

Reinforcement Sensitivity and Risk for Psychopathology Following Exposure to Violence: A Vulnerability-Specificity Model in Latino Youth

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Abstract Urban Latino youth are exposed to high rates of violence, which increases risk for diverse forms of psychopathology. The current study aims to increase specificity in predicting responses by testing the hypothesis that youths' reinforcement sensitivity—behavioral inhibition (BIS) and behavioral approach (BAS)—is associated with specific clinical outcomes and increases risk for the development of such problems following exposure to violence. Utilizing a short-term longitudinal design, Latino youth ($N = 168$) provided reports of BIS/BAS and emotional/behavioral problems at Time 1, exposure to violence between Time 1 and Time 2, and clinical symptoms at Time 2. Results suggested that reinforcement sensitivity moderated the relation between violence exposure and psychopathology, such that increasing levels of BIS were associated with elevated risk for internalizing and posttraumatic stress symptoms following exposure to violence whereas BAS increased risk for externalizing problems. The importance of building on existing knowledge to understand minority youth psychopathology is discussed.

Keywords Behavioral inhibition · Behavioral approach · Violence exposure · Latino · Internalizing · Externalizing · Posttraumatic stress

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Introduction

Exposure to violence represents a major public health concern in the United States [1]. Despite overall high rates of exposure, violence disproportionately impacts poor, urban, and ethnic minority youth [2, 3]. An estimated 50–96% of urban youth report exposure to witnessed community violence [4–6] and urban youth report exposure to more severe forms of violence [7]. Results from the National Survey of Adolescents [8] suggest that relative to their non-Hispanic White counterparts, Latino youth are more likely to have witnessed community violence (50% vs. 34.3%) and to have been physically assaulted (20.7% vs. 15.5%). Latino youth are the largest and fastest growing ethnic minority group in the United States [9, 10] and they appear to be at disproportionate risk of violence exposure.

Exposure to violence is consistently associated with elevated levels of posttraumatic stress symptoms (PTSS) [11]. However, violence exposure is also associated with a broad range of emotional and behavioral problems including depression and anxiety [6, 12, 13] and aggression, conduct disorder, and substance use [14, 15]. It is clear that exposure to violence is associated with both internalizing and externalizing problems, but much less is known about factors that predict specific adjustment trajectories for youth exposed to violence.

Behavioral Inhibition and Approach (BIS/BAS)

Reinforcement sensitivity theory (RST), as proposed by Gray [16, 17], details two primary systems that regulate approach and avoidance behavior: The behavioral inhibition system (BIS) and the behavioral approach system (BAS). According to this model, the BIS is sensitive to conditioned signals of punishment, loss of reward, and novelty, and inhibits behavior that could lead to negative outcomes [18]. The activation of the BIS relates to the experience of negative affect such as anxiety and sadness [19]. Avoidance behavior and negative affect are therefore enhanced when the possibility of danger or punishment is perceived. Conversely, the BAS is sensitive to conditioned signals of reward and activity in this system produces increased movement towards one's goals [20]. Activation of the BAS increases impulsive behavior, as opportunities for reward are pursued with little regard for possible negative consequences. Aside from a tendency to engage in goal-directed activities, greater BAS sensitivity is associated with positive emotions such as hope and happiness in the face of possible reward [21].

BIS/BAS and Youth Psychopathology

Studies utilizing performance tasks to assess response perseveration (i.e., continued pursuit of possible reward despite increasing ratio of punishment to reward) have implicated elevated BAS in children with conduct disorder [22, 23]. Children with comorbid conduct disorder and ADHD also display greater response perseveration relative to children with conduct disorder alone and normal controls [24]. While these studies highlight the relevance of the BAS for externalizing problems, an exclusive reliance on assessing BAS does not clarify whether BAS dominance or an underactive BIS confers vulnerability. Such studies have also employed small clinical samples and cross-sectional designs, which may amplify observed differences in BAS responsiveness.

A separate body of work has focused primarily on internalizing outcomes. Notably, childhood behavioral inhibition in laboratory novelty paradigms is prospectively related to

the development of anxiety disorders [25, 26]. Coplan and colleagues [27] found that children high on BIS and low on BAS are at particular risk for problems including depressive symptoms, negative affect, and fear of negative evaluation as well as lower positive affect and subjective well-being relative to children with other BIS/BAS profiles. Similarly, Vervoort and colleagues [28] found higher levels of BIS in children with anxiety disorders relative to controls. However, these cross-sectional studies omitted the assessment of externalizing symptoms, which may also be associated with disturbances in relative levels of BIS/BAS.

Few studies have assessed both BIS and BAS as well as symptoms of multiple psychiatric disorders in children. Colder and O'Connor [29] found that parent-reported sensitivity to reward (BAS impulsivity/fun seeking dimensions) was associated with externalizing problems in children. Conversely, parent-reported sensitivity to punishment (BIS) was associated with internalizing problems. Muris and colleagues [30] found that children's self-reported BIS was associated with self- and parent-reported emotional problems and anxiety symptoms as well as parent-reported depressive symptoms. Child-reported BAS was related to self- and parent-reported hyperactivity/conduct problems and self-reported aggression. These two studies suggest that individual differences in BIS and BAS confer vulnerability for internalizing and externalizing forms of psychopathology, respectively. However, because these studies are cross-sectional and may confound reports of symptoms with measures of reinforcement sensitivity, it is important to test whether BIS/BAS increases risk for future psychopathology. To our knowledge, there are no prospective longitudinal studies examining both BIS and BAS as risk factors for a wide range of difficulties.

A Vulnerability-Specificity Model of Youth Psychopathology

It is unlikely that individual differences in temperament fully account for the emergence of psychopathology [31]. From a vulnerability model, individual differences in BIS/BAS may increase risk for disorder or protect against negative effects under adverse conditions, but have less of an impact at lower levels of adversity [32]. Johnson et al. [33] proposed that BIS levels may predict greater reactivity to life events that involve danger and may be associated with psychiatric disorders through this association with heightened reactivity. However, previous research has not examined how adverse life events may increase risk for psychopathology given an underlying vulnerability characterized by BIS/BAS system responsiveness.

