

Behavioral Inhibition and Risk for Posttraumatic Stress Symptoms in Latino Children Exposed to Violence

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Published online: 14 March 2013
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Abstract Latino children in urban contexts marked by poverty are at high risk of being exposed to violence and developing posttraumatic stress disorder (PTSD). Nonetheless, there is great variability in individual responses to violence exposure. This study examines risk for developing re-experiencing, avoidance, and arousal symptoms of PTSD as a function of individual differences in behavioral inhibition and exposure to community violence. Participants were 148 Latino students (M age =11.43 years, $SD=0.69$; 55 % girls) living in an area marked by poverty and crime. Children completed self-report measures of behavioral inhibition and posttraumatic stress symptoms during a baseline assessment. During a follow-up interview 6 months later, children completed self-report measures of exposure to community violence since the baseline assessment and posttraumatic stress symptoms. Structural equation models revealed that behavioral inhibition at baseline was positively associated with PTSD avoidance and arousal symptoms at follow-up, after controlling for symptoms at baseline. Furthermore, behavioral inhibition moderated the association between violence exposure and symptoms such that violence was more strongly associated with the development of PTSD avoidance symptoms as behavioral inhibition increased. Results suggest that individual differences in behavioral inhibition contribute to risk for specific PTSD symptoms and are important for understanding variation in responses to trauma exposure. By examining diathesis-stress models within a disorder, we may be better

able to elucidate the etiology of a disorder and translate this improved understanding into personalized intervention approaches that maximize effectiveness.

Keywords Behavioral inhibition · Violence exposure · Latino · Posttraumatic stress · Avoidance

Exposure to community violence among children and adolescents is a major public health problem in the United States (Cooley-Strickland et al. 2009; Koop and Lundberg 1992). Community violence is defined as deliberate acts occurring in the community that are intended to cause harm to a person or group (Cooley-Quille et al. 1995). Examples of community violence include being physically assaulted, robbed, threatened, shot or stabbed. Furthermore, exposure to community violence is typically categorized as involving personal victimization, witnessing of such violence perpetrated on others, and hearing about such violence occurring in the community (Fowler et al. 2009).

While community violence can impact youths regardless of race/ethnicity or socioeconomic status, it disproportionately impacts racial/ethnic minority youths, those living in poverty, and those living in urban settings (Bureau of Justice Statistics 1997; Stein et al. 2003). An estimated 50–96 % of urban children and adolescents are exposed to community violence (Stein et al. 2003). Exposure to one form of violence is often associated with exposure to other forms and longitudinal studies suggest chronically elevated rates of exposure over time (Fowler et al. 2009). In a sample of urban African-American and Latino boys, 80 % reported being exposed to community violence over their lifetime, 65 % reported being exposed in the past year, and 50 % were exposed to more than one event (Gorman-Smith and Tolan 1998). In a large sample of immigrant school children in Los Angeles, Jaycox and colleagues (2002) found that 49 % of children reported personal victimization in the

Author Note This research was supported by a Dissertation Research Grant from the University of California Institute for Mexico and the United States (UC MEXUS). We gratefully acknowledge the assistance of Bennett L. Leventhal, M.D. in the development of this manuscript.

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previous year whereas 80 % reported witnessing community violence.

Latinos are now the largest ethnic minority group in the U.S., comprising 23 % of the population under age 18 (Pew Research Center 2011). Data from the National Survey of Adolescents suggest that Hispanic youths in the U.S. are at increased risk of being physically assaulted (50 % vs. 34.3 %) or witnessing violence (20.7 % vs. 15.5 %) relative to their Caucasian counterparts (Crouch et al. 2000). Of note, Hispanic youths reported significantly higher rates of witnessed violence across all income levels (Crouch et al. 2000). Consistent with research reviewed above, exposure to community violence is even higher among Latino children living in disadvantaged communities, with 63–94 % reporting exposure to violence in their schools and communities in the past year (Gudiño et al. 2011; Kataoka et al. 2009).

Children and adolescents exposed to community violence are at increased risk for developing posttraumatic stress disorder (PTSD), as well as internalizing and externalizing problems (e.g., Gudiño et al. 2011; Kataoka et al. 2009). In a meta-analysis of the effects of community violence exposure on the mental health of children and adolescents, Fowler and colleagues (2009) found the strongest association with PTSD symptoms, followed by externalizing and internalizing problems. Notably, witnessing community violence, personal victimization, and hearing about community violence all predicted PTSD symptoms equally (Fowler et al. 2009). Although this meta-analysis included a relatively small number of Latino samples and results should thus be interpreted with caution, Latino samples evidenced the strongest effect sizes for the association between violence exposure and PTSD (Fowler et al. 2009).

