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Do parenting behaviors modify the way sensation seeking influences antisocial behaviors?

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Abstract

Background: Parenting behaviors have been shown to moderate the association between sensation seeking and antisocial behaviors.

Methods: Data were obtained from the Boricua Youth Study, a longitudinal study of 2,491 Puerto Rican youth living in the South Bronx, New York, and the metropolitan area of San Juan, Puerto Rico. First, we examined the prospective relationship between sensation seeking and antisocial behaviors across three yearly waves and whether this relationship varied by sociodemographic factors. Second, we examined the moderating role of parenting behaviors - including parental monitoring, warmth, and coercive discipline - on the prospective relationship between sensation seeking and antisocial behaviors.

Results: Sensation seeking was a strong predictor of antisocial behaviors for youth across two different socio-cultural contexts. High parental monitoring buffered the association between sensation seeking and antisocial behaviors, protecting individuals with this trait. Low parental warmth was associated with high levels of antisocial behaviors, regardless of the sensation seeking level. Among those with high parental warmth, sensation seeking predicted antisocial behaviors but the levels of antisocial behaviors were never as high as those of youth with low parental warmth.

Conclusions: Study findings underscore the relevance of person-family context interactions in the development of antisocial behaviors. Future interventions should focus on the interplay between individual vulnerabilities and family context to prevent the unhealthy expression of a trait that is present in many individuals.

Keywords

sensation seeking; delinquency; antisocial behavior; parenting; child development

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Introduction

Individuals with high sensation seeking tend to seek varied, novel, complex, and intense situations and experiences. These individuals are willing to take physical, social, and financial risks for the sake of these experiences (Zuckerman & Neeb 1979). Sensation seeking has been associated with problem behaviors including high risk sexual behaviors and gambling (Miles et al., 2001) and predicts the escalation of substance use from adolescence to early adulthood (Quinn & Harden, 2013). Longitudinal increases in sensation seeking are associated with increases in delinquency from early to late adolescence (Mann et al., 2017). However, sensation seeking has also been linked to positive outcomes including engagement in stimulating activities, and a cognitive and perceptual preference for complexity, creativity and flexibility (Roberti, 2004).

The association of sensation seeking with problem behaviors appears to be linked to one's risk appraisal, with lowered perception of negative consequences of behaviors, and increased likelihood of engagement in antisocial behaviors (Horvath & Zuckerman, 1993). Similar to other personality traits (Briley & Tucker-Drob, 2014; Ferguson, 2010), there is evidence that the sociocultural environment can modify the trajectory and expression of sensation seeking (Martins et al., 2015). A study focused on high sensation seeking adolescents, for example, suggested that those living in resourceful social backgrounds more frequently engage in positive stimulating activities, while those living in disadvantaged social backgrounds appear to be more likely to engage in antisocial behaviors or drug abuse (Hansen & Breivik, 2001). Identifying factors that may prevent high sensation seeking from leading to problem behavior or protect from engagement in antisocial behaviors is a strategy of high potential impact for prevention.

More broadly, there has been a shift in the understanding of the complexity and interplay of the factors that lead to the development of antisocial behaviors. The focus on the direct influence of vulnerabilities (e.g. genotypes, personality traits) on psychopathology has shifted to elucidating how these different vulnerabilities interact with environmental factors in order to lead to adverse outcomes (Dick et al., 2009; Kim-Cohen et al., 2006). Parenting is an important environmental factor for youth antisocial behaviors, likely to be of greater importance during childhood. Dimensions of parenting relevant for child antisocial behaviors include parental monitoring (knowledge about the child's whereabouts, activities, social engagement and supervision), parental warmth (involvement in youth's life and expression of acceptance, approval, and affection), and coercive discipline (a negative practice typically involving punitive measures including physical punishment) (Allen et al., 2016). For instance, a British nationally representative birth cohort including children ages 5–12 demonstrated that high parental monitoring completely accounted for associations between social disadvantage and the course of children's antisocial behaviors (Odgers et al., 2012). Regardless of the course of the antisocial behaviors, maternal warmth and parental monitoring explained the decrease of their children's antisocial behavior decreased, while other family-level risk factors (e.g., socioeconomic disadvantage, parental psychiatric history) had no such effect (Odgers et al., 2012).