In the current study, we tested a model of risk for psychopathology following exposure to violence with the aim of increasing specificity in predicting outcomes. Exposure to violence represents a particularly viable adversity variable to study, given that it appears to confer a *general* risk for psychopathology. We therefore predicted that exposure to violence would increase risk for PTSS, internalizing problems, and externalizing problems. Furthermore, we hypothesized that relative levels of BIS and BAS would increase risk for internalizing and externalizing problems, respectively. To elucidate *specific* pathways of risk in response to violence exposure, we controlled for baseline levels of overall problem severity and examined whether future exposure to violence and dimensions of BIS/BAS interact to predict specific patterns of divergence prospectively. We hypothesized that BIS would moderate the association between violence exposure and posttraumatic stress and internalizing outcomes such that a stronger association between violence and these forms of psychopathology would be evident as BIS levels increase. Similarly, we expected that violence exposure would moderate the association between BAS and externalizing

outcomes such that violence exposure would be more strongly associated with externalizing outcomes as BAS levels increase.

Method

Participants

Participants included 168 Latino students ($M = 11.42$ years, $SD = .70$; range: 11–14 years) recruited from a large public middle school in an urban area of Southern California. The sample included slightly more girls ($n = 94$; 56%) than boys ($n = 74$; 44%). Sixty-two students (36.9%) were born in another country and had lived in the United States for an average of 3.82 years ($SD = 2.88$). The majority of immigrant children were born in Mexico ($n = 39$; 62.9%) followed by El Salvador ($n = 14$; 22.6%) and other Latin American countries including Honduras, Ecuador, Colombia, and Guatemala ($n = 9$; 14.5%). In this sample, 95.8% of students' mothers and 96.4% of students' fathers were born outside of the United States.

The data collection site was a public middle school enrolling more than 2,000 students, with 91.4% of these students identifying as Latino/Hispanic. Census tract data for the year 2000 indicates that the school is located in a relatively impoverished neighborhood. Of families with children under the age of 18, 23.3% live below the federal poverty level. Latinos/Hispanics comprise 76% of the population within the census tract, and 51.5% of household adults are foreign-born. The majority of households (83.5%) speak a language other than English, with only 36.0% reporting speaking English "very well." Compared to the national average of 80.4%, only 48.4% of those 25 years or older attained a high school diploma.

Measures

Demographic Variables (Time 1)

During the baseline assessment, youths completed a demographics questionnaire assessing age, gender, racial/ethnic background, and place of birth of the youth, their mother, and their father. For youths indicating that they were born outside of the US, length of residence in the US was also assessed.

Behavioral Inhibition and Approach (Time 1)

Individual differences in behavioral inhibition (BIS) and behavioral approach (BAS) were assessed with an age-downward version of the Carver and White BIS/BAS scales [20] used by Muris et al. [30]. This version, which uses simplified language, has been used with children ages 8–12 and has demonstrated acceptable internal consistency reliability in this age group ($\alpha = .78$ for BIS and $.81$ for BAS). Students reported the degree to which they agree with items on a 4-point scale ranging from 1 ("strongly disagree") to 4 ("strongly agree") with subscale scores computed by summing the responses to items from each scale. The BIS/BAS Scales have one 7-item scale assessing BIS (e.g., "I usually get very tense when I think something unpleasant is going to happen"). The BIS subscale contains one item which is reverse scored and, in the current study, this item was omitted because it

negatively impacted the internal consistency of the BIS scale. The resulting 6-item BIS scale demonstrated acceptable internal consistency ($\alpha = .79$). The three BAS subscales include Drive (4 items; e.g., “I do everything to get the things that I want”), Reward Responsiveness (5 items; e.g., “I feel excited and full of energy when I get something that I want”), and Fun Seeking (4 items; e.g., “I am always willing to try something new, when I think it will be fun”). The internal consistency reliability of the overall 13-item BAS scale was good ($\alpha = .88$), while the reliability for the Fun Seeking (4 items; $\alpha = .56$), Drive (4 items; $\alpha = .77$), and Reward subscales (5 items; $\alpha = .79$) was comparable to that found in previous studies.

Exposure to Violence (Time 1 to Time2)

The Exposure to Violence Scale (EVS) [6] was used to assess exposure to violence between Time 1 and Time 2. The self-report scale includes 3 items on witnessing violence (e.g., “How often have you seen someone else getting beaten up?”), 3 items on personal victimization (e.g., “How often have you yourself been slapped, punched, or hit?”), and 2 items on witnessing weapon-related violence (e.g., “How often have you seen someone else being attacked or stabbed with a knife?”). Two items from the original EVS assessing a history of being shot with a gun or stabbed with a knife were omitted from the current study. On the EVS, youth indicate how often they have witnessed/experienced each event using a 4-point scale ranging from 0 (“never”) to 3 (“very often”). The EVS has been validated in a large sample of adolescents ($N = 3,735$) that included 23% Hispanics [6]. The EVS has also been used previously with Latino immigrant children [34]. Subscale scores for witnessing, victimization, and weapon-related violence are computed by summing responses of relevant scales while a total score can be computed by summing responses across all items. In the current sample, the EVS victimization ($\alpha = .60$), witnessing ($\alpha = .75$), and weapon-related ($\alpha = .65$) subscales as well as the total scale ($\alpha = .79$) produced acceptable internal consistency.

Posttraumatic Stress Disorder (PTSD) Symptoms (Time 1 and 2)

The Child PTSD Symptom Scale (CPSS) [35] was used to assess symptoms of posttraumatic stress disorder (PTSD). The CPSS is a 17-item self-report measure designed for use with children ages 8–18. A sample item assessing the presence of re-experiencing asks, “Have you been acting or feeling as if the event was happening again?” Youth rate the frequency with which each item has occurred in the past month using a 4-point Likert scale ranging from 0 (“Not at all”) to 3 (“5 or more times a week”). Items can be combined to obtain subscale scores for re-experiencing, avoidance, and arousal symptoms as well as a total sum score. The CPSS has demonstrated good test-retest reliability as well as convergent and discriminant validity [35]. In this sample, the internal consistency reliability for the total score ($\alpha = .91$) as well as the re-experiencing ($\alpha = .85$), avoidance ($\alpha = .79$), and arousal ($\alpha = .73$) subscales was acceptable.

