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## Transmission of Antisocial Behavior across Generations: The Role of Psychophysiology

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## **Abstract**

Antisocial and disruptive behavior is believed to be determined partially by genetics; however, the role of physiological stress response systems is understudied. The current study addresses this gap. A mediated moderation model was tested in which parental antisocial behavior was a predictor of child behavior problems, moderated by parent sympathetic nervous system (SNS) activity and mediated by child SNS activity. In a sample of 60 families with a child between the ages of 6 and 12 years, mothers and fathers reported on their antisocial behavior and their children's behavior problems. Parent and child skin conductance (skin conductance level and response) were assessed during a 3 minute resting baseline period. Although full criteria for mediated moderation were not found, results indicated partial support for the model. Mother antisocial behavior was associated with child delinquency when mothers had higher skin conductance level; father antisocial behavior was linked to higher child delinquency when fathers had lower skin conductance response. Father antisocial behavior was related to lower child skin conductance level when fathers had lower skin conductance level. Children's lower skin conductance response was associated with greater child aggression.

## **Background**

Antisocial behavior is defined by the American Psychiatric Association (APA) as "a pervasive pattern of disregard for, and violation of the rights of others" (APA, 2000). Characteristics of antisocial behavior include a lack of remorse for other people, persistent lying, irresponsible behavior, a disregard for safety, and poor behavioral and anger management (Westermeyer & Thuras, 2005). Antisocial behavior may begin as early as the prepubescent years of childhood (Patterson, DeBaryshe, & Ramsey, 1990).

It has been shown that there are links between parental antisocial behavior and child behavior problems. For example, parental antisocial alcoholism is related to antisocial pathways to alcoholism in offspring. Having an antisocial parent conveys risk for a variety of behavioral problems in children, such as bullying other children, destroying or vandalizing property, using dangerous weapons, physical cruelty to others, frequently lying for personal gain, picking fights, etc. (Herndon & Iacono, 2005).

One reason that parent and child behavioral issues are related may be due to genetics (Young et al., 2000). However, there are few studies of how genetic factors contribute to the transmission of behavioral problems. Heritable psychophysiological processes may play a key role. Psychophysiology is a division of psychology that studies physiological responses in accordance with mental processes. The purpose of the current study is to examine the psychophysiological processes in the association between parent and child antisocial and aggressive behaviors.

### *Sympathetic Nervous System*

The sympathetic nervous system (SNS) is one part of the body's autonomic nervous system. One of its main functions is to induce the fight or flight response, and to help the body maintain

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homeostasis in various environments under stress (Jansen, Nguyen, Karpitskiy, Mettenleiter & Loewy, 1995). The SNS enacts the fight or flight response in humans when they are under stress by releasing adrenaline throughout the body, dilating pupils, opening secretion of sweat glands in hands, and increasing heart rate. These various reactions help people to prepare physiologically for fight or flight. These facts about the sympathetic nervous system are important in understanding physiological responses in parents and children with antisocial behavior (Porges, 2001). There are various measures of SNS activity; in the current study, skin conductance is examined. Skin conductance assesses the activity of the eccrine sweat glands, which are solely enervated by the SNS. Sweat increases the conductivity of the skin. Greater SNS activity leads to higher skin conductance, which can be examined in terms of the overall skin conductance level, or the degree to which skin conductance show momentary increases for unknown reasons (nonspecific responses) during a certain period.

### *Sympathetic Activity and Antisocial Behavior*

Antisocial behavior has been related to reduced physiological responses. Children, adolescents and adults who have low resting heart rate demonstrate greater severe and aggressive antisocial behavior (Armstrong et al., 2009). Adolescent males that exhibit characteristics of antisocial behavior were found to have less physiological response when exposed to various aversive or stressful stimuli, such as photographs of wounded or injured people, than those who did not show symptoms of antisocial behavior (Mezzacappa, et al., 1997). It is possible that low physiological activity is associated with fearlessness and lack of empathy. Such fearlessness and lack of empathy are characteristic of antisocial behavior.

