

Vigilance, the Amygdala, and Anxiety in Youths With a History of Institutional Care

Jennifer A. Silvers, Bonnie Goff, Laurel J. Gabard-Durnam, Dylan G. Gee, Dominic S. Fareri, Christina Caldera, and Nim Tottenham

ABSTRACT

BACKGROUND: Early adversity is commonly associated with alterations of amygdala circuitry and increased anxiety. While many theoretical and clinical accounts of early adversity suggest that it increases vigilance to threatening stimuli, the current study tested whether heightened anxiety and amygdala reactivity associated with early adversity enhanced goal-directed attention for threatening stimuli. Showing this association would provide support that these adversity-induced alterations are developmental adaptations of the individual.

METHODS: A sample of 34 children and adolescents who experienced early adversity in the form of previous institutionalization (26 girls and 8 boys; mean age = 13.49 years) and a comparison group of 33 children and adolescents who were reared by their biological parents since birth (16 girls and 17 boys; mean age = 13.40 years) underwent functional magnetic resonance imaging scanning while completing a visual search task that involved quickly locating a negative target (fearful face) or positive target (happy face) in an array of neutral distracter stimuli (neutral faces).

RESULTS: Across both groups, individual differences in vigilant behavior were positively associated with amygdala responses for negative versus positive stimuli. However, a moderation analysis revealed that the degree to which amygdala responses were greater for negative versus positive stimuli was associated with greater anxiety symptomatology for previously institutionalized youths but not for comparison youths.

CONCLUSIONS: Together, these findings suggest that institutional care strengthens linkages between amygdala reactivity and anxiety, perhaps serving to enhance goal-directed attention. The findings are discussed as both adaptations and risk to the individual.

Keywords: Amygdala, Attention, Early life stress, Emotion, fMRI, Neurodevelopment

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Accumulating evidence submits that early caregiving adversity—defined as negative experiences related to the family or caregiving (1)—alters amygdala development and increases anxiety symptomatology (2–9). Theoretical accounts of these associations posit that early adversity reprioritizes developmental goals such that threat vigilance is emphasized over other behaviors, perhaps to promote self-preservation, and that this vigilance confers greater anxiety (9–12). However, no prior work has examined whether adversity-induced alterations in amygdala function moderate the link between vigilance and anxiety. The current study sought to directly test whether a history of previous institutional (i.e., “orphanage”) care, a significant adversity, potentiates the link between amygdala-based threat vigilance and anxiety.

The literature on attentional gating mechanisms shows that stimuli with salient bottom-up features can be prioritized when they align with our top-down goals (13). For example, threatening cues, such as a menacing snake and a fearful face, are detected more rapidly than nonthreatening stimuli (14–16), but this process is facilitated when consistent with goal states. The

amygdala can support this additional attentional vigilance and orient attention toward salient emotional stimuli in one of two ways—either through a crude noncortical route or by amplifying cortical processing of such stimuli (17–21). As such, the amygdala plays a crucial role in rapidly detecting and guiding attention toward motivationally relevant stimuli (16,22).

Faster detection of threatening stimuli has been associated with trait anxiety in both clinical and nonclinical samples both during development and during adulthood (23–25). Numerous neuroimaging studies have linked anxiety to exaggerated amygdala responses to threatening stimuli in children, adolescents, and adults (26,27). These associations raise the possibility that individuals with elevated amygdala reactivity, although at greater risk for anxiety, might incur an advantage when it comes to identifying threatening information. Importantly, links between vigilance and anxiety may be bidirectional in early life stress–exposed youths—anxiety could be interpreted as a natural consequence of stress that promotes vigilance, and thus survival—just as vigilance and associated neurobiological changes may trigger anxiety.