Internalizing and Externalizing Symptoms (Time 1 and 2)

Youth symptoms of psychopathology were assessed with the DSM-Oriented Scales from the Youth Self-Report (YSR) [36]. On the YSR, youth read a series of statements and indicate how true each statement is for them in the past 6 months. Responses are provided

using a 3-point scale ranging from 0 (“not true”) to 2 (“very true”). The DSM-oriented scales produce *T*-scores adjusted for youth age and sex based on a nationally representative normative sample. In the current study, internalizing symptoms were assessed with two DSM-oriented scales from the YSR. The 13-item *Affective Problems* scale was used to assess symptoms consistent with major depression and dysthymia. The obtained Cronbach’s alpha for this scale in the current sample was .75. Symptoms of separation anxiety, generalized anxiety, and specific phobia were assessed with the 6-item *Anxiety Problems* scale ($\alpha = .63$). Externalizing problems were assessed with the 15-item *Conduct Problems* scale ($\alpha = .75$) and the 5-item *Oppositional Defiant Problems* scale ($\alpha = .71$).

Procedure

All study materials were available in English and Spanish. Spanish versions of materials without an existing translation were created through the recommended procedure of translation, back-translation, and subsequent reconciliation of discrepancies [37].

Students in 10 sixth grade and 2 mixed-grade homeroom classrooms were targeted for participation. From these 12 classrooms, a total of 331 students were invited to participate and were given a recruitment letter and consent form to deliver to their parent. To maximize the likelihood that parents received the materials, both student-level and classroom-level incentives were offered. Students that returned a completed consent form, indicating whether or not the parent had provided consent, received a small incentive (e.g., choice of candy or snack). At the classroom level, students had the opportunity to earn a party for the classroom if at least 95% of students in that class returned a completed consent form, regardless of whether parents provided consent. A total of 273 (82.5%) parents returned a signed consent form and of these, 170 (62.3%) parents provided consent for their child to participate in the study. The overall recruitment rate was therefore 51.4%. The final sample included 168 Latino students at Time 1 (two students withdrew from the school before data collection began). Youth surveys were administered to students in groups, with researchers administering all questionnaires by reading items aloud. During the Time 1 interview, youth provided information about demographic characteristics, BIS/BAS levels, and symptoms of posttraumatic stress, internalizing, and externalizing problems. As an incentive for participation, students received one \$10 merchandise gift card.

Six months after the Time 1 survey, students were interviewed again (Time 2) following the procedure described above. At Time 2, four students were not interviewed because they had withdrawn from the school and three students were absent on multiple occasions and were not available to be interviewed. The retention rate at Time 2 was therefore 95.83% ($n = 161$). Measures administered at Time 2 assessed exposure to violence between the Time 1 and Time 2 assessments as well as symptoms of posttraumatic stress, internalizing, and externalizing problems since the Time 1 assessment. As an incentive for participation at Time 2, students received one \$15 merchandise gift card. All study procedures were approved by the University of California, Los Angeles Institutional Review Board.

Data Analytic Approach

Structural equation modeling (SEM) with *Mplus* Version 6 [38] was utilized to test the hypotheses detailed above. Maximum likelihood (ML) estimation procedures with robust solutions (MLR) were used for all fit indices. Because of the high retention rate for participation at Time 2, there were few missing data (minimum covariance coverage of 95%). However, missing data were imputed using a model-based imputation method using

ML estimation. Goodness of fit of the model was assessed with the Satorra–Bentler chi-square (S–B χ^2) [39], the robust comparative fit index (RCFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR) [40].

Results

BIS/BAS Measurement Model

The proposed model of dispositional risk for psychopathology included six latent constructs. The sum scores from the Personal Victimization, Witnessed Violence, and Weapon-Related Violence subscales of the EVS [6] were used as three indicators of the construct of violence exposure (VEX T1–T2). Therefore, the construct of violence exposure in the model represents the severity of exposure to new violence in the 6 months preceding the Time 2 assessment. Indicators of the construct of behavioral approach (BAS) included the Drive, Reward, and Fun Seeking subscales of the BIS/BAS scales [20] whereas behavioral inhibition (BIS) was measured with the 6 subscale items as indicators. In terms of youth psychopathology, the latent construct of PTSS T2 was formed by the Re-Experiencing, Avoidance, and Arousal subscales from the CPSS [35] administered at Time 2. Age and gender normed *T*-Scores from the Affective Problems and Anxiety Problems scales of the YSR [36] administered at Time 2 were used as indicators of the construct of internalizing problems (INT T2). Finally, the latent construct of externalizing problems (EXT T2) was formed by utilizing *T*-Scores from the Conduct Problems and Oppositional Defiant Problems scales of the YSR.

The fit of this measurement model was adequate, $\chi^2(137) = 187.158, p = .003$, Robust CFI = .959, RMSEA = .047 (90% CI = .028–.063), and SRMR = .055. All measured variables loaded significantly onto their respective constructs ($p < .001$) and standardized loadings were in the range from .53 to .93. Factor loadings and summary statistics for measured variables are presented in Table 1 while bivariate correlations among latent and measured variables are presented in Table 2.

BIS/BAS Direct Effects Structural Model

A direct effects structural equation model was created to examine the hypothesized relationships between dispositional variables at Time 1 (BIS/BAS) and violence exposure between Time 1 and Time 2 on symptoms of youth psychopathology at Time 2. This direct effects model included the hypothesized paths from behavioral inhibition to both internalizing problems and PTSS. The model also included a hypothesized path from behavioral approach at Time 1 to youth externalizing problems at Time 2. Additionally, paths from violence exposure to each of the mental health outcomes and correlations between psychopathology latent variables were also included in the model. In addition to the paths designed to test *a priori* hypotheses, paths from behavioral inhibition to externalizing problems and from behavioral approach to internalizing and PTSS were included to assess the specificity of hypothesized pathways. The initial model provided an adequate fit to the data, $\chi^2(137) = 187.159, p = .003$, Robust CFI = .959, RMSEA = .047 (90% CI = .028–.063), and SRMR = .055. Two minor model modifications were then made based on empirical considerations, correlating error variances between BAS Reward and BIS item #3 and between BAS Drive and BIS item #1. The modified model represented a good fit to the data, $\chi^2(135) = 165.490, p = .038$, Robust CFI = .975, RMSEA = .037 (90%

