a) overt and relational aggression and (b) maladaptive SIP were modest in this female adolescent sample. However, relationships between aggression and SIP were stronger for the comparison girls than for the girls with ADHD. The relevance of SIP models for adolescent girls and clinical implications of findings are discussed.

Keywords Social information processing · Girls · Adolescence · ADHD · Relational aggression · Physical aggression

A. Y. Mikami (✉)
Department of Psychology, University of Virginia, 102 Gilmer Hall, P.O. Box 400400, Charlottesville, VA 22904-4400, USA
e-mail: mikami@virginia.edu

S. S. Lee
Department of Psychology, University of California, Los Angeles, 1285 Franz Hall, Box 951563, Los Angeles, CA 90095, USA

S. P. Hinshaw · B. C. Mullin
Department of Psychology, University of California, Berkeley, 3210 Tolman Hall, Berkeley, CA 94720, USA

Introduction

Studies of aggressive behavior problems have historically focused on overt, physical aggression. Because boys are more likely than girls to engage in overtly aggressive behaviors (Coie and Dodge 1998; Maccoby and Jacklin 1980), research on the development and consequences of aggression in girls is far smaller than that for boys. Girls may be more likely than boys to display relationally aggressive behaviors, defined by spreading rumors, excluding someone, or attempting to damage someone's reputation. When both relational and overt forms of aggression are considered, the prevalence of aggression in girls and boys appears nearly equivalent (Crick and Grotpeter 1995). Furthermore, like overt aggression, perpetrators and victims of relational aggression are characterized by elevated indicators of poor adjustment including peer rejection, internalizing, and externalizing problems (Crick 1997; Crick and Grotpeter 1995). It is critical to uncover causes and consequences of both types of aggressive behavior given the salience of relational aggression in girls.

Social information processing (SIP) biases (see Crick and Dodge 1994; Dodge 1980) are well-established correlates of overt, physical aggression. According to the SIP model, children who assume hostile attributions to peers' ambiguous behaviors and generate aggressive, ineffective solutions to social problems are more overtly aggressive than peers without these patterns (Dodge 1980; Dodge et al. 1990; Lochman 1987). Both hostile attributions and aggressive/ineffective response generation have been shown to be distinct, but equally important aspects of SIP problems (Lansford et al. 2006; Zelli et al. 1999).

SIP biases have been further shown in prospective research to (a) be predicted by early overt aggression and

peer rejection, and (b) in turn predict future escalations in overt aggression (Dodge et al. 2003; Lansford et al. 2006). SIP biases may also mediate the longitudinal relationship between early experiences of maltreatment by parents or peers and the increased likelihood of children developing overtly aggressive behavior later (Dodge et al. 2003; Dodge et al. 1995). It is notable, however, that the vast majority of SIP studies have focused on overt, physical aggression with male samples. Much less is known about the nature of SIP biases in girls and whether associations extend to relational aggression. If aggression is an angry response to a perceived provocation, girls may be predisposed and socialized to express this reaction through indirect and relational means, while boys may express their reaction through overt, physical aggression (Keenan and Shaw 1997).

In terms of sex differences related to SIP, in large community samples of elementary school-aged children girls have shown fewer SIP problems than boys (Fraser et al. 2005; Lansford et al. 2006). However, the girls who do have SIP biases appear comparably at risk for the same overtly aggressive outcomes as are their male counterparts (Dodge et al. 2003; Zelli et al. 1999), and both sexes were found to benefit equally from a skills training intervention to change maladaptive SIP (Fraser et al. 2005).

Crick and colleagues (1995; 2002) have found that instruments for SIP biases may need adjustment to capture relational aggression. SIP is typically assessed by asking participants to imagine themselves in a hypothetical scenario depicting an ambiguous provocation related to overt, physical aggression (e.g., a peer touched your toy and now the toy is broken). The participant then provides an interpretation of the peer's intention and suggests a solution. In an advance in research methodology, relationally aggressive scenarios can also be used (e.g., there is a party to which you weren't invited). Relationally aggressive children in third through sixth grade were shown to display more SIP biases in relationally aggressive scenarios relative to overtly aggressive scenarios. Overtly aggressive children displayed more SIP biases in overtly aggressive scenarios relative to relationally aggressive scenarios. Girls were more likely to display relationally aggressive behavior than were boys, but children who were relationally aggressive showed the same pattern of hostile attributions regardless of sex (Crick and Grotpeter 1995; Crick et al. 2002).

Notably, other studies have not supported the relevance of the SIP model for girls or the equivalence of SIP for relational aggression in both sexes. A study of girls in fourth through sixth grade found no concurrent relationship between relational aggression and the SIP variables of hostile attribution biases and aggressive solutions (Crain et al. 2005), even though relationally aggressive vignettes were used. Other work has found that SIP biases are related

to overt aggression for boys but not girls (Schultz et al. 2000), and to relational aggression for girls but not boys (Andreou 2006). However, these last two studies did not use the typical vignette procedure to assess SIP and instead used peer nominations of SIP and an emotion-labeling task, which may contribute to the discrepant findings.