While exposure to community violence increases risk for the development of PTSD, only a small minority of exposed youths develop full PTSD (Copeland et al. 2007; Cuffe et al. 1998). Although they may not meet full criteria for the disorder, a higher proportion of children living in contexts marked by poverty and chronic exposure to violence may experience clinically elevated PTSD symptoms. For example, Jaycox and colleagues (2002) found that 32 % of immigrant school children in Los Angeles presented with elevated PTSD symptoms. PTSD symptoms are also associated with significant impairment, with 9 % of Latino students reporting being unable to attend school and 17 % reporting declining grades due to PTSD symptoms (Kataoka et al. 2009). Thus, despite chronic and widespread exposure to community violence among Latino children in urban environments marked by poverty, there is great variability in risk for developing PTSD. This variability, in turn, suggests that pre-existing vulnerability factors may modify risk for developing PTSD (Myers et al. 2012).

Child behavioral inhibition may represent one such vulnerability factor moderating risk for the development of

PTSD. The Behavioral Inhibition System (BIS) and the Behavioral Activation System (BAS), as detailed in Reinforcement Sensitivity Theory (RST; Gray 1987, 1991), regulate approach-avoidance behavior. The BIS is sensitive to conditioned cues of punishment, loss of reward, and novelty and is responsible for inhibiting behavior in the face of such cues (Smillie et al. 2006). Conversely, the BAS is sensitive to conditioned cues of reward and promotes goal-directed behavior aimed at obtaining such rewards (Carver and White 1994). While the sensitivity of the BIS/BAS systems is believed to be biologically based, input from the environment conditions the overall reactivity of the system (Scholten et al. 2006).

An extensive body of work has documented how childhood behavioral inhibition to the unfamiliar in laboratory novelty paradigms predicts the development of anxiety disorders prospectively (e.g., Kagan et al. 1999; Reeb-Sutherland et al. 2009). There is also accumulating evidence that BIS is specifically associated with internalizing problems (including PTSD) whereas BAS is associated with externalizing problems (e.g., Colder and O'Connor 2004; Gudiño et al. 2012; Muris et al. 2005). Thus, individual differences in relative levels of BIS and BAS appear to be important in determining risk for the development of internalizing and externalizing problems, respectively. However, it is also important to note that the majority of inhibited children (70 %) do not develop an anxiety disorder (Biederman et al. 1993). Behavioral inhibition may thus present a general diathesis, with environmental stressors also playing an important role in the etiology of psychopathology. This may be especially applicable to the development of PTSD, where exposure to a traumatic event (environmental factor) is central to the etiology of the disorder.

Ruchkin et al. (2002) found that harm avoidance, a construct from the Cloninger et al. (1993) biopsychological model of temperament that overlaps substantially with behavioral inhibition, was positively associated with PTSD symptoms in incarcerated Russian juveniles. In a cross-sectional study of military veterans, Myers and colleagues (2012) found that adult behavioral inhibition was associated with increase re-experiencing, avoidance, and arousal symptoms of PTSD. To our knowledge, only one study has examined the interaction between BIS/BAS vulnerability and violence exposure in predicting later psychopathology. While exposure to violence was associated with all forms of psychopathology, baseline levels of BIS specifically increased risk for the development of internalizing problems and PTSD whereas baseline levels of BAS increased risk for externalizing problems (Gudiño et al. 2012). The authors suggest that in the context of chronic exposure to violence, BIS may amplify a tendency to perceive danger and to respond to threat with inhibition and negative affect (Gudiño et al. 2012). Moreover, elevated BIS may

predict heightened reactivity to life events involving danger, which in turn increases risk for psychopathology (Johnson et al. 2003). For children who are predisposed to be sensitive to cues of threat and danger, an environment marked by chronic exposure to violence provides ongoing reinforcement of this belief.

Support for the contention that BIS increases risk for the development of PTSD following exposure to violence is bolstered by research on related constructs. For example, Gil and Caspi (2006) found that individual differences in harm avoidance before exposure to a terrorist attack increased risk for the development of PTSD 6 months following the attack in a sample of undergraduate students in Israel. In a cross-sectional sample of adolescent females, Shenk et al. (2012) found that experiential avoidance mediated the relationship between child maltreatment and PTSD symptoms. Furthermore, experiential avoidance emerged as the only significant mediator of this effect when also accounting for cortisol reactivity and respiratory sinus arrhythmia (Shenk et al. 2012). Thus, attempts to control or inhibit the experience of painful thoughts and emotions (experiential avoidance) and the tendency to respond with inhibition to signals of aversive stimuli or to avoid novelty and punishment (harm avoidance) appear to be important for understanding the association between exposure to violence and the development of PTSD.

In the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association 2000), PTSD is classified as an anxiety disorder. Unlike most other disorders in the DSM-IV-TR, however, a diagnosis of PTSD requires exposure to an environmental stressor (a traumatic event; Criterion A). Symptom criteria for PTSD are divided into three clusters that include persistent re-experiencing of the traumatic event (Criterion B), “persistent avoidance of stimuli associated with the trauma and numbing of general responsiveness” (Criterion C), and persistent symptoms of increased arousal (Criterion D). As a robust predictor of anxiety disorders, BIS may confer a general risk for all symptoms of PTSD (a main effect). However, relative levels of BIS may also further increase risk for specific symptom profiles within a disorder.