Table 1 Descriptive statistics and factor loadings

Variable/latent construct	<i>M</i>	<i>SD</i>	Factor loading ^a
Sex [% female (N)]	.56	(94)	
Age	11.42	.70	
Total problems (T1)	.00	.80	
BIS			
BIS item 1	1.94	.88	.57
BIS item 3	2.60	.96	.57
BIS item 6	1.99	.97	.70
BIS item 9	2.48	1.06	.69
BIS item 15	2.52	1.06	.59
BIS item 18	1.67	.88	.56
BAS			
Reward	15.81	3.61	.75
Drive	9.84	3.45	.82
Fun seeking	9.34	2.46	.83
Violence exposure (T1–T2)			
Victimization	1.36	1.54	.73
Witnessing	3.40	2.25	.68
Weapon-related	.50	1.06	.53
Internalizing (T2)			
Affective problems	56.12	7.45	.93
Anxious problems	55.00	6.74	.74
Posttraumatic stress (T2)			
Re-experiencing	3.89	3.27	.86
Avoidance	4.07	3.98	.84
Arousal	4.15	3.29	.88
Externalizing (T2)			
Conduct problems	56.42	8.03	.86
Oppositional defiant problems	54.55	6.60	.78

^a All factor loadings significant at $p < .001$

CI = .009–.055), and SRMR = .053, resulting in improved model fit, $\chi^2(2) = 18.948$, $p < .001$.

Given a focus on understanding specific patterns of symptom divergence, we control for total symptoms of psychopathology at Time 1 and prospectively assess associations between subsequent exposure to violence and increases in specific types of symptoms. To assess total problems at Time 1, we created a measured variable composite representing the mean z -score of all psychopathology subscales (Posttraumatic Stress, Anxiety, Affective Problems, Oppositionality, and Conduct Problems). We therefore modeled paths from this total problems measured variable at Time 1 to the latent variables of posttraumatic stress, internalizing problems, and externalizing problems at Time 2. Given that this variable was exogenous, Total Problems at Time 1 were also correlated with other exogenous variables. To account for the possible effects of youth age and gender on the constructs of interest, the measured variables of youth age and sex were added to the model. Initially, direct paths from youth age to each of the latent constructs as well as from youth sex to each of the latent constructs were added. Significant paths ($p < .05$) were retained, including paths

Table 2 Bivariate correlations among latent and measured variables

Construct	1	2	3	4	5	6	7	8
1. Behavioral approach	–							
2. Behavioral inhibition	.656***	–						
3. Violence exposure (T1–T2)	.019	.244***	–					
4. Posttraumatic stress (T2)	.144*	.510***	.785***	–				
5. Internalizing problems (T2)	.123 [†]	.441***	.670***	.812***	–			
6. Externalizing problems (T2)	.216**	.276***	.733***	.632***	.685***	–		
7. Sex	.197**	.288***	–.090	.188**	.057	.227**	–	
8. Age	–.015	–.022	.102 [†]	–.042	.053	.061	–.076	–
9. Total problems (T1)	.325***	.477***	.515***	.622***	.590***	.619***	.160*	.042

* $p < .05$, ** $p < .01$, *** $p < .001$, [†] $p < .10$

from youth sex to behavioral inhibition, behavioral approach, externalizing problems, and PTSS, as well as paths from youth age to PTSS.

Figure 1 presents the final direct effects model with standardized regression coefficients included. An examination of the fit indices for the final model indicated that the model presented an excellent fit to the data, $\chi^2(179) = 220.484$, $p = .019$, Robust CFI = .970, RMSEA = .037 (90% CI = .016–.053), and SRMR = .052. Time 1 behavioral inhibition was significantly and positively related to youth internalizing problems at Time 2 ($\beta = .326$, $p = .017$) and PTSS at Time 2 ($\beta = .349$, $p = .004$). Conversely, Time 1 behavioral approach was significantly and positively related to youth externalizing problems at Time 2 ($\beta = .218$, $p = .027$) and negatively related to PTSS at Time 2 ($\beta = -.182$, $p = .048$). As expected, youth exposure to violence between T1 and T2 was significantly and positively related to youth internalizing ($\beta = .462$, $p < .001$), externalizing ($\beta = .671$, $p < .001$), and posttraumatic stress ($\beta = .641$, $p < .001$) problems at Time 2.

BIS/BAS Vulnerability-Specificity Model

Increasing specificity in predicting youth responses to violence exposure was a primary aim of the study. To test the hypotheses that dispositional factors can moderate the relation between violence exposure and youth psychopathology, two interaction terms were added to the model described above. The interaction between behavioral inhibition and violence exposure and the interaction between behavioral approach and violence exposure were added using the full-information ML (FIML) information approach to calculate latent variable interactions. Given that such a model requires numerical integration and the independence model is difficult to ascertain, standard model fit indices, which estimate “goodness of fit” relative to an independence model, are not calculated. Instead, the appropriateness of modeling an interaction is determined by first examining whether the interaction term is significant. Secondly, a log likelihood difference test is used to determine whether freely estimating the interaction term, as opposed to modeling the interaction but constraining that path to zero, provides a better fit to the data.