To date, few studies have examined the connection between parenting behaviors and antisocial behaviors specifically in relation to a well-known risk factor: sensation seeking. A study conducted with a sample of adolescent twins found evidence for an interaction between sensation seeking and parental monitoring predicting adolescent delinquency, and a three-way interaction between sensation seeking, peer deviance and parental monitoring predicting adolescent delinquency (Mann, Kretsch, Tackett, Harden, & Tucker-Drob, 2015). Nonetheless, it is unknown whether other supportive parenting behaviors moderate the relationship between sensation seeking and antisocial behaviors. A deeper understanding of the interplay between sensation seeking and modifiable parenting factors in the development of antisocial behaviors is needed. Knowledge of which specific parenting factors are relevant and what their impact is, taking sensation seeking into consideration, would inform targeted interventions that could be implemented in earlier stages of life, having a greater impact in decreasing negative outcomes. Hypothetically, interventions that protect children with high sensation seeking from antisocial behaviors could also lead to the expression of positive outcomes linked with this trait.

The current study seeks to extend knowledge regarding the longitudinal development of antisocial behaviors among youth by analyzing data from a large prospective cohort study of Puerto Rican youth ages 5–13 growing up in two different sociocultural contexts (Puerto Rico and the South Bronx, NY). This study seeks to examine parenting behaviors that may moderate the association between sensation seeking and antisocial behaviors. The aims of this study are: 1) to document the prospective relationship between sensation seeking and antisocial behaviors from early childhood through early adolescence (ages 5–13 years) and to explore whether this relationship varies by sociodemographic factors; and 2) to examine the moderating role of parenting behaviors on this prospective relationship between sensation seeking levels and antisocial behaviors.

Methods

Sample

The present study was based on the Boricua Youth Study (BYS), a longitudinal study of children and adolescents of Puerto Rican background, which conducted 3 yearly assessments from the summer of 2000 to the fall of 2004 (Bird et al., 2006). A total of 2,491 Puerto Rican (PR) children 5 to 13 years of age were recruited at baseline in the South Bronx (SBx), New York (n = 1,138) and in the standard metropolitan area of San Juan and Caguas, Puerto Rico (n = 1,353). Even though all children were ages 5 to 13 years at enumeration, some were 1 year older or more at the time of their first interview (n=100 interviewed at age 14 and n=7 at age 15). Each sample was a multistage probability sample of the target population weighted to represent the populations of Puerto Rican children in the two sociocultural contexts. Retention rates by the third assessment wave were very high (85.6% in SBx and 89.7% in PR). Sampling methods and procedures have been described in detail elsewhere (Bird et al., 2006, 2007). Study procedures were approved by the New York State Psychiatric Institute and the University of Puerto Rico Medical School Institutional Review Boards.

Measures

Variables were measured at study waves 1, 2 and 3 from 2000–2004. Specific variables and wave(s) included in the current analysis are described below.

Outcome:

Antisocial behaviors. For each of the three waves of data collection, parents responded to the conduct disorder and oppositional defiant disorder schedules of the diagnostic interview schedule for children (DISC-IV) (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000; Bravo et al., 2001). Children completed the Elliot Delinquency Scale. Items measuring past-year delinquency were developmentally appropriate and some differed across two age groups (ages 5 to 9 and age 10 and older). For the younger group, the delinquency scale contained 29 items, and 36 items for the older group. Representative items for both age groups included stealing, intentionally damaging others' property and shoplifting. Representative items for the older group included carrying a weapon, snatching a purse or wallet, pick-pocketing, throwing rocks or bottles at people, and so on. Responses to the DISC and Elliot were used to develop an Antisocial Behavior Severity Index (ASBSI), described in detail elsewhere (Bird et al., 2005; 2007; Morcillo et al., 2011). The ASBI (which is not a symptom count or averaged measure) provides a classification along a spectrum that takes into account severity, frequency of occurrence during the previous year, presence of multiple behaviors and developmental heterotypic continuity (Caspi, 2005). Therefore, normative developmental expectations of behaviors for the different age groups are considered. Similar rating could be given to different behaviors based on the developmental period (e.g., the same score was given to a 5–9-year-old who tried alcohol or tobacco once in the past year as a 10+ year old who got drunk in public in the past year). The resulting measure is a 0 to 5 ordinal scale, with higher scores indicating more serious, and frequent engagement in antisocial behaviors.