To our knowledge, there are no longitudinal studies examining the relationships between SIP and both relational and overt aggression among girls. Importantly, longitudinal studies can answer essential questions about predicting the development of SIP or aggression over time. Also to our knowledge, all samples testing SIP and relational aggression in either sex have used children as participants, not adolescents. This is a crucial limitation because covert, relational forms of aggression increase from childhood to adolescence for both sexes whereas overt forms decrease during this interval (Zimmer-Gembeck et al. 2005). Although SIP biases are relevant to overtly aggressive behaviors in childhood, it is unknown whether SIP extends to more developmentally sensitive forms of adolescent aggressive behaviors.

There are several reasons to believe that, particularly in adolescence, the SIP model may be less relevant for girls than for boys. The first two reasons relate to the fact that SIP biases may be more difficult to assess in girls than in boys. SIP has been almost exclusively assessed by giving participants hypothetical vignettes and asking them to imagine themselves in that theoretical situation.

First, the key type of aggression manifested by girls—relational aggression—entails subtle, covert, and secretive actions (e.g., “I would tell lies about her to ruin her reputation”) (Crick and Grotpeter 1995) as opposed to overt physical violence (e.g., “I would beat her up”). In analogue tasks such as those used to measure SIP, participants may be unlikely to overtly endorse to an examiner a secretive response strategy—even if this is the strategy that they would actually employ. This argument may explain why past research has demonstrated that relationally aggressive children display relationally aggressive attribution biases, but may not endorse relationally aggressive retaliatory strategies (Crick et al. 2002). Yet, both attribution biases and aggressive responses are important in the SIP model (Lansford et al. 2006; Zelli et al. 1999). As youth age they become more likely to express aggression in relational relative to overt means (Zimmer-Gembeck et al. 2005), perhaps making SIP biases even less apparent for adolescent girls relative to girls in childhood.

Second, girls are known to be more advanced than boys in their verbal skills (Keenan and Shaw 1997). Social interactions among girls are marked by more verbal interchanges relative to the interactions of same-age boys, indicative of a sex difference in communication style that is ingrained by adolescence (Maccoby 2002). Relational

aggression has been conceptualized as requiring verbal intelligence to perform (Andreou 2006). By contrast, language impairments have been found to be related to SIP biases and also to mediate the relationship between overt aggression and SIP (Zadeh et al. 2007). An exclusively verbal, hypothetical task such as those used to assess SIP may play to the cognitive strengths of adolescent girls, who could give socially appropriate answers that do not involve aggression—even if these girls would in fact actually enact relationally aggressive responses.

Finally, other work suggests that girls' development may be marked by multifinality, such that girls with overt, physically aggressive behavior may be at risk for a wider range of problems in adolescence than are boys (Pajer et al. 2007; Robins and Price 1991). Compared to boys, girls may be more likely to display a discontinuous path of aggressive behavior from childhood to adolescence and therefore be less likely to develop the SIP biases characteristic of longstanding aggression.

Most studies conducted on SIP have involved community samples. However, because they are at high risk for aggression, both in childhood and in adolescence, youth with attention-deficit/hyperactivity disorder (ADHD) represent an ideal group in which to test relationships between SIP biases and aggressive behavior (Mannuzza and Klein 2000). Furthermore, youth with ADHD are known to have trouble attending to important social information (Mikami et al. 2007). Pre-adolescent boys with ADHD and overtly aggressive behavior may display more SIP problems than boys with ADHD only (Matthys et al. 1999; Murphy et al. 1992), who are, in turn, more likely to display SIP biases than comparison boys. Girls with ADHD have been underrepresented in the research literature relative to their male counterparts (Hinshaw and Blachman 2005). Girls with ADHD are less likely than boys with ADHD to have comorbid overt, physical aggression (Gaub and Carlson 1997); but they are at higher risk in adolescence for both overt aggression (Hinshaw et al. 2006) and relational aggression (Zalecki and Hinshaw 2004) relative to girls without ADHD, making the SIP construct important to investigate in this population. To our knowledge, this investigation represents the first study of SIP biases in a female ADHD sample.

Hypotheses

We first hypothesized that girls' adolescent SIP biases of hostile attributions and aggressive, ineffective responses would be predicted by childhood peer rejection, relational and overt aggression, and concurrently associated with adolescent measures of relational and overt aggression.