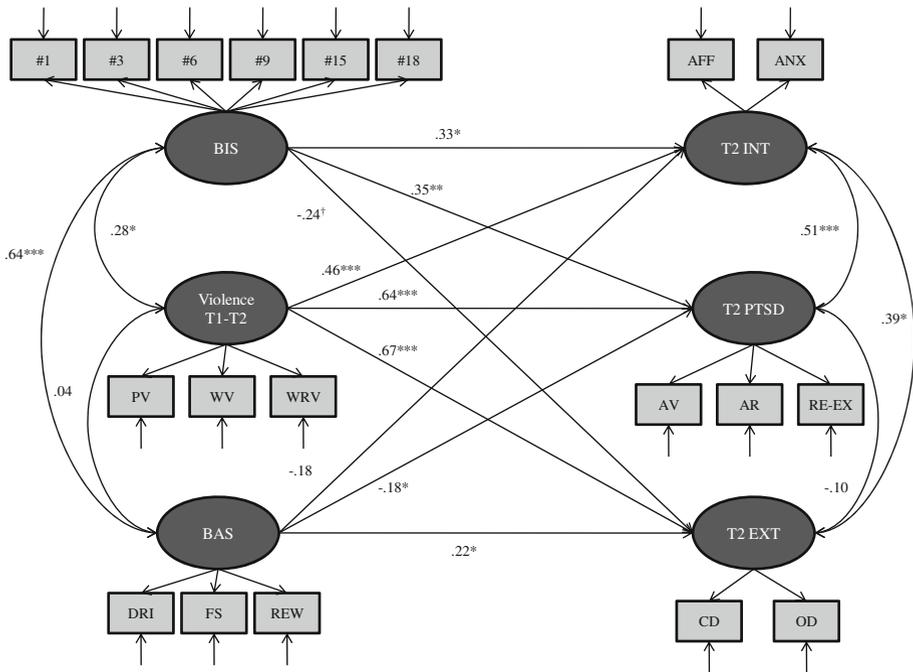


Fig. 1 BIS/BAS direct effects model. $\chi^2(179) = 220.484, p = .019$, Robust CFI = .970, RMSEA = .037 (90% CI = .016–.053), and SRMR = .052. Measured variables of youth age, sex, and Time 1 Total Problems not depicted in the diagram. *BIS* behavioral inhibition, #1–18 are individual BIS subscale items, *PV* personal victimization, *WV* witnessed violence, *WRV* weapon-related violence, *BAS* behavioral approach, *DRI* drive, *FS* fun seeking, *REW* reward responsiveness, *T2 INT* T2 internalizing problems, *AFF* affective problems, *ANX* anxiety problems, *T2 PTSD* PTSD symptoms at T2, *AV* avoidance, *AR* arousal, *Re-Ex* re-experiencing, *T2 EXT* T2 externalizing problems, *CD* conduct problems, *OD* oppositional defiant problems. * $p < .05$, ** $p < .01$, *** $p < .001$, † $p < .10$

As depicted in Fig. 2, the interaction between behavioral inhibition and violence exposure significantly predicted Time 2 internalizing problems ($B = 5.407, p = .045$). Similarly, the interaction between behavioral inhibition and youth exposure to violence significantly predicted Time 2 symptoms of PTSD ($B = 1.083, p = .037$). Finally, the interaction between the latent variables of behavioral approach and violence exposure significantly predicted T2 externalizing problems ($B = .763, p = .023$). A scaled chi-square test (based on loglikelihood values) used to compare these nested models indicated that the model freely estimating the interaction terms provided a significantly better fit relative to the model where the interactions were set to zero, $\chi^2(3) = 11.88, p = .008$.

To interpret the interaction effects, a simple slopes analysis [41] was used to plot the model-derived factor scores. To ease interpretability, factor scores were plotted as z-scores. As seen in Fig. 3a, the relationship between violence exposure and youth internalizing problems at Time 2 was stronger as levels of initial behavioral inhibition increased. Similarly, the relationship between youth exposure to violence and symptoms of post-traumatic stress at Time 2 was stronger as levels of initial behavioral inhibition increased (see Fig. 3b). Conversely, initial levels of behavioral approach moderated the relationship between violence exposure and youth externalizing problems at Time 2 such that a stronger relationship was present as levels of behavioral approach increased (see Fig. 3c).

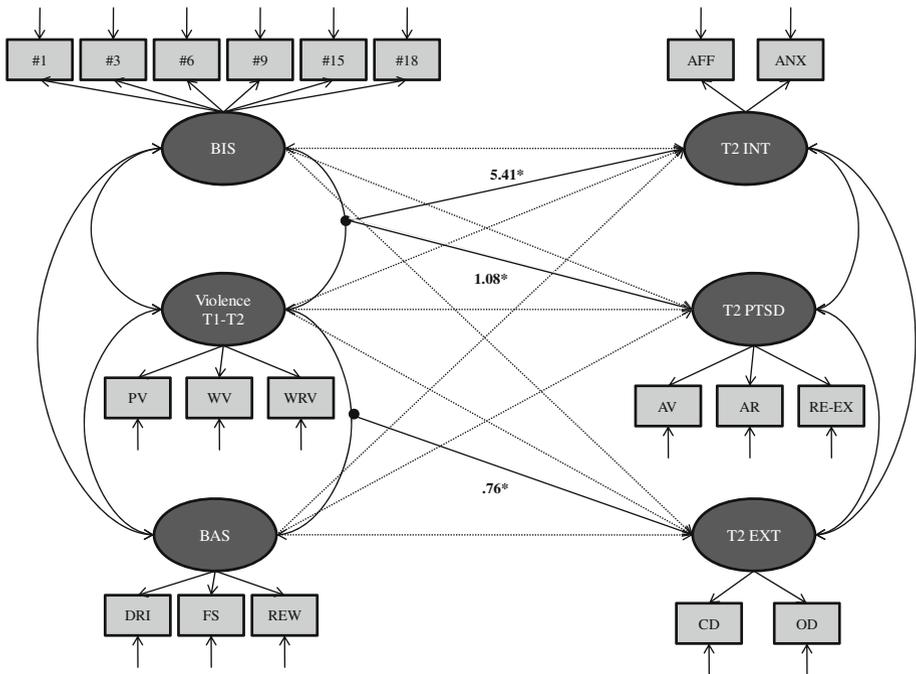


Fig. 2 BIS/BAS vulnerability-specificity model. Measured variables of youth age, sex, and Time 1 total problems not depicted in the diagram. * $p < .05$, ** $p < .01$, *** $p < .001$, † $p < .10$

Discussion

The current study examined the main and moderating effects of reinforcement sensitivity in predicting risk for specific forms of psychopathology following exposure to violence. Consistent with previous research, youth exposure to violence emerged as a general risk factor for PTSS, internalizing problems, and externalizing problems. We also extended previous research by examining dimensions of temperament as risk factors for psychopathology. Based on previous research [29, 30], we hypothesized that behavioral inhibition (BIS) would increase risk for internalizing problems (anxiety and depression), and PTSS whereas behavioral approach (BAS) would increase risk for externalizing problems (conduct problems and oppositional defiant problems). Our results provided support for these hypotheses in a sample of urban Latino youth.