Physiological responses in children who experience persistent antisocial and aggressive behaviors are different than in children who do not experience those types of behaviors (Herpertz et al., 2001). Low resting heart rate is often observed in antisocial adolescents and children. Low resting heart rate is a sign of something known as physiological under-arousal. However, there are many reasons why a person could experience low resting heart rate, and not all of them are related to signs or symptoms of antisocial behavior. Some researchers believe that the two are significantly related and that reduced heart rate and antisocial behavior are both heritable, and may have an inverse relationship (Rhee & Waldman, 2002).

It is also important to understand physiological response measures of the sympathetic nervous system. There are various ways to measure the reactivity of the SNS, many of which are used in psychology. The measure used in this study is known as skin conductance. Skin conductance measures the conductance of electricity on the surface of the skin, which is directly influenced by the SNS. Skin conductance is one of the only pure physiological measures that is influenced only by the SNS, therefore it is used as a direct measure of SNS activity. Skin conductance is measured by two different variables: tonic skin conductance level (SCL) and nonspecific skin conductance response (SCR), that are measured in terms of electrodermal activity (EDA) (Lykken & Venables, 1971). Traditionally, adults who exhibit antisocial behavior have different skin conductance levels and responses than adults who do not have any antisocial traits or characteristics (Siddle et al., 1976), which is what we expect to see in the current study.

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## *The Present Study*

The proposed study will be the first known examination of the role of physiological stress responses in the transmission of antisocial behavior from parent to child. It is important to study this in order to better understand antisocial behavior and aggression, and how it may be transmitted and manifested, as well as how it affects children and their behavioral problems. This study may help researchers take steps to prevent or regulate transmission or manifestation of antisocial or aggressive behaviors in children. I hypothesize a mediated moderation model. Specifically, I propose that parent antisocial behavior will be more strongly linked to child behavior problems when parents exhibit lower SNS activity. Further, lower child SNS activity will mediate the effect of this interaction.

## **Methods**

### *Participants*

The data for this analysis has been obtained from a larger study on child sleep and family relationships. For this analysis, there were 60 families. Families were recruited via telephone, flyers, radio advertisements, and referrals from past participants. Eligibility criteria included: (1) A child between the ages of 6 and 12 was able to participate; (2) A mother and a father figure had been living together in the same household for at least 2 years; and (3) Children were not suffering from any chronic or acute illness or disability. Fifty two percent of children were girls. Mean age of children was 8.80 years ( $SD = 1.94$  years). Ninety percent of parents were married; 89% of fathers and 93% of mothers were biologically related to the child. Families were from a wide range of socioeconomic status (SES) levels, with incomes ranging from less than \$6,000 a year ( $N = 3$ ) to over \$150,000 a year ( $N = 3$ ; Mode = \$55,000 to \$74,999). Mean years of education was 15.74 for mothers and 15.60 for fathers ( $SD = 2.37$  and 2.89, respectively). Ninety-eight percent of fathers and 98% of mothers had high school diplomas; 57% of fathers and 54% of mothers had at least a 4-year college degree. In terms of father ethnicity, 81% were European American, 15% African American, and the remainder were of other race. For mother ethnicity, 85% were European American, and the remaining 15% were African American.

### *Procedure*

This study was conducted with the approval of the institution's Internal Review Board (IRB). Informed consent and assent was obtained. Participants visited the laboratory for one session of approximately 3 hours. After acclimation to the laboratory, children were attached to the physiological recording equipment and asked to sit alone for 3 minutes to obtain an assessment of baseline resting skin conductance level and nonspecific response. Later, each parent separately had their baseline resting skin conductance assessed for 3 minutes. Electrodes are attached to the palm of the non-dominant hand. Parents completed questionnaire measures of their antisocial behavior and their child's behavior problems. Participants were fully debriefed and provided with monetary compensation.