Second, we hypothesized that, like their male counterparts, girls with ADHD would display more SIP biases than comparison girls. Because of the verbal nature of the SIP task, we statistically controlled for Verbal IQ in all analyses. Finally, because of lack of research on SIP in females with ADHD, we did not make directional hypotheses about whether the relationship between SIP biases and aggression would be stronger for girls with ADHD than for comparison girls.

Based on findings of Crick and colleagues (2002), we hypothesized that SIP biases in vignettes with relationally aggressive content would be most associated with girls' relationally aggressive behavior, and SIP biases in vignettes with overtly aggressive content would be most associated with girls' overtly aggressive behavior. Also, based on findings that oppositional defiant disorder (ODD) and conduct disorder (CD) are prevalent among youth with ADHD (Barkley 1998; Lee and Hinshaw 2004) and that they are also associated independently with SIP biases among boys (Matthys et al. 1999), we hypothesized that this diagnostic comorbidity might additionally predict SIP.

Method

Participants

Participants were 228 girls (ages 6–12, mean age 9.5 at baseline): 140 with ADHD (Combined Type and Inattentive Type), and 88 comparison girls. Girls participated in research summer day camps from 8 a.m. to 3 p.m. for five consecutive weeks where they attended activities such as art, P.E., and drama. Girls were grouped into classrooms of about 25 same-age, but mixed diagnosis, peers, led by a group leader and several adult assistants. Most parents agreed to have their daughters with ADHD participate without taking stimulant medications; for families that requested a medication trial, data herein reflect unmedicated behavior. Please see Hinshaw (2002) for further details.

Ninety two percent of the sample returned for follow-up assessments 4.5 years later (ages 11–18, mean age 14.2), 122 girls with ADHD and 81 comparison girls. We used extensive procedures developed by experts in longitudinal studies (Stouthamer-Loeber et al. 1992) to bolster the retention rate (see further details in Hinshaw et al. 2006). Retained girls did not differ from those lost to attrition on baseline demographic variables at above-chance rates. Attrition rates were equal among girls with ADHD versus comparison girls. Parents, teachers, and adolescents completed a variety of questionnaire measures and tasks to assess functioning (see Hinshaw et al. 2006).

Both ADHD and comparison girls were recruited through pediatricians, schools, and advertisements; girls with ADHD were additionally recruited through mental health centers. Ethnic diversity was achieved (53% Caucasian, 27% African American, 11% Latina, 9% Asian American). Probands were required to meet clinical cutoffs on parent and teacher rating scales (CBCL: Achenbach 1991a; TRF: Achenbach 1991b; SNAP-IV: Swanson 1992), and diagnosis was validated through parent clinical interviews (DISC-IV: Shaffer et al. 2000). To participate as a comparison child, girls needed to be below ADHD cutoffs on rating scales, and there could be no diagnosis of ADHD on the DISC-IV. Comparison girls were close to national norms for behavior problems on well-established parent and teacher rating scales (Hinshaw 2002).

Follow-up Measures

SIP Vignettes

This measure was collected only at the follow-up assessment. We followed the procedures developed by Dodge and colleagues (1993); this vignette procedure has been widely used to assess SIP biases and validity has been documented (see, for example, Dodge et al. 2003, 1995, 1990). Participants were read five hypothetical scenarios and shown a picture of the scenario, while being asked to imagine that they were personally involved in them. Stories depicted ambiguous situations of peer provocation (“a group of peers say you can’t sit with them at lunch”), selected to be relevant to adolescents and to include relationally aggressive scenarios given the prevalence of this type of aggression for girls. The participant was asked to verbalize (a) reasons why the peers in the story acted in the way they did and (b) possible ways to respond to the hypothetical situation. Participants’ attributions and responses were recorded during interviews, and later coded in accordance with standardized systems for this measure by coders unaware of participants’ ADHD or comparison diagnosis or aggressive behavior.

Hostile Attribution Bias

Participants’ reasons for the peer’s actions were coded as a hostile attribution (“they did it because they don’t like me”) or a non-hostile attribution (“they did it because there wasn’t any room for me that day”). Conceptually, hostile attributions were coded when the participant inferred that the peer performed the action to be mean, or to intentionally hurt or harm. Non-hostile attributions were coded when the participant inferred that the peer did the action by

accident, in an attempt to be helpful, or with a neutral intention. We calculated a score consisting of the number of times a hostile interpretation was endorsed among the five stories.

Aggressive Responses to Social Problems

Participants’ suggested responses to the provocation were coded as aggressive (“I’d take her stuff and see how she likes it”) or nonaggressive (“I’d just walk away”). Conceptually, aggressive responses were coded when the participant endorsed that she would do something to be mean, or to intentionally hurt or harm the peer in retaliation. Nonaggressive responses were coded when the participant endorsed any other type of strategy, which could be prosocial or passive. We calculated a score consisting of the number of times a participant provided an aggressive response during the five stories.