Our focal question, however, centered on understanding whether dispositional factors such as BIS and BAS represent an underlying vulnerability for specific patterns of maladjustment following exposure to violence. As hypothesized, for internalizing problems and posttraumatic stress problems, violence exposure was more strongly related to psychopathology as youth levels of BIS increased. Youth reported levels of BAS also moderated the association between violence exposure and youth externalizing problems such that violence exposure was more strongly associated with externalizing problems as youth levels of BAS increased. Reinforcement sensitivity therefore emerged as an important predictor of youth mental health outcome following violence exposure.

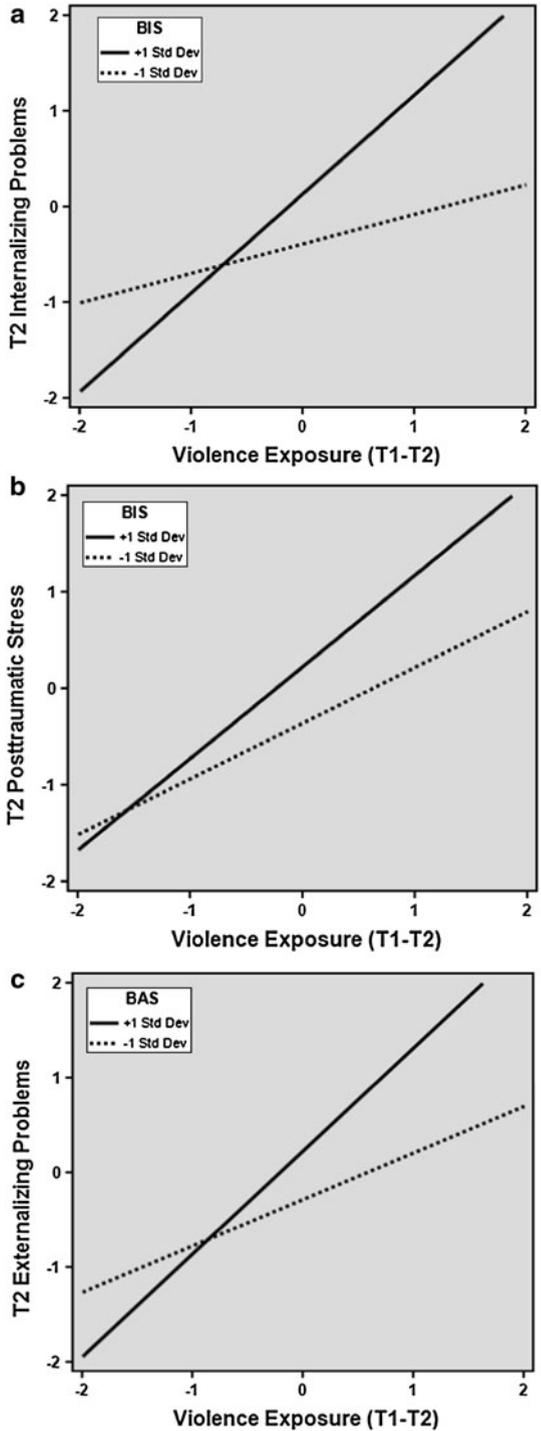
While the direct effect of BIS/BAS sensitivity on psychopathology has been replicated across studies of youth and adults, it is unlikely that reward sensitivity itself leads to

Fig. 3 Moderating effects of behavioral inhibition and approach on the relation between violence exposure and psychopathology. Figures utilize model-derived factor scores obtained from final SEM model, with data converted to z-scores to ease interpretability.

a Association between violence exposure and internalizing symptoms as moderated by level of behavioral inhibition.

b Association between violence exposure and PTSS as moderated by level of behavioral inhibition.

c Association between violence exposure and externalizing symptoms as moderated by level of behavioral approach



psychopathology. Instead, these results suggest that temperament may be related to later psychopathology through its association and interaction with life experiences. The literature has documented the extensive behavioral, emotional, and cognitive dysregulation that can follow exposure to traumatic events [42]. The current findings may take us one step closer to understanding the specific pattern of dysregulation that follows exposure to violence. For youth exposed to violence, this stressor may amplify a pre-existing vulnerability.

When youth are faced with chronic exposure to violence, an overactive BIS may heighten youths' sensitivity to perceive danger and cues of punishment, therefore reinforcing their perceptions of threat and exacerbating a tendency to respond by inhibiting behavior and experiencing negative affect. Johnson and colleagues [33] have suggested that BIS levels may predict greater reactivity to life events that involve danger and may therefore be associated with psychopathology through this association with heightened reactivity. Conversely, for youth with an overactive BAS, exposure to violence may amplify a tendency to act impulsively and pursue rewards with little regard for consequences, and behavior problems may be exacerbated due to simultaneous low levels of behavioral inhibition.

Existing diathesis-stress models reported in the literature [43] commonly highlight how a given diathesis (e.g., biological risk or cognitive style) increases risk for a specific disorder (e.g., depression) in the context of stressors (e.g., negative life events). However, the current vulnerability-specificity model is unique in that personality dimensions are used to gain specificity in predicting both whether youth will develop clinical problems as well as which type of problems are more likely to emerge. Given that violence exposure confers a *general* risk for psychopathology, it presents a particularly suitable stressor to study. In essence, we focused on a *nonspecific* risk factor and sought to elucidate *specific* pathways of risk for psychopathology. While the current study is not able to test the specific processes that lead to increased psychopathology, it represents an important step in elaborating our understanding of risk.

Because of elevated risk of exposure to violence in urban Latino youth, we sought to extend models developed with majority populations to aid our understanding of risk for psychopathology in this unique context. Within Gray's BIS/BAS model, the environment is one prominent feature that shapes reinforcement sensitivity patterns. Latino socialization goals emphasize *respeto* (respect) and qualities such as humility, deference, and obedience in youth [37, 44], which may make inhibited behavior highly acceptable within this context. Conversely, a positive drive, sense of efficacy, and high levels of optimism and motivation present within immigrant communities [45, 46] may make certain aspects of behavioral approach (e.g., drive) culturally desirable. The cultural context and specific socialization practices that Latino youth are exposed to may profoundly shape their patterns of behavior. Additional research is needed to elucidate the intersection between culture, reinforcement sensitivity, and developmental psychopathology.