Behavioral inhibition in adults has been shown to explain additional variance in PTSD avoidance symptoms over and above that explained by general trait anxiety (Myers et al. 2012). Conceptually, it makes sense that a vulnerability to respond to perceived threat with behavioral inhibition (high BIS) would moderate the association between exposure to violence and the development of PTSD avoidance symptoms (an interactive effect). Research with adults suggests that meeting PTSD avoidance/numbing criteria is relatively uncommon when compared to re-experiencing and arousal criteria and that meeting avoidance/numbing criteria is a strong predictor of meeting full diagnostic criteria for the disorder (North et al. 1999). In addition to having a potentially important role in the

etiology of PTSD, avoidance symptoms are primary targets of current evidence-based approaches to the treatment of PTSD in both adults and children (Foa 2011; Silverman et al. 2008).

The current study examined the main and moderating effects of behavioral inhibition on the development of specific PTSD symptom clusters in a longitudinal sample of Latino children at high risk of exposure to violence. Consistent with cross-sectional research with adults, relative levels of BIS in children were hypothesized to exert a main effect on all PTSD symptom clusters after accounting for baseline symptom levels. As prior research has found a negative association between relative levels of BAS and overall PTSD symptom severity (Gudiño et al. 2012), an exploratory aim of the current study examined associations between BAS levels and PTSD symptom clusters. However, the central aim of this study was to examine whether BIS moderates the relationship between violence exposure and the development of specific PTSD symptoms. In particular, it was hypothesized that relative levels of BIS moderate the association between violence exposure and subsequent symptoms such that a stronger association between exposure and PTSD avoidance symptoms would be evident as baseline levels of BIS increase.

Method

Participants

Participants were 148 Latino students (55.4 % girls) with a mean age of 11.43 years ($SD=0.69$) recruited from a public middle school in Southern California. Most mothers (97.24 %) and fathers (97.18 %) were immigrants from Latin America and 37.2 % of children were immigrants themselves. Most immigrant children were born in Mexico ($n=34$; 61.8 %), with the remainder born in El Salvador ($n=13$; 23.6 %) or other Latin American countries ($n=8$; 14.5 %). On average, immigrant children had lived in the United States for 3.94 years ($SD=2.82$). The majority of students at the school (81.4 %) identified as Hispanic/Latino. Data from the American Community Survey (U. S. Census Bureau 2009) indicate that the school is located in an impoverished area, with 20 % of families in the surrounding neighborhood living below the federal poverty level.

Measures

Behavioral Inhibition and Activation Youth behavioral inhibition and activation were assessed with a child version of the BIS/BAS Scales (Carver and White 1994) that uses simplified language (Muris et al. 2005). The BIS/BAS Scales consist of a 7-item BIS Scale and three BAS subscales assessing Drive (4 items), Reward Responsiveness (5

items), and Fun Seeking (4 items). In the current study, the one reverse-scored item was omitted from the BIS scale because it negatively impacted the internal consistency of the scale. For each item, children use a 4-point scale (1=“strongly disagree”, 4=“strongly agree”) to indicate how much they agree with each statement. The BIS (English $\alpha=0.76$, Spanish $\alpha=0.82$), Drive (English $\alpha=0.76$, Spanish $\alpha=0.79$), Reward Responsiveness (English $\alpha=0.76$, Spanish $\alpha=0.87$), and Fun Seeking (English $\alpha=0.52$, Spanish $\alpha=0.68$) subscales demonstrated adequate to good internal consistency in the current sample.

Exposure to Violence Child exposure to violence during the study period (between the Time 1 and Time 2 assessments) was assessed using the Exposure to Violence Scale (EVS; Singer et al. 1995). The EVS included 3 items assessing witnessed violence (e.g., seeing someone being beaten up), 3 items assessing personal victimization (e.g., being slapped, punched or hit), and 2 items assessing witnessing weapon-related violence (e.g., seeing someone attacked with a knife or gun). Two items assessing whether a child had themselves been shot with a gun or stabbed with a knife were omitted due to low endorsement. For each item, children rated how often they had experienced or witnessed each type of violence using a 4-point scale (0=“never”, 3=“very often”). The EVS has demonstrated good psychometric properties in large and diverse samples of youths (Kataoka et al. 2003; Singer et al. 1995). In the current sample, the EVS victimization (English $\alpha=0.61$, Spanish $\alpha=0.58$), witnessing (English $\alpha=0.75$, Spanish $\alpha=0.79$), and weapon-related (English $\alpha=0.68$, Spanish $\alpha=0.43$) subscales demonstrated internal consistency reliability comparable to that found in previous studies (Singer et al. 1995, 2004). However, given that individual subscales have few items and demonstrate lower internal consistency and the fact that among urban and ethnic minority youths there is much overlap in exposure to witnessed violence and victimization, analyses in the current study utilize the EVS Total Violence Score. This total score, calculated by summing responses across all items, demonstrated good internal consistency in the current sample (English $\alpha=0.77$, Spanish $\alpha=0.86$).