Ineffective Solutions to Social Problems

Participants’ solutions were also coded as being ineffective, average, or particularly effective. All aggressive solutions as well as withdrawn nonaggressive solutions that were unlikely to solve the problem or lead to better peer relations (“I’d cry; I’d tell the teacher”) were considered ineffective, and assigned a score of 3. Average solutions, assigned a score of 2, diffused or did not escalate the problem (“I’d walk away”; “I’d say ‘ok whatever’”). Particularly effective solutions were creative ways to resolve the problem (“I’d say bye and ask if I could join tomorrow”) and were assigned a score of 1. We calculated a total ineffectiveness score by taking the average of the participant’s scores across the five stories.

To assess inter-rater reliability, 45 of the 204 participant responses were selected at random to be double coded. Because values are continuous (e.g., the number of hostile attributions out of all the stories, ranging from 0 to 5), intraclass correlation coefficients were used to calculate the inter-rater reliability between the two raters: hostile attribution bias = .95, aggressive responses = .84, ineffective solutions = .87.

Following the suggestion of Crick et al. (2002), scenarios were divided into relationally aggressive ($n = 3$; “Imagine that you see a bunch of kids talking in a circle about 15 feet away. You yell out ‘Hey Everybody.’ The kids keep talking and don’t say anything to you”) and overtly aggressive ($n = 2$; “Imagine that you are walking down the hallway at your school and you see another girl coming toward you. There are lots of kids in the hallway. This other kid yells out, ‘Hey geek. Yeah I mean you,

nerd.”). We separated the dependent measures noted above for these two types of scenario.

Adult-informant Relational Aggression

Parents and teachers reported on participants' relationally aggressive behavior using the Children's Social Behavior Scale (CSBS; Crick 1996), a well-validated, commonly used adult informant questionnaire. Each of the five items (sample item: tries to exclude certain peers) uses a 5-point metric from 1 (never true) to 5 (almost always true). Internal consistency in our sample was .83 for parents and .92 for teachers. Because scores from multiple informants lead to more valid measures of behavioral constructs, parent and teacher reports were converted into z-scores, and averaged together (weighted equally) to create a composite score of adult informant relational aggression. The correlation between parent and teacher reports was modest to moderate ($r = .44$; $p = .00$), but this is comparable to the findings of Achenbach et al. (1987) that the average correlation approximates .3 between informants who rate children's behavior problems.

Adult-informant Overt Aggression

Parents and teachers reported on participants' overtly aggressive behavior using the Aggressive Behavior narrow-band subscale on the Child Behavior Checklist (CBCL; Achenbach 1991a) and parallel Teacher Report Form (TRF; Achenbach 1991b). Each item is rated on a scale from 0 = Not true to 2 = Very true or often true. All CBCL and TRF subscales are commonly used and possess excellent reliability and validity (Achenbach 1991a, b). Parent and teacher reports were converted into z-scores, and then averaged together (weighted equally) to create a composite score of adult informant overt aggression. The correlation between parent and teacher reports was $r = .51$; $p = .00$.

Self-report Overt Aggression

Because of theorizing that delinquent behavior represents a subtype of overt aggression that becomes more salient in adolescence (Hinshaw and Lee 2003), and also may not be known by parents and teachers, adolescents completed the Self-Reported Delinquency scale (Elliott et al. 1985). As suggested by Elliot et al. (1985), we created a score reflecting the number of different types of antisocial acts committed, of 36 possible types. Scores correlate moderately ($r = .34-.41$) with parent and teacher report of delinquency on the CBCL/TRF.

Baseline Measures

Peer Rejection

Standard sociometric procedures (Coie et al. 1982) were conducted during the summer program, in which participants nominated the three peers in their classroom of 24–26 same-age girls who they most liked to play with, and the three peers they least liked to play with. Peer rejection scores were calculated by taking the proportion of least liked nominations received (relative to the number of peers in the class making nominations) and subtracting the proportion of most liked nominations received. This variable has been shown to have predictive validity in our sample (Mikami and Hinshaw 2006), and to differentiate youth with ADHD from comparison youth. See Blachman and Hinshaw (2002) for further details.

Peer-nominated Relational Aggression

In the same sociometric interviews, participants nominated up to three peers in the summer program classroom as most likely to spread rumors, gossip, tell lies about peers, and threaten to not be friends anymore when angry. Relational aggression scores were calculated by taking the proportion of these nominations received. See Zalecki and Hinshaw (2004).

Peer-nominated Overt Aggression

In the sociometric interviews, participants nominated up to three peers in the summer program classroom as most likely to hit, kick, push, call names, or physically attack peers. Overt aggression scores were calculated by taking the proportion of these nominations received (Zalecki and Hinshaw 2004).