Main Predictor:

Sensation Seeking. Sensation seeking was measured through 10 items from the sensation seeking scale (Russo, Lahey, & Christ 1991), a shorter version of Zuckerman et al.'s sensation seeking scale (Zuckerman & Neeb 1979). Seven items represent Zuckerman & Neeb's thrill- and adventure-seeking factor and three are from the social disinhibition subscale. The scale was adapted for children as young as 5 years old by the BYS team. For each item, children were instructed to identify which of two behaviors was more like them ($\alpha = 0.72$) (see Appendix S1: Sensation Seeking Scale). The consistency of sensation seeking scale measures across different ages has been described in detail elsewhere (Martins et al., 2015).

Parenting behaviors.

To examine the moderating effects of potentially modifiable parenting behaviors in the pathways to antisocial behaviors, we included parental monitoring, warmth and coercive discipline. Parenting behaviors were assessed through parental report at waves 1 and 2.

Parental Monitoring was assessed using the Parental Monitoring Scale (Patterson & Stouthamer-Loeber, 1984). The scale consists of 9 items that assess how closely parents kept track of children's whereabouts and supervised activities during the past year (Bird et al., 2006; Santesteban-Echarri et al., 2017). Responses ranged from 0 to 3 and were averaged, with higher values indicating increased monitoring. The Parental Monitoring Scale ($\alpha = 0.55$) (Bird et al., 2006) has good test-retest reliability (0.77) and correlates with measures of delinquency, with good differentiation between moderate versus persistent delinquent offenders (Patterson & Stouthamer-Loeber, 1984).

Parental Warmth was assessed according to the Maternal Acceptance and Warmth scale, a 13-item adaptation of Hudson's Index of Parental Attitudes (Hudson, 1982). This measure includes items about trust, understanding, closeness, and feelings between mother and child. Participants responded using a 4 point Likert scale ranging from 0 = never/almost never or not at all to 3 = very often or a lot (wave 1 $\alpha = .81$ overall, .81 in NY and .82 in PR; wave 2 $\alpha = .82$ overall, .83 in NY and .82 in PR). Responses were averaged.

Parental Coercive Discipline was assessed using the parent version of the Parental Discipline scale (Goodman et al., 1998). Parents responded to 6 items measuring coercive discipline and punishment. Responses ranged from 0=never/almost never to 3 very often and were averaged. This scale has yielded an internal consistency of .67 (Rivera, López, Guarnaccia, Ramirez, Canino, & Bird, 2011).

Sociodemographic factors: We examined factors (all measured at wave 1) that have been widely studied as general risk factors for antisocial behaviors in children. These included: sociocultural context (study site, Puerto Rico and South Bronx), household socioeconomic status (classified by income/number of household residents according to US federal poverty guidelines) and child gender. Age is a continuous measure assessed at each wave. For interpretation of the model, age was defined as younger (6 years old) and older (14 years old).

Data Analysis

Descriptive means and standard deviations of all variables at each wave were calculated. Parenting variables were standardized for subsequent regression analyses so their beta coefficients could be readily compared to one another in magnitude; other variables were not standardized. Longitudinal mixed effects regression models were used to estimate the prospective association between sensation seeking and parenting behaviors at wave t-1 with the dependent variable, antisocial behavior at wave t, for t = 2, 3 (i.e. the next wave). The first model we fit only included main effects as predictors: antisocial and parenting behaviors in the previous wave (monitoring, warmth and coercive discipline) and sociodemographic factors (site, gender, and time-varying age). A random family effect was included to control for clustering of children within families, and a random intercept and random slope of previous sensation seeking were included to account for repeated measures on participants over time. The second model we fit extended the first model by including interactions between sensation seeking in the previous wave and both sociodemographic factors and parenting behaviors. This model was used to examine whether the effect of

previous sensation seeking on future antisocial behaviors (e.g., sensation seeking at wave 1 and antisocial behavior at wave 2) was moderated by sociodemographic factors or parenting behaviors. To facilitate interpretation of statistically significant interactions, predicted slopes of sensation seeking are contrasted for low and high values of the moderating factors. Analyses included all subjects regardless of missing at wave 2 and wave 3 (8.2% missing at wave 2 and 12.2% missing at wave 3) under the standard missing at random assumption. **To examine whether the observed interactions were consistent across different contexts, we also tested for a three-way interaction between site and the significant two-way interactions observed in the second model between sociodemographic factors or parenting behaviors and sensation seeking.** All analyses incorporated sampling weights so the final estimates represent the original population and were conducted in SAS software (version 9.4, 2013, SAS, Inc., Cary, NC). Statistical significance was set at $\alpha < 0.05$.