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## *Measures*

### *Parent Antisocial Behavior*

Parents completed the Sub Types of Antisocial Behavior Questionnaire (STAB), which measures rule-breaking (11 items; e.g., “I shoplifted things”), physical (10 items; e.g., “I felt like hitting people”), and social aggression (11 items; e.g., “I tried to hurt someone’s feelings”) (Burt & Donnellan, 2009). Items were scored on a scale from 1 to 5, with higher scores indicating more frequent antisocial behavior. Reliability coefficients were .33, .65, and .81 for mothers, respectively. Reliability coefficients were .65, .80, and .78 for fathers, respectively. Because reliability of rule breaking was so low, and additional examination of this scale revealed very little variability, rule breaking is not considered further.

### *Child Behavior Problems*

Parents completed the externalizing scale of the Child Behavior Checklist (CBCL), which provides assessments of child aggression (20 items; “get’s in many fights”) and delinquency (13 items; “lying or cheating”) (Achenbach, 1991). Items are scored on a scale from 0 to 2, with higher scores indicating the behavior is more characteristic of the child. The CBCL is the most widely used measure of children’s behavior problems, and has well-established reliability and validity. Mother and father reports were considered separately in the present investigation.

### *Skin Conductance Acquisition and Scoring*

Electrodes were GSR Disposable Sensors from Lafayette Instrument (Lafayette, IN). A custom bioamplifier from Mindware Technologies (BioNex Model 3711-08; Gahanna, OH) is used during data collection, and the signal is digitized with the Mindware acquisition system BioLab 2.5 at a sampling rate of 1,000 readings per second. The signal is then processed using an analysis software package from Mindware, EDA 3.0.10. The software provides estimates of average skin conductance level throughout the baseline period, and the extent of nonspecific skin conductance responses. Variables are scaled to microSiemens (mS).

### *Data Analysis*

Analyses were conducted with multiple regression models using PASW Statistics version 18. First, interactions between parental antisocial behavior (either social aggression or physical aggression) and parent skin conductance (level or nonspecific responses) were tested in the prediction of children’s behavioral problems. Separate models were fit for mother and father report of children’s aggression or delinquency. Interactions were tested following guidelines set forth by Aiken and West (1991). Variables were mean centered before computing cross products, and significant interactions were probed such that simple slopes of the association between parent antisocial behavior and child behavior problems were tested at +1 and -1 SD of parent skin conductance. Due to low power, marginal associations are also reported. Next, interactions between parental antisocial behavior and parent skin conductance were tested in the prediction of children’s skin conductance level and nonspecific responses. Finally, children’s skin conductance level and nonspecific responses were considered as predictors of children’s

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behavioral problems. All models controlled for child sex and age. Child sex and age were also examined as potential moderators of associations, including three-way interactions with age or sex. Only one significant three-way interaction was observed, and therefore these interactions are not interpreted.

## Results

### *Preliminary Analyses*

Means and standard deviations for all variables are presented in Table 1. Correlations among variables are also shown in Table 1. Significant positive associations between some measures of parent report of child behavior problems were observed. Mother social aggression and physical aggression were also positively related to each other. Mother social aggression was correlated with lower child delinquency as reported by fathers. Mother skin conductance level was positively related to mother skin conductance responses. Greater father skin conductance level was related to greater child skin conductance level. Greater father skin conductance responses were associated with lower mother reported child aggressive behaviors. Children skin conductance level and skin conductance responses were positively correlated.

### *Interactions between Parent Antisocial Behavior and Parent Skin Conductance*

#### *Prediction of Child Behavior Problems*

Mother social aggression and skin conductance level interacted to predict father report of child delinquency,  $\beta = .36, p = .058$ . This interaction is plotted in Figure 1A. When mother skin conductance level is lower, greater mother social aggression is associated with children's lower delinquency. When mother skin conductance is higher, however, there is no association between mother social aggression and child delinquency. Father physical aggression interacted with father skin conductance responses to predict mother reported child delinquency,  $\beta = -.37, p < .05$ . This interaction is plotted in Figure 1B. Although neither simple slope was significant, it appears that when father physical aggression is higher, children with fathers higher in skin conductance responses have lower delinquency than children with father lower in skin conductance responses.