Adult-informant Relational Aggression

Similar to follow-up, parents and teachers reported on participants' relationally aggressive behavior using the CSBS (Crick 1996). Parent and teacher reports were converted into z-scores, and then averaged together. The correlation between parent and teacher reports was $r = .34$; $p = .00$.

Adult-informant Overt Aggression

Parents and teachers reported on participants' overtly aggressive behavior using the Aggressive Behavior

narrow-band subscale on the CBCL (Achenbach 1991a) and parallel TRF (Achenbach 1991b), similar to at follow-up. Parent and teacher reports were converted into z-scores, and then averaged together. The correlation between parent and teacher reports was $r = .70$; $p = .00$.

Verbal IQ

This was assessed through Verbal IQ scores from the WISC-III (Wechsler 1991), a well-established measure of verbal cognitive ability with excellent psychometric properties.

Data Analytic Plan

First, relationships between baseline risk factors and the dependent variable of adolescent SIP biases were tested via hierarchical multiple regressions. Because girls with ADHD were nearly one standard deviation lower in Verbal IQ relative to comparison girls—a common finding in the ADHD literature (see Table 2)—and because of the verbal nature of the SIP task, this variable was controlled on step 1. The childhood measures of overt aggression, relational aggression, or peer rejection were then placed (one at a time in separate regressions) on step 2, childhood ADHD status (dummy coded as ADHD versus comparison) on step 3, and then the interaction between the childhood risk factor and ADHD on step 4. Second, in a different set of regressions, relationships between concurrent aggressive behavior and SIP biases were assessed by placing Verbal IQ on step 1, the adolescent measure of overt aggression or relational aggression on step 2, childhood ADHD status on step 3, and the interaction between aggression and ADHD status on step 4. Significant interactions were probed in the manner recommended by Holmbeck (2002). Dependent variables were each of the three SIP biases: hostile attribution bias, aggressive responses, and ineffective solutions. We conducted 15 regressions involving baseline measures (five baseline predictors for each of the three SIP biases as dependent variables) and 9 regressions involving follow-up measures (three follow-up predictors for each of the three SIP biases as dependent variables).

In order to examine the potential effect of Verbal IQ on the interactions between ADHD and aggressive behavior, we added the interactions between Verbal IQ and aggressive behavior and Verbal IQ and ADHD status on steps 5 and 6, and then the three-way interaction of aggressive behavior, Verbal IQ, and ADHD on step 7. In no case was any interaction involving Verbal IQ significant, so we have dropped these from analyses. Because girls with ADHD and comparison girls did not differ on any demographic

measure such as age, number of adults in the household, family income, and maternal education (Hinshaw et al. 2006), these variables were not included.

We further conducted exploratory analyses incorporating ODD and CD, conditions highly comorbid with ADHD, into ANOVA models. Finally, we conducted exploratory correlations between (a) overt and relational aggression and (b) the key SIP indicators, separately for overtly versus relationally aggressive vignettes.

Results

Descriptive Statistics

Correlations revealed modest to moderate relationships among the three SIP variables: hostile attribution bias, aggressive responses, and ineffective solutions. Aggressive responses and ineffective solutions had modest correlations with baseline and follow-up measures of relational aggression and overt aggression. However, hostile attribution bias was not correlated with aggression (see Table 1).

ADHD versus Comparison Group Differences

Table 2 displays the results of *t*-tests (without covariates) evaluating ADHD-comparison group differences with respect to SIP variables. Girls with ADHD generated more ineffective solutions to the vignettes, with a small effect size. ADHD and comparison girls did not differ on the other SIP variables of hostile attributions and aggressive responses. However, when Verbal IQ was added as a covariate, ADHD was no longer significantly associated with ineffective solutions. Verbal IQ was significantly correlated with the SIP variables of hostile attributions and aggressive responses, but the association between Verbal IQ and ineffective solutions was not significant. Girls with ADHD displayed higher scores on nearly all measures of relational aggression and overt aggression, with large effect sizes, relative to comparison girls.

The majority (91/140) of girls with ADHD had comorbid ODD or CD in childhood; by contrast relatively few (6/88) of the comparison girls did. In order to examine the potential contribution of comorbid ODD and CD to SIP variables, we next conducted ANCOVAs with childhood ODD or CD diagnoses (collapsed into one) as a covariate, with ADHD as the independent variable, and without the covariate of Verbal IQ. ADHD remained significantly associated with more ineffective solutions ($F(1,200) = 5.21$; $p = .02$) even after statistically controlling for ODD/CD, but not with the other SIP variables. Childhood ODD/