Results

Prospective association between sensation seeking and parenting behaviors

Table 1 reports descriptive statistics for age, sensation seeking, antisocial behaviors and parenting behaviors. The sample was on average 9 years old at wave 1, 10, and 11 at waves 2 and 3. Sensation seeking and parenting variables had similar mean values and variability across all waves. Sensation seeking was significantly correlated with antisocial behaviors and parenting behaviors at all three waves (Table S1). Youth with higher sensation seeking had a significant increase in antisocial behaviors at the next wave after controlling for previous antisocial behaviors, sociodemographic factors and parenting variables (Table 2, Model 1). There was significant variability between individuals in the level of antisocial behaviors (variance of random intercept = 0.61) and in the strength of the association with sensations seeking (variance of random slope = 0.04) as compared to the unexplained variance within person across time, i.e. random error (0.71). After controlling for previous antisocial behaviors and sensations seeking, males, older participants, and South Bronx residents had higher mean antisocial behaviors. Parental monitoring was not associated with antisocial behaviors at the next wave ($b = -0.001$, standard error (SE) = 0.021, $p = 0.963$). Youth with parents reporting one standard deviation higher warmth had decreased antisocial behaviors at the next wave ($b = -0.183$, SE = 0.023, $p < 0.001$) and those who reported higher coercive discipline had children with increased antisocial behavior at the next wave ($b = 0.044$, SE = 0.021, $p = 0.037$). Taking into consideration the standard deviation of ASBI (SD = 1.37 across all waves), these beta coefficients imply moderate 0.53 standard deviations lower ASBI for youth with parents at the high vs low levels of warmth (+2 vs. -2 standard deviations) (i.e. $-0.183 \times 1.37 = 0.53$), and small 0.13 standard deviation higher ASBI differences at high verses low levels of parental discipline.

Interactions between sensation seeking with sociodemographic factors and parenting behaviors

When we tested the moderating effects of sociodemographic factors and parenting behaviors on the relationship between sensation seeking and antisocial behaviors (Table 2, Model 2), age, previous parental monitoring and warmth were found to significantly interact with

previous sensation seeking ($p = 0.040$, $p = 0.0002$, and $p = 0.035$ respectively). Gender, site and coercive discipline did not significantly interact with previous sensation seeking. The BIC of the interaction model including only those significant interactions (Table S2) was 15352.8 compared to the main effects only model 15353.0 indicating a better fit.

The positive interaction between age and sensation seeking indicated that the strength of the relationship between sensation seeking and antisocial behaviors at the next time point became stronger as children became older (Table 3, Figure 1). For younger children (6 years old), previous sensation seeking had no effect on antisocial behaviors ($b = 0.011$, $SE = 0.020$, $p = 0.586$), while for older children (14 years old), high sensation seeking predicted high antisocial behaviors at the next time point ($b = 0.075$, $SE = 0.017$, $p < 0.0001$).

The interaction with parental monitoring indicates that - in the presence of high parental monitoring - the strong effect of sensation seeking on antisocial behaviors is no longer present (Table 3, Figure 2), while the association between sensation seeking and antisocial behaviors is still present at low levels of parental monitoring (low parental monitoring, $b = 0.079$, $SE = 0.015$, $p < 0.0001$, high parental monitoring, $b = 0.004$, $SE = 0.014$, $p = 0.765$). When parental warmth is low, antisocial behavior is high regardless of the sensation seeking level (Table 3, Figure 3), rendering a null association between sensation seeking and antisocial behaviors ($b = 0.016$, $SE = 0.015$, $p = 0.312$). Finally, the significant interaction with parental warmth indicates that, in the presence of high parental warmth, as sensation seeking increases, antisocial behavior also increases ($b = 0.061$, $SE = 0.014$, $p < 0.0001$).