#### *Prediction of Child Skin Conductance*

Father social aggression interacted with father skin conductance level in the prediction of children's skin conductance level,  $\beta = .40, p < .05$ . This interaction is plotted in Figure 2A below. When father skin conductance level is higher, greater father social aggression is associated with greater child skin conductance. When father skin conductance is lower, father social aggression is associated with lower child skin conductance.

#### *Child Skin Conductance as a Predictor of Child Behavior Problems*

Associations between child skin conductance and child behavior problems were moderated by child age. For example, child skin conductance responses interacted with child age in the prediction of mother reported child delinquency,  $\beta = .28, p = .067$ . The interaction is plotted in

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Figure 3A. Although neither simple slope was significant, when child skin conductance responses are lower, young children engage in greater delinquency than older children. This same interaction predicted father report of child aggression,  $\beta = -.31, p < .05$ . This interaction is plotted in Figure 3B. Child skin conductance responses were associated with greater child aggression only for younger children.

Because parent antisocial behavior and parent skin conductance was found to interact in the prediction of children's skin conductance level but not response, no tests of mediation are conducted.

### Discussion

The present study aimed to identify relations between parent antisocial behavior and child behavior problems, and determine the role of sympathetic nervous system activity (as indexed by skin conductance level and responses) in these relations. The proposed model was that parent antisocial behavior and skin conductance would interact to predict child behavior problems, and that these associations would be mediated by child skin conductance. Results partially supported this model.

Results indicated that relations between parent antisocial behavior, particularly mother social aggression and father physical aggression, and children's delinquency were moderated by parent skin conductance. The pattern of findings differed for mother and father antisocial behavior. With regard to mother social aggression, children were at lower risk of delinquency only when mothers exhibited higher skin conductance level. For father physical aggression, children appeared to be at greater risk for delinquency only when fathers exhibited lower skin conductance responses. In both cases, it appears that greater SNS arousal is protective and lower SNS arousal is a risk factor. This is consistent with the hypothesis that greater SNS activity protects against the development of cold, callous, antisocial behavior. Findings are also supported by prior studies of SNS activity and antisocial behavior, both in adults and children. The current study extends findings to examine relations between parent SNS activity and child behavioral issues.

Results also indicated that relations between father social aggression and children's skin conductance level were moderated by father skin conductance level. Father social aggression was linked to children's higher skin conductance level only when father's also had higher skin conductance level. Father social aggression was linked to children's lower skin conductance level only when father's also had lower skin conductance level. These findings support the role of genetics in antisocial behavior, with the caveat that expected relations between father and child skin conductance were apparent only in the context of environmental risk (e.g., greater father social aggression). Such an interpretation of findings would be consistent with a modern understanding of how heritability occurs (Ge et al., 1996)

Unfortunately, children's skin conductance level was not found to predict children's behavioral problems and thus full criteria for mediation were not met. However, children's skin conductance response was associated with child aggression and delinquency. In the context of lower child skin conductance response, young children had greater delinquency than older



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children. In contrast, older children had greater aggression than younger children. These findings suggest complex relations between child SNS activity and behavioral problems. It is possible that the manifestation of behavioral problems associated with SNS under-arousal depends on developmental period. Interestingly, aggression is less normative for older children, while delinquency is less normative for younger children (Crick, 1997). Thus, SNS under-arousal may increase risk for behavioral problems that are developmentally inappropriate. Although findings did not pertain to skin conductance level, findings do open the door for future studies on the role of SNS activity in the transmission of antisocial behavior from parent to child.

Findings should be interpreted with caution given the limitations of the study. The sample size was very small for the complexity of the model under investigation. For this reason, null findings should not be interpreted, as they may be due to low power. The cross-sectional design is another important limitation. It is not clear what the causal direction of association between variables may be. For example, it is possible that aggressive and delinquent children create stress and frustration for parents, increasing their aggressive behavior. More longitudinal research is needed to shed additional light on these phenomena. Not all of the parents in the current study were genetically related to the child, although the overwhelming majority was. Non-biological relations may have prevented the detection of associations between parent and child behavior. Finally, participants in this study were predominantly European American, and it is not clear whether findings would generalize to more diverse samples.