Table 1 Correlations among study variables

Construct	1	2	3	4	5	6	7	8	9	10	11
1. SIP aggressive responses	–	.40***	.16*	.31***	.07	.08	–.09	.18**	.15*	.08	.02
2. SIP ineffective solutions		–	.01	.19**	.04	.16*	.08	.17*	.11	.08	.11
3. SIP hostile attribution bias			–	.00	–.01	–.01	.04	–.02	–.04	–.01	.02
4. Fup self-report overt aggression				–	.31***	.17*	–.05	–.02	–.06	.09	.22**
5. Fup adult-report overt aggression					–	.59**	.43***	.46***	.44***	.73***	.42***
6. Fup adult-report relational aggression						–	.34***	.45***	.42***	.44***	.38***
7. Bln peer rejection							–	.75***	.73***	.59***	.39***
8. Bln peer noms overt aggression								–	.86***	.64***	.35***
9. Bln peer noms relational aggression									–	.60***	.45***
10. Bln adult-report overt aggression										–	.54***
11. Bln adult-report relational aggression											–

Bln = Baseline; Fup = Follow-up

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 2 ADHD and comparison group differences on SIP variables and aggressive behaviors

Variable	ADHD	Comparison	Cohen's d	r^a
SIP aggressive responses	0.76 (0.89)	0.64 (0.87)	0.14	0.92
SIP ineffective solutions	2.36 (0.36)	2.25 (0.30)	0.33	2.40*
SIP hostile attribution bias	3.50 (1.11)	3.42 (1.21)	0.07	0.49
Fup self-report overt aggression ^b	0.04 (1.11)	–0.06 (0.81)	0.10	0.69
Fup adult-report overt aggression ^b	0.34 (0.92)	–0.56 (0.38)	1.28	6.78**
Fup adult-report relational aggression ^b	0.10 (0.58)	–0.16 (0.39)	0.53	6.74**
Bln peer rejection	0.08 (0.26)	–0.13 (0.12)	1.04	7.26**
Bln peer noms overt aggression	0.17 (0.22)	0.01 (0.03)	1.02	6.66**
Bln peer noms relational aggression	0.16 (0.17)	0.02 (0.05)	1.12	7.36**
Bln adult-report overt aggression ^b	0.49 (0.85)	–0.78 (0.23)	2.04	13.60**
Bln adult-report relational aggression ^b	0.27 (0.87)	–0.43 (0.52)	0.98	6.74**
Bln verbal IQ from WISC-III	101.34 (14.44)	113.74 (13.31)	0.89	6.88**

Bln = baseline, Fup = follow-up. Values in table are raw score means with standard deviations in parentheses

^a Group contrasts in this table are tested using two-sided *t*-tests without covariates

^b This number is a z-score; positive numbers correspond to greater amounts of the construct

* $p < .05$; ** $p < .01$

CD was not associated with any SIP variable. When both Verbal IQ and childhood ODD/CD were included as covariates, neither ADHD nor ODD/CD was significantly associated with any SIP variable.

Baseline Measures Predicting Adolescent SIP

After statistically controlling for Verbal IQ on step 1, the dependent variable of adolescent aggressive responses was not predicted by any baseline measure of aggression at step 2, although the peer nomination measure of overt aggression was marginally significant (R^2 change = 0.02; $p = .07$). Although there was no main effect for adult-reported overt aggression in predicting aggressive responses

(R^2 change = 0.00; $p = .90$), there was an interaction effect with ADHD diagnosis (R^2 change = 0.03; $p = .02$). Probing of the interaction revealed that the relationship between adult-reported overt aggression and adolescent aggressive responses was significant for the comparison girls ($\beta = 1.16$; $p = .01$), but not for the girls with ADHD ($\beta = 0.02$; $p = .87$). Similarly, although there was no main effect for peer-nominated relational aggression (R^2 change = 0.01; $p = .15$), there also was an interaction effect with ADHD diagnosis (R^2 change = 0.02; $p = .05$). Probing of the interaction revealed that the predictive relationship between peer-nominated relational aggression and adolescent aggressive responses was significant for the comparison girls ($\beta = 0.76$; $p = .02$), but not for the girls with ADHD ($\beta = 0.11$; $p = .15$).

Ineffective solutions were predicted by peer-nominated overt aggression (R^2 change = 0.02; $p = .05$), after statistically controlling for Verbal IQ. Neither peer-nominated relational aggression nor adult-informant overt or relational aggression was related to adolescent ineffective solutions. No interactions were found between baseline measures and ineffective solutions.

There were no main effects for baseline measures predicting hostile attribution bias after statistically controlling for Verbal IQ. However, there was a significant interaction between baseline peer rejection and ADHD (R^2 change = 0.03; $p = .01$). Probing of this interaction revealed that the predictive relationship between peer rejection and hostile attributions was significant for the comparison girls ($\beta = 0.49$; $p = .02$), but not for the girls with ADHD ($\beta = -0.04$; $p = .62$).