Three-way interaction between site, parenting behaviors and sensation seeking

None of the interactions between sociodemographic factors or parenting behaviors and sensation seeking were further moderated by site in the 3-way interaction model (all p -values > 0.10) (see Table S3).

Discussion

Overall, our study findings extend knowledge about the benefits of parental behaviors beyond their protection against problematic behaviors in youth by documenting the moderating effects of specific dimensions of parenting on antisocial behaviors when considering levels of sensation seeking, a trait that has been linked to problematic outcomes. Consistent with a person-family context interaction, we found that while sensation seeking was a strong predictor of antisocial behaviors, high levels of parental monitoring buffered this association, protecting those with high sensation seeking from engaging in antisocial behaviors. Furthermore, low parental warmth was associated with high levels of antisocial behaviors, regardless of sensation seeking, while among those experiencing high parental warmth, sensation seeking predicted antisocial behavior.

Our findings suggest that high parental monitoring protect youth with sensation seeking traits from antisocial behaviors. The moderating effect of parental monitoring on the relationship between sensation seeking and antisocial behaviors converge with studies demonstrating that parental monitoring moderates the trajectories of externalizing behaviors among carriers of a high-risk GABRA2 gene, a variant that has been associated with

sensation seeking, conduct disorder, antisocial behaviors and substance use disorders (Dick et al., 2009). Studies have shown that the effect of this high-risk genotype on externalizing behavior is stronger under conditions of low parental monitoring and weaker under conditions of high parental monitoring (Dick et al., 2009; Trucco, Villafuerte, Heitzeg, Burmeister, & Zucker, 2016). Mechanistically, as opposed to other parental behaviors such as warmth and coercive discipline, high parental monitoring may specifically halt a trajectory of antisocial behavior by preventing exposure to opportunities to engage in such behaviors or preventing the shaping of these behaviors via the positive reinforcement of deviant peers among those at high risk (for example, those with high sensation seeking levels and/or genetically predisposed) (Haynie & Osgood, 2005; Mann et al., 2015). Indeed, some studies have suggested that deviant peer affiliation mediates the association between sensation seeking and another problematic behavior like substance use (Hampson, Andrews & Barckley, 2008).

A gene-environment interaction model of “differential susceptibility” has been proposed where certain attributes or genetic variants confer a greater “plasticity” to the environment, predisposing individuals to develop or function poorly under adverse conditions but also to develop or function especially well under positive circumstances (Belsky & Pluess, 2009). Exemplifying this model, studies have shown that carriers of the GABRA2 variants have worse outcomes compared to the comparison group when the environment is negative but demonstrate better outcomes than the comparison group when the environment is supportive (Trucco et al., 2016). Although we did not test positive outcomes, our study found that, partially consistent with this idea, in spite of multiple stressors, the high-risk children that receive effective monitoring do not end up engaging in antisocial behaviors. If sensation seeking represents a phenotype for some of these genetic variants, offering these children opportunities to participate in highly stimulating or complex activities while reducing unsupervised time and exposure to delinquent peers/activities via adequate parental monitoring, may offer the possibility for a healthy expression of sensation seeking.

Low parental warmth has a defining effect on youth antisocial behaviors. When youth experience low parental warmth, their levels of antisocial behaviors are high regardless of the presence of a trait like sensation seeking. Low parental warmth may interfere with the development of a prosocial conceptualization of interpersonal relationships and an emotional connectedness with others (Laible & Thompson, 2002). Among those experiencing high parental warmth, sensation seeking was related to the likelihood of engaging in antisocial behaviors. This suggests that for high sensation seeking youth raised in families with high parental warmth, strategies that address sensation seeking may decrease antisocial behaviors. Importantly, in our study, overall, the level of antisocial behavior among youth experiencing high parental warmth never reaches the level among those experiencing low parental warmth. This finding is congruent with the generalized effect of parental warmth across different types of psychiatric disorders recently reported in the same sample (Santesteban-Echarri et al., 2017).