Despite these limitations, the current study makes an important contribution to the study of child behavior problems. Specifically, findings suggest that SNS activity may play an important role in the transmission of adult antisocial behavior to children. Both parent and child SNS activity were involved in associations, and it appears that the combination of parent antisocial behavior and SNS under-arousal may be especially detrimental for children.



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Table 1: Means, Standard Deviations, and Correlations among Study Variables

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1. Mom Social Agg.	16.42	4.53		.38**	-.01	.00	.14	.30	-.03	-.08	-.11	.00	.23	.06	-.11	-.29*	.07	.04	
2. Mom Phys. Agg.	14.61	3.22			-.07	.11	-.11	-.06	-.20	.01	-.16	-.12	.09	.03	.03	-.19	-.01	.04	
3. Dad Social Agg.	16.58	4.05				.53	-.07	-.01	-.15	-.11	-.08	.02	.25	.01	.18	.05	.11	-.16	
4. Dad Phys. Agg.	14.88	3.73					-.11	-.22	-.11	.19	-.13	.10	.08	.03	-.07	-.16	.01	-.15	
5. Mom SCL	3.33	2.64						.48**	.21	.09	.20	.07	.17	.12	-.13	-.03	.01	-.02	
6. Mom SCR	20.64	14.41							.25	.21	.21	.25	.17	.17	-.01	-.06	.23	.12	
7. Dad SCL	6.09	5.33								.23	.52***	.10	-.10	.22	-.03	.04	-.01	.04	
8. Dad SCR	22.96	11.09									-.02	.24	-.30*	.04	.21	.02	-.11	.07	
9. Child SCL	7.08	6.14										.40**	.10	.07	-.05	.08	.00	.30	
10. Child SCR	31.33	20.69											.21	.04	.05	.05	.04	.14	
11. Child Agg. MR	26.75	5.14												.44***	.02	-.20	-.22	-.03	
12. Child Del. MR	14.22	1.42													-.04	-.10	-.26	.02	
13. Child Agg. DR	26.72	5.30														.64***	-.10	-.06	
14. Child Del. DR	14.15	1.26															.12	-.01	
15. Child Age	8.80	1.94																	-.02
16. Child Male	0.47	0.50																	

Note: Agg = Aggression, Phys. = Physical, Del = Delinquency, MR = Mom Report, DR = Dad Report; \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

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### **Figure Captions**

*Figure 1.* Interactions between Parent Antisocial Behavior and Skin Conductance in the Prediction of Children's Behavior Problems

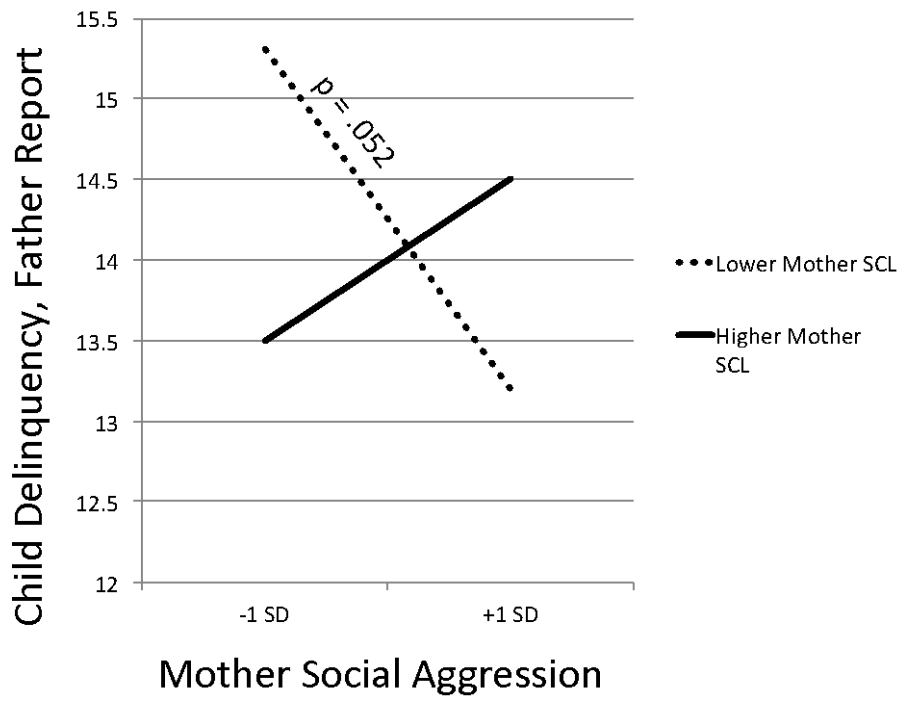
*Figure 2.* Interactions between Parent Antisocial Behavior and Skin Conductance in the Prediction of Children's Skin Conductance