We then reconducted regressions with the addition of childhood ODD/CD as a predictor in the third step of the regression. Thus, Verbal IQ remained on step 1, the relevant measure of aggression on step 2, ODD/CD was placed on step 3, ADHD on step 4, and the interaction between aggression and ADHD on step 5. In no case was childhood ODD/CD significant in predicting SIP variables, and all other main and interaction effects for aggression and ADHD, as described above, remained unchanged.

Follow-up Measures and Concurrent SIP

After statistically controlling for Verbal IQ on step 1, adolescent aggressive responses on step 2 were associated with both concurrent, adult-informant overt aggression (R^2 change = 0.02; $p = .03$) and adolescent self-reported overt aggression (R^2 change = 0.08; $p = .00$). Additionally, there was an interaction effect between adult-informant overt aggression and ADHD diagnostic status (R^2 change = 0.05; $p = .00$). Probing of this interaction revealed that the relationship between adult-informant overt aggression and aggressive responses was significant for the comparison girls ($\beta = 0.83$; $p = .01$), but not for the girls with ADHD ($\beta = -0.07$; $p = .46$). Adult-informant relational aggression was not associated with aggressive responses.

Ineffective solutions were associated with adolescent self-reported overt aggression (R^2 change = 0.03; $p = .01$), but not with adult-reported overt or relational aggression after statistically controlling for Verbal IQ. None of the interactions between aggression and ADHD was significant.

None of the variables was concurrently associated with hostile attribution bias. However, there was a significant interaction effect between adult-informant overt aggression and ADHD diagnostic status (R^2 change = 0.05; $p = .01$) in predicting this variable. Probing of the interaction again

revealed that there was a significant relationship between adult-informant overt aggression and hostile attribution bias for the comparison girls ($\beta = 0.73$; $p = .02$), but not for the girls with ADHD ($\beta = -0.15$; $p = .13$).

As was found in the models using the baseline measures of aggression, when childhood ODD/CD diagnosis was added as a predictor in models including Verbal IQ, in no case did ODD/CD predict SIP variables and the pattern of findings among aggression, ADHD, and SIP variables remained the same.

Relationally Aggressive and Overtly Aggressive Vignettes

We separated the dependent variables of SIP biases into those from the relationally aggressive vignettes ($n = 3$) versus those from the overtly aggressive vignettes ($n = 2$). Correlations among the three SIP biases from relationally aggressive and overtly aggressive vignettes were modest (hostile attribution bias: $r = .23$, $p < .01$; aggressive responses: $r = .19$, $p < .01$; ineffective solutions: $r = .27$, $p < .001$).

As displayed in Table 3, there were no strong differences in the association between aggressive behaviors and SIP in the overtly aggressive versus relationally aggressive vignettes. However, aggressive responses and ineffective solutions in the overtly aggressive vignettes were somewhat associated with aggressive behaviors in general. Aggressive responses and ineffective solutions in the relationally aggressive vignettes were not associated with either overtly or relationally aggressive behaviors. Neither relational nor overt aggression was associated with hostile attribution bias.

Discussion

In a longitudinal study of adolescent girls with and without ADHD, we found modest associations between SIP biases and both relational and overt aggression in bivariate correlations. After statistically controlling for Verbal IQ, childhood measures of peer-nominated overt aggression predicted ineffective solutions to the vignettes in adolescence. Regarding concurrent relationships, after statistically controlling for Verbal IQ adult-informant and self-reported overt aggression were associated with aggressive responses; self-reported overt aggression was additionally associated with ineffective solutions. Yet associations were not found between aggressive behaviors—either at baseline or at follow-up—and hostile attributions. There were no strong differences in the associations between aggression variables and SIP biases

Table 3 Correlations involving relationally aggressive versus overtly aggressive vignettes

	Bln peer overt	Bln adult overt	Fup adult overt	Fup self overt	Bln peer relational	Bln adult relational	Fup adult relational
<i>Overtly aggressive stories</i>							
Aggressive responses	.14*	.14*	.08	.27***	.09	.06	.13
Ineffective solutions	.14*	.12	.11	.22***	.06	.12	.21**
Hostile attribution bias	.00	-.01	.03	.02	-.02	.06	-.04
<i>Relationally aggressive stories</i>							
Aggressive responses	.13	-.02	-.04	.17*	.13	-.07	.02
Ineffective solutions	.13	.02	-.01	.08	.11	.05	.07
Hostile attribution bias	-.02	-.01	-.05	-.03	.05	-.04	.02

Bln = Baseline; Fup = Follow-up

* $p < .05$; ** $p < .01$; *** $p < .001$

depending on whether the vignette had overtly or relationally aggressive content.

Girls with ADHD provided more ineffective solutions than did comparison girls, but not after statistically controlling for the higher Verbal IQ of comparison girls. Other differences between diagnostic groups in SIP were non-existent. Relationships between (a) adolescent SIP biases and (b) childhood aggression and peer rejection were consistently stronger for comparison girls than for girls with ADHD, in five of the regressions conducted; in no case was the finding in the other direction. Childhood ODD/CD diagnoses, when added to models, failed to predict SIP variables or change the relationships between aggressive behaviors and ADHD in predicting SIP.