Posttraumatic Stress Disorder (PTSD) Symptoms of Posttraumatic Stress Disorder were assessed with the Child PTSD Symptom Scale (CPSS; Foa et al. 2001). The CPSS consists of 17 items that parallel DSM-IV-TR (American Psychiatric Association 2000) symptoms for re-experiencing, avoidance, and arousal clusters of PTSD. Children rate how frequently each symptom has occurred in the past month using a 4-point scale (0=“Not at all”, 3=“5 or more times a week”). The CPSS has demonstrated good psychometric properties (Foa et al. 2001), including in research with Latino school children (Kataoka et al. 2003). In the current sample, the CPSS total (Time 1 and Time 2 $\alpha=0.91$), re-experiencing (Time 1 English $\alpha=0.85$, Spanish $\alpha=0.81$; Time 2 English

$\alpha=0.83$, Spanish $\alpha=0.83$) avoidance (Time 1 English $\alpha=0.80$, Spanish $\alpha=0.79$; Time 2 English $\alpha=0.79$, Spanish $\alpha=0.86$), and arousal (Time 1 English $\alpha=0.73$, Spanish $\alpha=0.72$; Time 2 English $\alpha=0.75$, Spanish $\alpha=0.76$) scales demonstrated good internal consistency.

Procedure

A total of 331 students from 10 6th grade and 2 mixed-grade homeroom classrooms were recruited for participation. Research staff invited students to participate and distributed a letter and consent form for students to deliver to their caregiver. Students who returned a signed consent form, regardless of whether consent was provided on the form, received a small incentive (e.g., a pencil or snack) and classrooms with at least 95 % of students returning a consent form earned a classroom reward. A total of 273 (82.5 %) parents returned a signed form and of these, 170 (62.3 %) parents provided consent for their child to participate in the study. All students also provided assent to participate. This represents an overall recruitment rate of 51.4 %. Because some students withdrew from the school before data collection began, the overall sample included 167 students at Time 1 and 161 students at the Time 2 assessment 6 months later (96.41 % retention rate). Given that exposure to trauma is a pre-requisite for posttraumatic stress disorder, analyses in the current study focus on the 148 students (91.9 % of the overall sample) who reported at least some exposure to violence between the Time 1 and Time 2 assessments.

Study measures were administered to groups of students, with trained research staff reading all instructions and items aloud to the group and students providing individual responses privately by marking their response on the survey itself. Additional research staff were available to provide individual assistance to students as needed. During the Time 1 assessment, children completed measures of behavioral inhibition/activation and symptoms of PTSD and received a \$10 merchandise gift card as an incentive. During the Time 2 assessment, children provided reports of exposure to violence since the Time 1 assessment and current symptoms of PTSD. They received one \$15 merchandise gift card for participation at Time 2.

All study materials were available in English and Spanish and students had the option of deciding which language they wanted to complete measures in. Most participants elected to complete measures in English (82.4 %), while 17.6 % elected to complete measures in Spanish. Spanish versions of materials without an existing translation were created through the recommended procedure of translation, back-translation, and subsequent reconciliation of discrepancies (Marín and Marín 1991). All study procedures were approved by the Institutional Review Board at the University of California, Los Angeles.

Data Analysis

Hypotheses were tested using Structural Equation Modeling (SEM) with *Mplus* Version 6 (Muthén and Muthén 1998–2010). Although there were few missing data (minimum covariance coverage of 97.3 %), a model-based imputation method using maximum likelihood estimation was used to account for missing data. Model fit indices were calculated using maximum likelihood estimation procedures with robust solutions (MLR). Goodness of fit of the model was assessed with the Satorra–Bentler chi-square (S–B χ^2 ; Satorra and Bentler 2001), the robust comparative fit index (RCFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR) (Jaccard and Wan 1996).

Results

Consistent with previous research examining exposure to violence among Latino children in urban communities, children in the current study reported high rates of exposure to community violence in the 6 months between the Time 1 and Time 2 assessments. As noted above, the current study focuses on the 91.9 % of children in the overall sample who reported at least some exposure to violence during the study period. Almost all children in this subsample (96.6 %) endorsed witnessing violence in their communities, most children (70.3 %) also endorsed

at least one item assessing personal victimization, and 27.7 % endorsed witnessing gun or knife violence. Of the eight violence exposure items included in the survey, on average children endorsed being exposed to 3.89 ($SD=1.71$) items at least “sometimes.” Total sum scores on the EVS in the current sample ranged from 1 to 16, with a mean of 5.72 ($SD=3.71$).