Early experiences, and particularly early adversity, alter developmental trajectories associated with emotion, threat learning, and attentional control (28–31). Given this fact and that early adversity is a risk factor for the development of anxiety (1,6,7), there are strong reasons to hypothesize that threat vigilance may moderate early adversity's influence on anxiety. Importantly, it is unknown whether all forms of early adversity evoke comparable attentional biases and anxious symptomatology. On the one hand, some theoretical models propose that different forms of early adversity may have varied developmental consequences (32–34). On the other hand, various forms of early adversity (abuse, neglect, and low socioeconomic status) share common threads such as not feeling safe or agentic in one's environment and have been linked to alterations of the amygdala and associated behavior (35). Studies examining how exposure to abuse or violence affects attention for threatening versus nonthreatening stimuli have mostly done so using dot-probe paradigms, which evaluate how automatically attending to threat cues incidentally biases attention. While some evidence suggests that abuse and neglect cause a negative attentional bias (i.e., attending to threatening or sad stimuli), other evidence suggests attentional avoidance (36–39). Prior work examining attentional biases toward threat in previously institutionalized (PI) children found that children who remain in institutional care display either no biased attention or a bias toward threat, whereas children who are randomly assigned to foster care show a bias toward positive stimuli (40,41). This line of work has also revealed that attentional biases toward positive stimuli and away from threatening stimuli predict fewer social and emotional problems, suggesting that individual differences in attention may confer risk or resilience for PI youths (40,41). Importantly, most prior research has focused on narrow age bands, leaving open the possibility that early adversity differentially affects attentional biases at different ages.

Amygdala hyperactivity is common to both PI youths and individuals with elevated anxiety (2,3,26,42). Thus, the amygdala presents itself as a potential neural link between adversity exposure and enhanced attention for threat. If such is the case, we might expect that amygdala responses confer anxiety for PI youths but not for comparison youths. Here, we employed a task that assesses goal-directed attention for threats versus positive stimuli and assessed whether amygdala engagement may support threat-directed attention but also increase risk for anxiety in PI youths.

PI youths were compared with a never-institutionalized comparison youth group on a neuroimaging task that involved rapidly locating either threatening or positive facial

expressions in a visual array. In addition to testing main effects, including how goal-directed attention differed for threatening and positive stimuli and how group status (PI vs. comparison) affected attention, we tested three novel hypotheses. First, we examined whether amygdala activity was associated with behavioral markers of goal-directed attention for threatening versus positive stimuli. Second, we examined whether behavioral or amygdala-based markers of attention for threatening versus positive stimuli predicted greater anxiety in PI youths but not in comparison youths (i.e., a moderation effect). This hypothesis was motivated by a growing literature suggesting that amygdala responses may interact with group categorization (e.g., genotype, diagnosis) to predict distinct functional outcomes related to anxiety and well-being (43,44). Finally, we conducted exploratory age analyses to examine whether responses to threat differentially predicted anxiety across development in PI youths.

METHODS AND MATERIALS

Participants

In total, 34 PI youths (26 girls and 8 boys; mean age = 13.49 years, SD = 2.87, range = 8.36–18.26) and 33 comparison youths (16 girls and 17 boys; mean age = 13.40 years, SD = 3.51, range = 8.10–18.99) participated in this study. There were more girls in the PI group than in the comparison group ($\chi^2 = 5.61, p = .02$), so gender was included as a covariate in all analyses. All participants were currently residing in the United States at the time of testing, and all research was completed at the University of California, Los Angeles. Participant demographic information is reported in Table 1, and correlations between study variables are presented in Table 2. This study was approved by the university's Institutional Review Board. All participants provided informed consent, and their parents provided informed consent, prior to participation.

The current data were collected as part of a larger study examining the effects of prior institutionalization on social and emotional development. A subset of participants who participated in this larger study completed the tasks and measures described here, and only data from the age range with maximal overlap between the PI and comparison groups (8–18 years) were analyzed. Of the 91 participants within this age range, 12 were excluded from analyses (5 PI youths and 7 comparison youths; 6 girls and 6 boys; mean age = 11.68 years) for correctly responding to fewer than 50% of targets for fearful faces and/or happy faces. Among the remaining 79 participants, 10 were excluded due to excessive head motion (4 PI youths and 6

Table 1. Sample Characteristics

Measure	Comparison (<i>n</i> = 33)	PI (<i>n</i> = 34)	Analysis		
			<i>t</i> or χ^2	<i>df</i>	<i>p</i>
Gender, Female	16	26	$\chi^2 = 5.61$	1	< .05
Age, Years	13.41 (3.51)	13.49 (2.87)	<i>t</i> = 0.10	65	n.s.
Full-Scale IQ (WASI) ^a	116.5 (16.16)	105.32 (14.16)	<i>t</i> = 2.98	64	< .005
Anxiety (SCARED)	6.25 (5.62)	15.19 (10.79)	<i>t</i> = 4.23	65	< .001

Data are mean (SD) or *n*.

n.s., nonsignificant ($p > .05$); PI, previously institutionalized; SCARED, Screen for Child Anxiety Related Disorders; WASI, Wechsler Abbreviated Scale of Intelligence.

^aFull-scale IQ was not available for 1 comparison participant.

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