In addition to extending this line of inquiry to an understudied population, this research extends previous work in other important ways. As noted above, the literature on BIS/BAS and psychopathology has often failed to examine both BIS and BAS within the same study or has focused on a restricted range of clinical outcomes. Similarly, studies that have assessed both BIS and BAS and a wide range of clinical outcomes have been cross-sectional. Therefore, the fact that this is the first study to examine the predictive power of BIS/BAS dimensions on psychopathology prospectively is a notable strength. Additionally, the use of SEM allowed for an examination of relationships across multiple clinical

outcomes while accounting for associations between constructs. In this manner, we relied on a powerful analytic technique to examine the complex associations between dispositional and contextual risk factors and clinical outcomes.

Despite these strengths, some limitations must be noted. While the current sample size is acceptable when considering some suggested guidelines [47–50], it will be important for future studies to replicate the results of SEM findings with a larger sample. Although we control for the effects of age and sex in our analyses, the sample size and our limited focus on early adolescents precludes us from examining whether our specificity models fit across the developmental spectrum. Given the short-term longitudinal design, we are also unable to model the potential impact of age of exposure to violence or of chronic exposure to violence. It should also be noted that all constructs were assessed through Youth Self-Reports and this may have led to a greater likelihood of finding significant associations due to shared method variance. While the longitudinal nature of the current project may increase our confidence in the validity of the results, future studies would benefit from replicating these results with multiple methods of assessment from multiple informants. The use of a convenience sample may also limit the extent to which participants are representative of the actual population. Furthermore, a focus on Latino youth in a disadvantaged community limits the extent to which these findings can be generalized to other populations. We view the results of this study as a potentially significant step in understanding youth psychopathology that warrants replication and extension to more diverse populations.

Summary

Latino youth living in urban communities are at high risk of being exposed to violence and are consequently at risk of developing a wide range of mental health problems. The current investigation sought to examine whether we could better understand specific pathways of risk for psychopathology in Latino youth by extending existing reinforcement sensitivity models of psychopathology developed with majority populations. We employed a short-term longitudinal design to test a vulnerability-specificity model of youth psychopathology. Behavioral inhibition (BIS) and behavioral approach (BAS) have been identified as risk factors for internalizing and externalizing problems, respectively. However, we hypothesized that reinforcement sensitivity moderates the association between violence exposure and psychopathology and can therefore explain some of the heterogeneity in psychopathology of youth exposed to violence. Results of structural equation models provided support for this vulnerability-specificity model, suggesting that BIS specifically increased risk for internalizing problems and PTSS following exposure to violence whereas BAS increased specific risk for externalizing problems. Through research aimed at furthering our understanding of specific pathways of adjustment and maladjustment in combination with research that translates this knowledge into clinical interventions, we may be better able to more effectively understand and meet the needs of urban Latino youth exposed to violence.

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References

1. Koop CE, Lundberg GD (1992) Violence in America: a public health emergency. *JAMA* 267:3075–3076
2. Bureau of Justice Statistics (1997) Age patterns of victims of serious violent crime (Publication NCJ-162031). US Department of Justice, Washington, DC. <http://www.ojp.usdoj.gov/bjs/pub/pdf/apvsvvc.pdf>
3. Stein BD, Jaycox LH, Kataoka S, Rhodes HJ, Vestal KD (2003) Prevalence of child and adolescent exposure to community violence. *Clin Child Fam Psychol Rev* 6:247–264
4. Aisenberg E (2001) The effects of exposure to community violence upon Latina mothers and preschool children. *Hisp J Behav Sci* 23:378–398
5. Gorman-Smith D, Tolan P (1998) The role of exposure to community violence and developmental problems among inner-city youth. *Dev Psychopathol* 10:101–116
6. Singer MI, Anglin TM, Song LY, Lunghofer L (1995) Adolescents' exposure to violence and associated symptoms of psychological trauma. *JAMA* 273(6):477–482
7. Youngstrom E, Weist MD, Albus KE (2003) Exploring violence exposure, stress, protective factors and behavioral problems among inner-city youth. *Am J Community Psychol* 32(1):115–129
8. Crouch JL, Hanson RF, Saunders BE, Kilpatrick DG, Resnick HS (2000) Income, race/ethnicity, and exposure to violence in youth: results from the National Survey of Adolescents. *J Community Psychol* 28(6):625–641
9. Ramirez RR, De la Cruz GP (2003) The Hispanic population in the United States: March 2002. US Census Bureau, Washington
10. Rodriguez MC, Morrobel D (2004) A review of Latino youth development research and a call for an asset orientation. *Hisp J Behav Sci* 26(2):107–127
11. Jaycox LH, Stein BD, Kataoka SH, Wong M, Fink A, Escudero P et al (2002) Violence exposure, posttraumatic stress disorder, and depressive symptoms among recent immigrant schoolchildren. *J Am Acad Child Adolesc Psychiatry* 41(9):1104–1110
12. Kliewer W, Lepore SJ, Oskin D, Johnson PD (1998) The role of social and cognitive processes in children's adjustment to community violence. *J Consult Clin Psychol* 66(1):199–209
13. Kliewer W, Cunningham JN, Diehl R, Parrish KA, Walker JM, Atiyeh C et al (2004) Violence exposure and adjustment in inner-city youth: child and caregiver emotion regulation skill caregiver-child relationship quality, and neighborhood cohesion as protective factors. *J Clin Child Adolesc Psychol* 33(3):477–487
14. McCabe KM, Lucchini SE, Hough RL, Yeh M, Hazen A (2005) The relation between violence exposure and conduct problems among adolescents: a prospective study. *Am J Orthopsychiatry* 75(4):575–584
15. O'Donnell DA, Schwab-Stone ME, Muyeed AZ (2002) Multidimensional resilience in urban children exposed to community violence. *Child Dev* 73(4):1265–1282
16. Gray JA (1987) The psychology of fear and stress. Cambridge University Press, New York
17. Gray JA (1991) The neuropsychology of temperament. In: Stelau J, Angleiter A (eds) Explorations in temperament. Plenum, New York, pp 105–128
18. Smillie LD, Pickering AD, Jackson CJ (2006) The new reinforcement sensitivity theory: implications for psychometric measurement. *Pers Soc Psychol Rev* 10:320–335
19. Gray JA (1978) The neuropsychology of anxiety. *Br J Psychol* 69(4):417–434
20. Carver CS, White TL (1994) Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: the BIS/BAS scales. *J Pers Soc Psychol* 67(2):319–333
21. Gray JA (1990) Brain systems that mediate both emotion and cognition. *Cogn Emot* 4(3):269–288
22. Shapiro SK, Quay HC, Hogan AE, Schwartz KP (1988) Response perseveration and delayed responding in undersocialized aggressive conduct disorder. *J Abnorm Psychol* 97(3):371–373
23. Fonseca AC, Yule W (1995) Personality and antisocial behavior in children and adolescents: an enquiry into Eysenck's and Gray's theories. *J Abnorm Child Psychol* 23(6):767–781
24. Matthys W, van Goozen SHM, de Vries H, Cohen-Kettenis PT, van Engeland H (1998) The dominance of behavioural activation over behavioural inhibition in conduct disordered boys with or without attention deficit hyperactivity disorder. *J Child Psychol Psychiatry* 39(5):643–651
25. Kagan J, Snidman N, Zentner M, Peterson E (1999) Infant temperament and anxious symptoms in school age children. *Dev Psychopathol* 11(2):209–224
26. Reeb-Sutherland BC, Vanderwert RE, Degnan KA, Marshall PJ, Pérez-Edgar K, Chronis-Tuscano A, Pine DS, Fox NA (2009) Attention to novelty in behaviorally inhibited adolescents moderates risk for anxiety. *J Child Psychol Psychiatry* 50(11):1365–1372
27. Coplan RJ, Wilson J, Frohlick SL, Zelenski J (2006) A person-oriented analysis of behavioral inhibition and behavioral activation in children. *Pers Individ Dif* 41(5):917–927