Our findings on the interaction between sensation seeking and parenting behaviors (monitoring and warmth) suggest that interventions may be particularly helpful in adolescence. It is possible that one of the mechanisms by which parental monitoring exerts a

protective effect on antisocial behaviors is confined to a critical time in development, prior to young adulthood when peers carry greater influence (Steinberg, Fletcher, & Darling, 1994). Given that late childhood and early adolescence are crucial periods for the onset of serious and chronic antisocial behaviors, and that these behaviors negatively affect educational attainment and vocational goals, support for parenting interventions instead of punitive measures may be a powerful target for public policy. Several behavioral family interventions are particularly effective for families with children with conduct problems that emphasize training in positive parenting knowledge and skills, including parental monitoring and supervision (Brody et al., 2012; Prado et al., 2012; Sanders, 2012).

Our finding that none of the interactions between parenting behaviors and sensation seeking were moderated by site are worth noting. Using the same dataset we have previously found that the trajectory of antisocial behavior was lower for those living in San Juan as compared to those living in the South Bronx, NYC (Bird et al., 2007), and that a higher level of parental Anglo cultural orientation was related to more severe youth antisocial behaviors (Duarte et al., 2008). We have also found that parental familism was inversely related to antisocial behaviors overtime although we did not find interactions between parental familism and site (Morcillo et al., 2011). Even though neighborhood conditions consistently emerge as predictors of children's antisocial behavior, our findings are in line with previous studies that highlight the importance of parenting behaviors, sometimes surpassing other factors that have been associated with antisocial behaviors (Ingoldsby et al., 2006). Also, several studies have demonstrated that parenting behaviors may mediate the effects of poverty and other structural neighborhood characteristics on antisocial behaviors (Chung & Steinberg, 2006; Odgers et al., 2012).

Limitations are noted. First, we relied solely on self- and parent-reported data for all of our measures. In particular, parenting behaviors were based on parental reports and not assessed with observed parent-child interactions or corroborated by their children. **Second, the internal consistency of parental monitoring is relatively low. It is important to note though, that the items used for this construct were not meant to be unidimensional or internally consistent but instead provide an index. Formative measurement rather than reflective measurement (Diamantopoulos & Siguaw, 2006) is a more appropriate model here and hence cronbach alpha is not expected to be high nor representative of the reliability index. We acknowledge that with the low alpha, if this were a reflective measure, the low reliability would have only attenuated the strength of the associations.** Third, while questions on parental monitoring included monitoring of internet and chat room activity, the follow-up of respondents spanned only 3 years and began more than 10 years ago. Therefore, data do not include parental monitoring of texting, video chatting, social media platforms and other more modern technologies. Fourth, given that some of our findings demonstrated marginally significant p-values, more replication studies are needed before drawing definite conclusions. Nonetheless, many of our findings expand and are consistent with the literature on person-family context interactions and the development of antisocial behaviors. Fifth, some of our measures have not been explicitly tested for measurement invariance across sites. Lastly, although the ASBSI scoring system allowed us to report a metric that is both easily interpreted and clinically relevant, reporting a single

score that collapses responses across multiple informants could result in a loss of information. Despite limitations, this is the first study to use a population-based homogeneous Latino subgroup living in two sites to investigate the moderating effects of parenting behaviors on antisocial behaviors in youth in relationship with varying sensation seeking levels.

Conclusion

The findings of this study offer support to studies on antisocial behaviors that demonstrate person-family context interactions and highlight the importance of considering modifiable parenting behaviors to develop interventions for at-risk populations. It is important to move away from targeting single traits or risk factors and viewing them as unmodifiable to focusing on strategies that can foster resilience in families and could lead to the healthy and positive expression of a trait that is present in many individuals.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key points

- Parenting behaviors modify the well-known association between sensation seeking and antisocial behaviors
- Sensation seeking predicted antisocial behaviors in a cohort study of children ages 5–13 years of the same ethnic background living in two different contexts
- High levels of parental monitoring buffered the association between sensation seeking and antisocial behaviors, protecting individuals with this trait
- Low parental warmth was associated with high levels of antisocial behaviors, regardless of the sensation seeking level, while among those experiencing high parental warmth, sensation seeking predicted antisocial behavior
- It is important to focus on the interplay between individual vulnerabilities and the family context when developing interventions

Figure 1.

Adjusted mean antisocial behavior at next wave predicted by interaction between age and sensation seeking at previous wave.

Figure 2.