Figure 1 depicts the model examining the main effects of BIS, BAS, and violence exposure on PTSD re-experiencing, avoidance, and arousal symptom clusters at Time 2. As seen in this figure, the total sum from the Exposure to Violence Scale (Singer et al. 1995) served as a measured variable assessing exposure to violence between Time 1 and 2. The latent construct of BIS was assessed using the 6 item-level indicators from the BIS/BAS Scales (Carver and White 1994) while indicators of BAS included the Reward, Drive, and Fun Seeking subscale scores from the same measure. The Re-Experiencing, Avoidance, and Arousal subscale scores from the CPSS (Foa et al. 2001) were included in the model as measured variables representing symptoms at Time 1 and Time 2. Although not depicted in the figure, baseline levels of re-experiencing, avoidance, and arousal symptoms were included as controls for the respective symptom cluster score at Time 2. Controls for child age and sex were also included by modeling paths to each of the Time 2 symptom clusters. Control variables were correlated with all other exogenous variables. Descriptive statistics and bivariate correlations among study variables are presented in Table 1.

Fig. 1 BIS/BAS Direct Effects Model. Standardized coefficients included in the figure. Control variables of child age, sex, and Time 1 re-experiencing, avoidance, and hyperarousal symptoms not depicted in the diagram. *BIS* Behavioral Inhibition; #1–6 are individual BIS subscale items; *BAS* Behavioral Activation; *FunS* Fun Seeking; *REW* Reward Responsiveness. * $p < 0.05$, ** $p < 0.01$, † $p < 0.10$

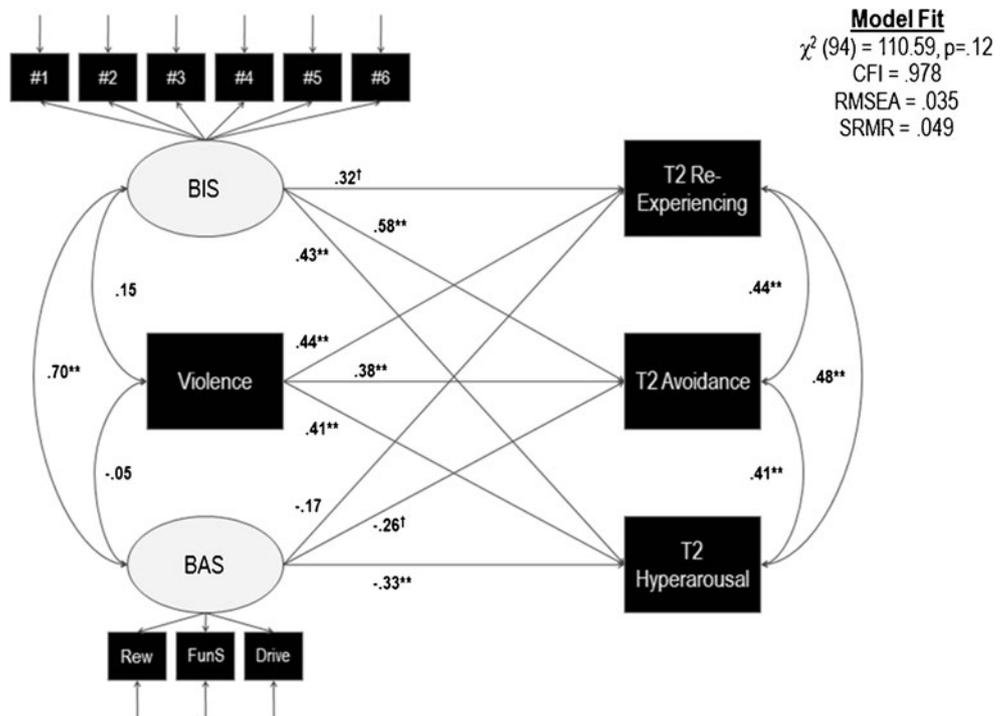


Table 1 Descriptive statistics and correlations between latent and measured variables

	M(SD)	1	2	3	4	5	6	7	8	9	10
1. Sex (Female)	55 %	–									
2. Age	11.43 (0.69)	–0.12	–								
3. BIS	0(0.43)	0.29**	0.01	–							
4. BAS	0(2.48)	0.19*	–0.13	0.70**	–						
5. Violence Exposure	5.72(3.71)	–0.07	0.12	0.15	–0.05	–					
6. T1: Re-Experiencing	3.91(3.43)	0.12	–0.10	0.31**	0.23**	0.19*	–				
7. T1: Avoidance	4.53(4.39)	0.11	–0.07	0.36**	0.28**	0.22**	0.76**	–			
8. T1: Hyperarousal	4.25(3.29)	0.09	–0.02	0.34**	0.29**	0.18*	0.70**	0.71**	–		
9. T2: Re-Experiencing	4.15(3.26)	0.22**	–0.08	0.38**	0.13	0.51**	0.39**	0.35**	0.31**	–	
10. T2: Avoidance	4.35(4.01)	0.15	–0.03	0.52**	0.19*	0.50**	0.33**	0.39**	0.31**	0.68**	–
11. T2: Hyperarousal	4.41(3.29)	0.20*	–0.03	0.40**	0.08	0.52**	0.38**	0.39**	0.45**	0.71**	0.68**

BIS Behavioral Inhibition System, BAS Behavioral Activation System, T1 Time 1 assessment, T2 Time 2 assessment. * $p < 0.05$, ** $p < 0.01$

Main Effect Model

Fit indices for the model in Fig. 1 indicated that this main effects model presented a good fit to the data, $\chi^2(95) = 124.79$, $p = 0.02$, Robust CFI = 0.96, RMSEA = 0.046 (90 % CI = 0.019–0.067), and SRMR = 0.051. Based on empirical considerations, a minor model modification was made by correlating error variances between BAS Reward and BIS item 3. This final model represented an excellent fit to the data, $\chi^2(94) = 110.59$, $p = 0.12$, Robust CFI = 0.978, RMSEA = 0.035 (90 % CI = 0.000–0.058), and SRMR = 0.049.