28. Vervoort L, Wolters LH, Hogendoorn SM, de Haan E, Boer F, Prins PJM (2010) Sensitivity of Gray's behavioral inhibition system in clinically anxious and non-anxious children and adolescents. *Pers Individ Dif* 48:629–633
29. Colder CR, O'Connor RM (2004) Gray's reinforcement sensitivity model and child psychopathology: laboratory and questionnaire assessment of the BAS and BIS. *J Abnorm Child Psychol* 32(4):435–451
30. Muris P, Meesters C, de Kanter E, Timmerman PE (2005) Behavioural inhibition and behavioural activation system scales for children: relationships with Eysenck's personality traits and psychopathological symptoms. *Pers Individ Dif* 38(4):831–841
31. Frick PJ (2004) Integrating research on temperament and childhood psychopathology: its pitfalls and promise. *J Clin Child Adolesc Psychol* 33(1):2–7
32. Pulkkinen L, Caspi A (eds) (2002) Paths to successful development: personality in the life course. Cambridge University Press, New York
33. Johnson SL, Turner RJ, Iwata N (2003) BIS/BAS levels and psychiatric disorder: an epidemiological study. *J Psychopathol Behav Assess* 25(1):25–36
34. Kataoka SH, Stein BD, Jaycox LH, Wong M, Escudero P, Tu W et al (2003) A school-based mental health program for traumatized Latino immigrant children. *J Am Acad Child Adolesc Psychiatry* 42(3):311–318
35. Foa EB, Johnson KM, Feeny NC, Treadwell KRH (2001) The child PTSD symptom scale: a preliminary examination of its psychometric properties. *J Clin Child Psychol* 30(3):376–384
36. Achenbach TM (1991) Integrative guide for the 1991 CBCL/4–18, YSR, and TRF profiles. University of Vermont, Department of Psychiatry, Burlington
37. Marin G, Marin BV (1991) Research with Hispanic populations. Sage, Newbury Park
38. Muthén LK, Muthén BO (1998–2010) Mplus user's guide. Muthén & Muthén, Los Angeles, CA
39. Satorra A, Bentler PM (2001) A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika* 66(4):507–514
40. Jaccard J, Wan CK (1996) LISREL approaches to interaction effects in multiple regression. Sage, Thousand Oaks, CA
41. Aiken LS, West SG (1991) Multiple regression: testing and interpreting interactions. Sage, Newbury Park
42. Cicchetti D, Toth SL (1995) Developmental psychopathology and disorders of affect. In: Cicchetti D, Cohen DJ (eds) Developmental psychopathology: risk, disorder, and adaptation, vol 2. Wiley, New York, pp 369–420
43. Hilsman R, Garber J (1995) A test of the cognitive diathesis-stress model of depression in children: academic stressors, attributional style, perceived competence, and control. *J Pers Soc Psychol* 69(2):370–380
44. Leyendecker B, Harwood RL, Lamb ME, Schölmerich A (2002) Mothers' socialisation goals and evaluations of desirable and undesirable everyday situations in two diverse cultural groups. *Int J Behav Dev* 26:248–258
45. Fuligni AJ (1997) The academic achievement of adolescents from immigrant families: the roles of family background, attitudes, and behavior. *Child Dev* 68:351–363
46. Portes A, Rumbaut R (1996) Immigrant American: a portrait, 2nd edn. University of California Press, Berkeley
47. Hoyle RH (1995) Structural equation modeling: concepts, issues, and applications. Sage Publications, Thousand Oaks
48. Kline RB (2005) Principles and practice of structural equation modeling, 2nd edn. Guilford Press, New York
49. Loehlin JC (1992) Latent variable models: an introduction to factor, path, and structural analysis, 2nd edn. Lawrence Erlbaum, Hillsdale
50. Muthén LK, Muthén BO (2002) Teacher's corner: how to use a Monte Carlo study to decide on sample size and determine power. *Struct Equ Modeling* 9(4):599–620