Adjusted mean antisocial behavior at next wave predicted by interaction between parental monitoring and sensation seeking at previous wave.

Figure 3.

Adjusted mean antisocial behavior at next wave predicted by interaction between parental warmth and sensation seeking at previous wave.

Table 1.

Descriptive Statistics for Child and Parenting Variables at Waves 1 to 3

	Wave 1		Wave 2		Wave 3	
	N = 2,491		N = 2,286		N = 2,187	
Measures	Mean	SD	Mean	SD	Mean	SD
Age	9.30	2.59	10.28	2.59	11.15	2.60
Antisocial Behaviors	1.33	1.40	1.16	1.35	1.07	1.33
Sensation Seeking	3.44	2.51	3.72	2.64	3.77	2.67
Parenting Behaviors						
Monitoring	14.08	2.57	14.06	2.54	13.61	2.68
Coercive discipline	0.50	0.56	0.44	0.53	0.39	0.51
Warmth	2.46	0.40	2.49	0.40	2.51	0.40

Table 2.

Longitudinal models predicting current antisocial behavior with previous antisocial behavior, previous sensation seeking (PSS), demographics and previous parenting behaviors.

Model 1					Model 2				
Predictors	Estimate [†]	Standard Error	t value	P-value	Predictors	Estimate [†]	Standard Error	t value	P-value
Previous antisocial behavior	0.069	0.016	4.45	<.0001	Previous antisocial behavior	0.069	0.016	4.45	<.0001
Previous sensation seeking	0.049	0.010	4.95	<.0001	Previous sensation seeking	−0.051	0.045	−1.14	0.256
Current age [*]	0.031	0.009	3.35	0.0009	Current age	0.006	0.015	0.4	0.687
Gender (Male vs. Female)	0.222	0.047	4.72	<.0001	Gender (Male vs. Female)	0.194	0.075	2.58	0.010
Site (Bronx vs. Puerto Rico)	0.167	0.052	3.19	0.002	Site (Bronx vs. Puerto Rico)	0.110	0.081	1.36	0.174
Previous Parental monitoring ^a	−0.001	0.021	−0.05	0.963	Previous Parental monitoring ^a	0.108	0.036	3.03	0.003
Previous Parental warmth ^a	−0.183	0.023	−7.88	<.0001	Previous Parental warmth ^a	−0.248	0.039	−6.29	<.0001
Previous Coercive discipline ^a	0.044	0.021	2.09	0.037	Previous Coercive discipline ^a	0.039	0.036	1.08	0.279
PSS [*] Age	0.007	0.004	2.06	0.040					
					PSS [*] Gender	0.010	0.019	0.53	0.597
					PSS [*] Site	0.016	0.021	0.77	0.441
					PSS [*] Previous Parental monitoring	−0.032	0.009	−3.78	0.0002
					PSS [*] Previous Parental warmth	0.019	0.009	2.11	0.035
					PSS [*] Previous Coercive discipline	0.001	0.008	0.11	0.914

PSS: Previous sensation seeking

^{*} Time varying variable (age at each wave)

^a Parenting predictor variables have been standardized

[†] Unstandardized beta coefficients

Table 3.

Specific contrasts testing 2-way interactions of sensation seeking with age and parenting variables.

	Estimate [†]	Standard Error	t Value	P-value
Previous Sensation Seeking*Age				
Slope Sensation Seeking for Younger Age	0.011	0.020	0.54	0.586
Slope Sensation Seeking for Older Age	0.075	0.017	4.33	<.0001
Previous Sensation Seeking*Parental monitoring				
Slope Sensation Seeking for Low Parent Monitoring	0.079	0.015	5.45	<.0001
Slope Sensation Seeking for High Parent Monitoring	0.004	0.014	0.30	0.765
Previous Sensation Seeking*Parental warmth				
Slope Sensation Seeking for Low Parent Warmth	0.016	0.015	1.01	0.312
Slope Sensation Seeking for High Parent Warmth	0.061	0.014	4.36	<.0001

[†]Unstandardized beta coefficients

Note: Slope estimates are from mixed effects regression model including all continuous predictors (see Table S1) with age fixed at 6 years old (younger) or 14 (older). Values of low and high monitoring and warmth are fixed at the 10th and 90th percentile of each variable respectively.