The modest relationships between aggression and SIP found in this sample, in contrast to the wealth of evidence linking aggression and SIP in other work largely with male children, were unexpected and challenge the relevance of the SIP model for adolescent girls and for relational aggression. It may be that the exclusively verbal, hypothetical nature of the scenarios used to assess SIP do not best measure these biases in girls and/or adolescents—two populations who have more fully developed verbal skills and are more likely to use relational aggression, relative to boys and children. We also note, though, that statistically controlling for Verbal IQ on step 1 of the regressions, as we did, is stringent, given that poor cognitive performance co-occurs with aggressive behavior and ADHD, and may share a similar genetic etiology (Hinshaw 1992).

Another interesting finding was that few relationships between hostile attribution bias and aggression emerged, relative to the two other SIP components of aggressive responses and ineffective solutions, which were better linked to aggression. It has been theorized that hostile attribution bias in particular, as opposed to the other SIP components, is associated with reactive aggression versus proactive aggression (Dodge and Coie 1987; Schwartz

et al. 1998). Thus, hostile attribution biases may show predictive power only to specified forms of aggression.

Finally, it is notable that when relationships did exist among aggression, peer rejection, and SIP biases, they consistently occurred more strongly for the comparison girls relative to the girls with ADHD. Studies of risk and resilience among youth with ADHD have yielded inconsistent findings about whether the relationship between risk and poor outcome is stronger for youth with ADHD than for comparison youth. On one hand, studies have found that boys with ADHD are more susceptible to the effect of deviant peer associations on drug abuse than are comparison boys (Marshal et al. 2003). Yet, the pattern of findings in the current study is more similar to other work documenting that childhood covert antisocial behavior predicted adolescent overt aggression for comparison boys only, and not boys with ADHD (Lee and Hinshaw 2004).

It may be that baseline aggressive behaviors and peer rejection, much more prevalent in the ADHD than in the comparison sample, are associated with a wide spectrum of problems for girls with ADHD. However, these relatively rare behaviors among comparison girls put them more at risk for a special set of SIP biases. Another possibility is that there are thresholds above which aggressive behavior problems are not associated with SIP biases, and girls with ADHD are more likely to have surpassed these thresholds relative to comparison girls. Ultimately, to our knowledge this is the first study of SIP among adolescent girls with ADHD, and results await replication.

In future research, we suggest the importance of assessing SIP biases in a less verbal, hypothetical manner, in order to test the theory that adolescent girls may show fewer SIP biases because of the nature of the task. Future studies might take measures of physiological arousal when giving the SIP vignettes, to see if males and females have a different sort of physiological response suggesting that, for girls, this is largely a cognitive task. Alternatively, the field

would be strengthened by using in vivo, experimental manipulations of ambiguous peer scenarios to elicit SIP biases—similar to the assessment of rejection sensitivity (Downey et al. 1998)—to then see whether the actual behaviors converge with the SIP vignette reports for boys but not for girls. Future research, planned in this sample, should also test longitudinal relationships between SIP and later relational aggression in girls. SIP has been found to predict growth in overtly aggressive behaviors (Lansford et al. 2006). Longitudinal data testing the predictive validity of SIP to relational aggression will add to the SIP model.

In closing, implications of these findings are that several roots of aggressive behavior in girls are likely to exist. Particularly for adolescent girls who display their aggression in relational ways, SIP biases may not make a large or predominant contribution to their aggressive behavior problems. Additionally, the traditional means of appraising social-cognitive correlates of aggression in preadolescent boys may not be accurate with adolescent girls. Practitioners conducting interventions to change SIP biases should consider the relevance of their treatments for targeting relational aggression and adolescent, female populations.

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Author Biographies

Amori Yee Mikami is an Assistant Professor of Psychology at the University of Virginia. She received her Ph.D. from the University of California, Berkeley. Her research interests include predictors of competence and impairment among youth with ADHD, with a particular focus on peer relationship difficulties in this population.

Steve S. Lee is an Assistant Professor of Psychology at the University of California, Los Angeles. He received his Ph.D. from the University of California, Berkeley. His research focuses on aggressive behavior and delinquency among youth with ADHD, including gene-environment interactions in the development of aggression.

Stephen P. Hinshaw is Chair and Professor of Psychology at the University of California, Berkeley. He received his Ph.D. from the University of California, Los Angeles. He has a longstanding program of research on social behavior among youth with ADHD and the social behavior of girls with this disorder.

Benjamin C. Mullin is a graduate student in Psychology at the University of California, Berkeley, with interests in ADHD and pediatric bipolar disorder.