Child exposure to violence between Time 1 and 2 was a strong predictor of re-experiencing ($\beta = 0.44$, $p < 0.001$), avoidance ($\beta = 0.38$, $p < 0.001$), and arousal ($\beta = 0.41$, $p < 0.001$) symptoms of PTSD at Time 2, after controlling for symptoms at Time 1. Behavioral inhibition at Time 1 was significantly associated with avoidance ($\beta = 0.58$, $p < 0.001$) and arousal ($\beta = 0.43$, $p = 0.002$) at Time 2, but not re-experiencing symptoms ($\beta = 0.32$, $p = 0.07$). Conversely, behavioral activation at Time 1 was negatively associated with arousal symptoms ($\beta = -0.33$, $p = 0.007$) and marginally associated with avoidance symptoms ($\beta = -0.26$, $p = 0.051$) at Time 2.

Interactive Model

To test the hypothesis that BIS/BAS moderate the association between violence exposure and specific PTSD symptoms, we followed an iterative procedure where we modeled the interaction between either BIS or BAS and violence exposure on each PTSD symptom cluster one at a time. Interactions between these latent and measured variables were modeled using the full-information maximum likelihood (FIML) approach. Such models require numerical integration and “goodness of fit” indices, which are calculated relative to an independence model, cannot be calculated. Instead, we

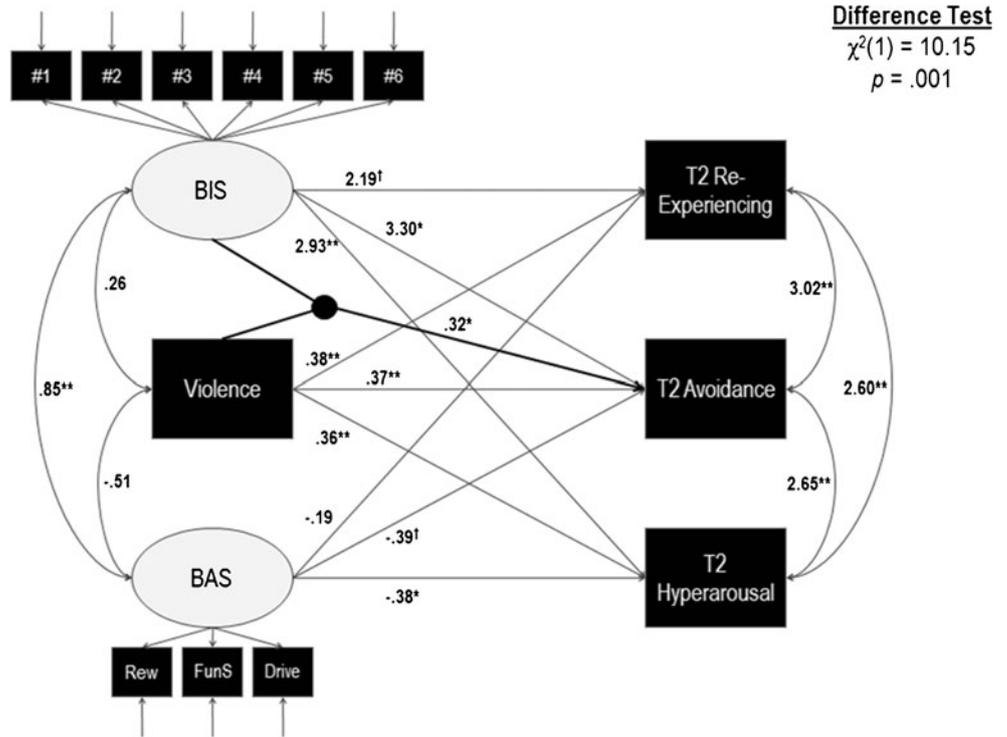
retained an interaction term in the final model when 1) the interaction term was statistically significant and 2) a scaled chi-square test (based on log-likelihood values) indicated that modeling the interaction significantly improved model fit relative to a model constraining the interaction to zero.