*Figure 3.* Interactions between Children's Skin Conductance and Child Age in the Prediction of Children's Behavior Problems

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Figure 1.

A.



B.

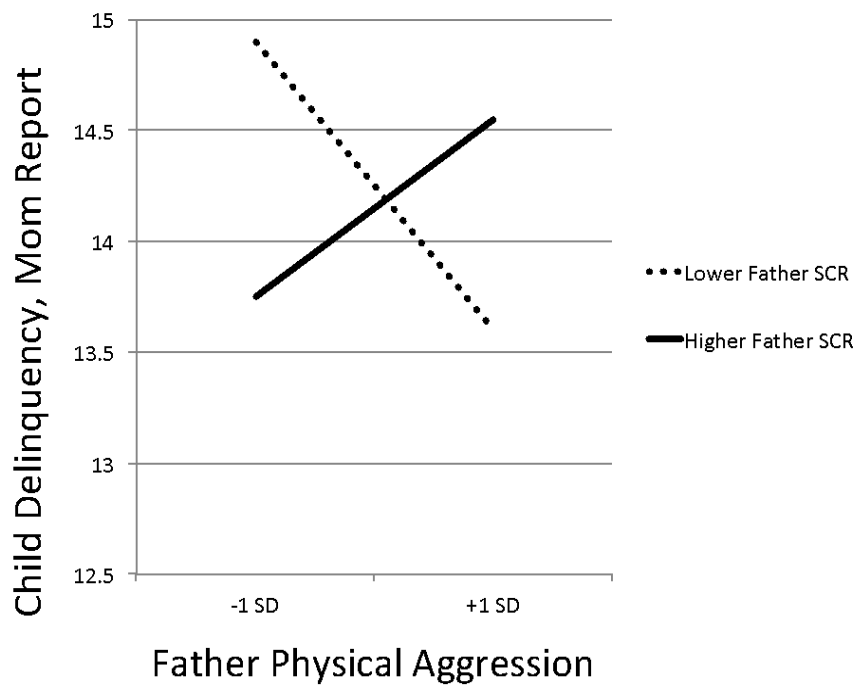
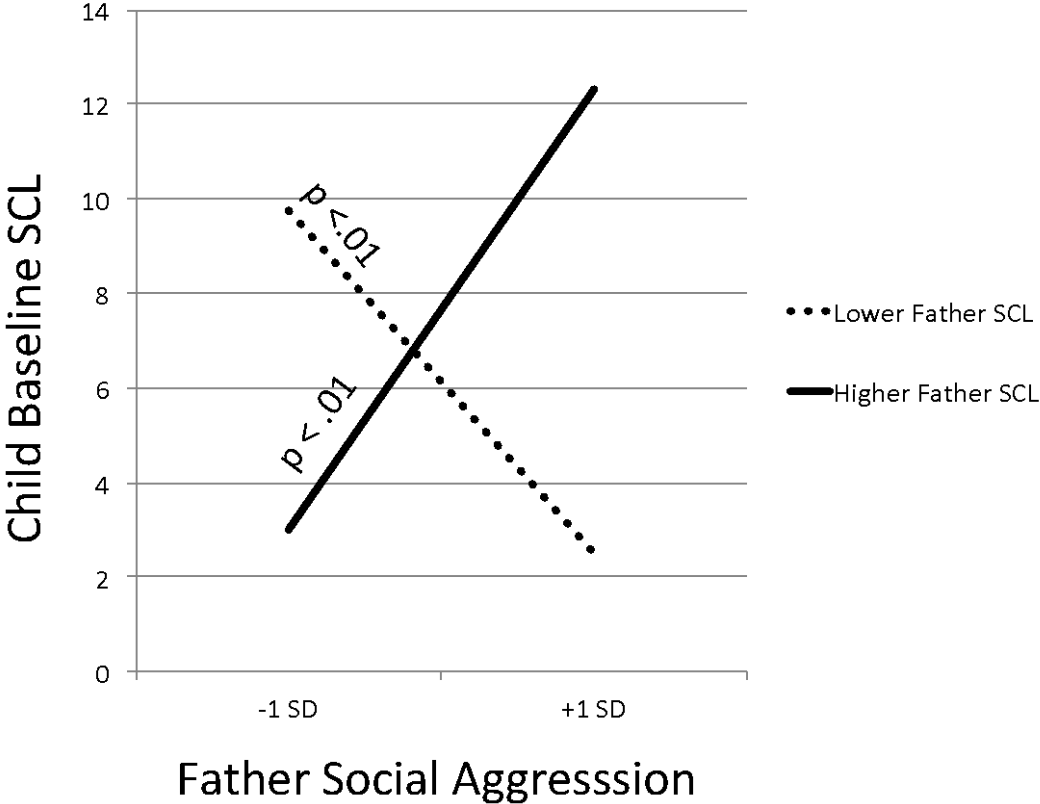