Results suggested that BIS significantly moderated the association between violence exposure and avoidance symptoms at Time 2 ($b = 0.32$, $p = 0.017$; see Fig. 2) and modeling this interaction significantly improved model fit, $\chi^2(1) = 10.15$, $p = 0.001$. As seen in Fig. 3, there was a much stronger association between exposure to violence over the study period and the development of avoidance symptoms at Time 2 for children with high baseline levels of BIS (+1 SD above the mean) compared to those with low levels of BIS (–1 SD below the mean). The main effects included in Model 2 demonstrated the same pattern as in Model 1 (see Fig. 2).

Discussion

The current study examined the main and moderating effects of reinforcement sensitivity on the development of specific PTSD symptom clusters in Latino children exposed to violence. Consistent with previous research conducted with urban and ethnic minority youths, Latino children in the current study reported chronic exposure to community violence. During the 6-month study period, 96.6 % of children witnessed violence in their communities, 70.3 % reported personal victimization, and 27.7 % endorsed witnessing gun or knife violence. On average, children in the current study reported being exposed to 4 different types of violence. Consistent with cross-sectional research with adults (e.g., Myers et al. 2012), baseline BIS was positively associated with avoidance and arousal symptoms 6 months later. Furthermore, BAS was negatively associated with arousal

Fig. 2 BIS/BAS Interaction Model. Unstandardized coefficients included in the figure. Control variables of child age, sex, and Time 1 re-experiencing, avoidance, and hyperarousal symptoms not depicted in the diagram. ** $p < 0.05$, *** $p < 0.01$, † $p < 0.10$



symptoms. These results highlight the importance of assessing both BIS and BAS when examining risk for psychopathology and point to specific main effects from behavioral inhibition to symptoms common across anxiety disorders (i.e., avoidance behavior and physiological arousal).

Conceptually, it makes sense that systems that regulate approach and avoidance behavior have unique and opposite effects on these aspects of PTSD. Bivariate correlations in the

present study did suggest a positive association between BIS and re-experiencing symptoms, as found in cross-sectional research with adults (Myers et al. 2012). However, the longitudinal and multivariate analysis in the present study suggested that behavioral inhibition is uniquely related to avoidance and arousal symptoms of PTSD. It is therefore possible that cross-sectional associations between BIS and re-experiencing symptoms are due to shared variance with PTSD severity more generally. Furthermore, relative levels of BIS were found to moderate risk for the development of avoidance symptoms following exposure to violence. Thus, high levels of BIS may predispose children to anxiety disorders generally. However, when such children are exposed to chronic violence they appear to be at specific increased risk of developing PTSD avoidance symptoms. This potential mechanism of risk is important given research reviewed above suggesting the significance of PTSD avoidance symptoms in predicting the presence of full PTSD and the centrality of avoidance in the treatment of PTSD.

It should be noted that Gray and McNaughton (2000) have revised RST to more fully describe a third system, the Fight-Flight-Freeze System (FFFS). The FFFS is now conceptualized as a punishment system that mediates rapid escape or defensive aggression to conditioned and unconditioned aversive stimuli whereas the BIS is conceptualized as being activated by conflict between possible reward and punishment. Therefore, BIS activation directs attention towards potential threat, encourages assessment of risk, and inhibits behavior (Heym et al. 2008) whereas FFFS is

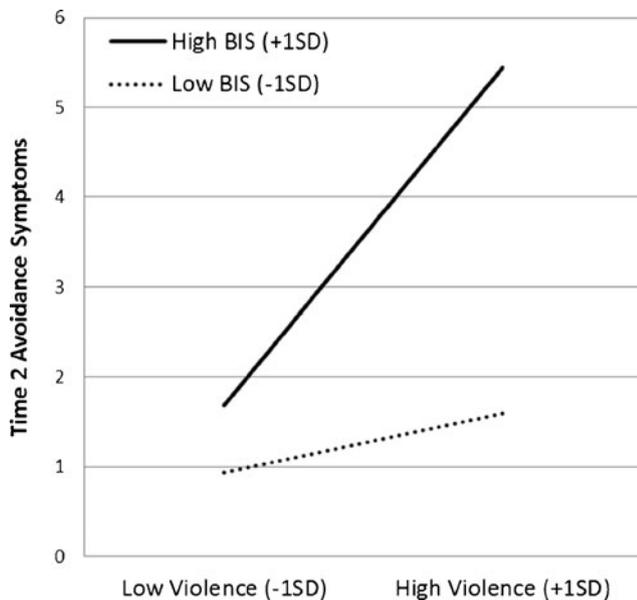


Fig. 3 Moderating effect of behavioral inhibition on the relation between violence exposure and PTSD avoidance symptoms

associated with emotions such as fear and panic (Vervoort et al. 2010).

Despite increased elaboration of the theory behind RST, the majority of the literature and available measures are based on the original RST and incorporate dimensions of both fear and anxiety. Although there have been some successful attempts to use factor analytic techniques to identify separate anxiety (BIS) and fear (FFFS) subscales from the original 7-item BIS scale (Heym et al. 2008; Poythress et al. 2008; Vervoort et al. 2010), factor solutions have not been consistent across studies. Additional research is needed to develop and validate measures of BIS/BAS that are consistent with revised RST and can be used with children and adolescents. In the current study, our data suggested that BIS was a unidimensional construct and we therefore use a single latent BIS factor. As the literature on revised RST and child PTSD risk factors continues to grow, it will be important to examine how BIS and FFFS uniquely contribute risk. One could hypothesize that the FFFS and associated feelings of fear or panic would be relevant at times of actual exposure to imminent threat or danger while BIS and related feelings of anxiety may be present in response to potential threat or danger characteristic of high-risk environments.

Our approach to examining risk for the development of PTSD builds on existing developmental psychopathology models while extending this line of research to Latino children. The use of a longitudinal design; measurement of BIS and BAS; the prospective assessment of exposure to violence; and an examination of complex multivariate associations using SEM are notable methodological strengths. Despite these strengths, several study limitations deserve notice. First, a reliance on child self-report measures is a limitation of our approach, as single-rater bias may have inflated associations between BIS/BAS and symptoms of PTSD. Additionally, perceptual biases related to BIS/BAS may influence perceptions of exposure to community violence. The use of multiple methods of assessment may be especially useful in improving future measurement and conceptualization of behavioral inhibition and avoidance symptoms. With respect to studying associations between behavioral inhibition and anxiety symptoms, the use of a non-clinical sample and a longitudinal design are two improvements over previous cross-sectional research. Furthermore, the use of SEM and the resulting fit statistics suggest that behavioral inhibition is a construct that is distinguishable from PTSD avoidance symptoms in our data. While these aspects of our design may temper some of our concerns, additional research utilizing combinations of behavioral, physiological, self- and observer-reported measures of behavioral inhibition and clinical problems is clearly warranted.

Although the current study was focused on understanding risk for PTSD in urban Latino children at high risk of

violence exposure, it will be important for future research to examine whether these results are generalizable to other populations, across different types of traumas, and across chronic versus single-incident traumatic events. The current study's recruitment rate of 51.4 % may also call the generalizability of results into question. It should be noted that this recruitment rate is consistent with that of other school-based research studies (e.g., Bloom-Hoffman et al. 2009). For example, Stein and colleagues (2007) assessed rates of active parental consent in research assessing exposure to violence and PTSD among Latino and African American school children. Their results suggest that only 46.4 % of distributed consent forms resulted in parental consent whereas 23 % resulted in active refusal (Stein et al. 2007). The authors reasoned that the sensitive nature of the questions and parental concerns about having their children respond to questions about violence exposure contribute to lower recruitment rates. Unfortunately, data to shed light on how participants differ from non-participants is not available in the current study. Given the focus on a relatively homogenous sample of Latino middle school students in a high-risk urban setting, it is possible that the current sample is representative of the overall school population in terms of sociodemographic factors. However, non-participants may differ from participants in terms of level of exposure to community violence and/or mental health symptoms. Improving the generalizability of research results will likely depend on improved efforts to engage racial/ethnic minority and vulnerable children and families in the research process.

While the current study focused almost exclusively on individual differences in temperament in Latino children, it will also be important for future research to more fully explore how social and cultural factors may mitigate risk for psychopathology. For example, the cultural context and socialization environment of Latino children may play an important role in shaping reinforcement sensitivity patterns. Cultural values emphasizing deference, obedience, respect, and humility (e.g., Leyendecker et al. 2002; Marín and Marín 1991) within Latino families may influence children's inhibited behavior (e.g., Gudiño and Lau 2010). The integration of theoretical models of culture and developmental psychopathology and additional research focused on examining individual variation within a disorder may be promising areas for elucidating processes of risk and resilience and improving prevention and intervention efforts.

The present study sought to move beyond main effect models of risk to more fully understand how temperament vulnerability interacts with environmental factors to confer risk for PTSD. An approach to developmental psychopathology research that focuses on identifying risk for specific symptom profiles within a disorder may prove quite fruitful in several important ways. For example, a greater understanding of how individual differences in behavioral inhibition

create general risk for anxiety disorders and specific risk for the development of PTSD avoidance symptoms following exposure to violence would lead to a more complete understanding of etiology.

Knowledge about etiology will also be greatly enhanced by continued research on the biological substrates that underlie behavioral inhibition, behavioral activation, and PTSD. However, research examining phenotypic differences can inform research on gene-environment interactions to the extent that it can assist in identifying more focused areas for further exploration. A more refined understanding of etiology could then improve our ability to personalize interventions for maximal effectiveness. For example, future research may suggest that while avoidance and numbing are important intervention targets for all children with PTSD, children with high behavioral inhibition require additional exposure-based intervention, more proactive intervention to generalize gains, and/or cognitive interventions targeting appraisals of threat that extend beyond trauma-related stimuli. Clinical assessment of behavioral inhibition may thus prove essential if it can inform case conceptualization and intervention planning. While these clinical implications are merely speculative at this point, they highlight the potential utility of translational research examining how biological, environmental, psychological, and cultural/contextual influences increase risk for the development of PTSD or promote resilience in the face of trauma.

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