Figure 2.

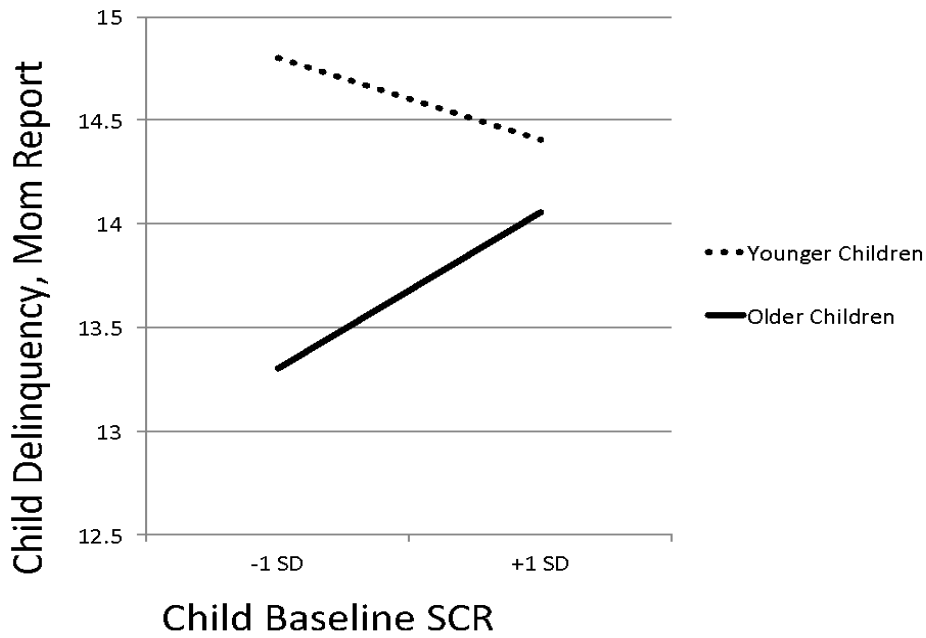
A.



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Figure 3.

A.



B.

