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Early adversity and learning: implications for typical and atypical behavioral development

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Background: Children who experience early adversity often develop emotion regulatory problems, but little is known about the mechanisms that mediate this relation. We tested whether general associative learning processes contribute to associations between adversity, in the form of child maltreatment, and negative behavioral outcomes. **Methods:** Eighty-one participants between 12 and 17 years of age were recruited for this study and completed a probabilistic learning Task. Forty-one of these participants had been exposed to physical abuse, a form of early adversity. Forty additional participants without any known history of maltreatment served as a comparison group. All participants (and their parents) also completed portions of the Youth Life Stress Interview to understand adolescent's behavior. We calculated measures of associative learning, and also constructed mathematical models of learning. **Results:** We found that adolescents exposed to high levels of adversity early in their lives had lower levels of associative learning than comparison adolescents. In addition, we found that impaired associative learning partially explained the higher levels of behavioral problems among youth who suffered early adversity. Using mathematical models, we also found that two components of learning were specifically affected in children exposed to adversity: choice variability and biases in their beliefs about the likelihood of rewards in the environment. **Conclusions:** Participants who had been exposed to early adversity were less able than their peers to correctly learn which stimuli were likely to result in reward, even after repeated feedback. These individuals also used information about known rewards in their environments less often. In addition, individuals exposed to adversity made decisions early in the learning process as if rewards were less consistent and occurred more at random. These data suggest one mechanism through which early life experience shapes behavioral development. **Keywords:** Learning; child development; social behavior; early life experience; child abuse.

Introduction

Children who experience high levels of early adversity are very likely to develop emotion regulatory problems that undermine adaptive social development. For example, physical abuse during early childhood is associated with the emergence of negative mental health outcomes including aggressive and oppositional behavior (Vachon, Krueger, Rogosch, & Cicchetti, 2015). Although associations between various forms of adversities and later behavioral problems are well-documented, much is still unknown about which specific processes lead to the range of negative outcomes observed in individuals who have had these negative early life experiences. Recently, many scholars who have been studying this issue have advocated for a new conceptual approach. Rather than focusing on specific outcomes (such as depressive or aggressive disorders), researchers are beginning to examine dimensional measures that broadly affect domains of children's functioning, such as social competence (Casey, Oliveri, & Insel, 2014; Pollak, 2015a). Success at understanding and adjusting to changing social environments is central for healthy adaptation. To this end, we report here on an experiment designed to test whether general associative learning processes are a viable mechanism through which early adversity has a negative impact on children's behavioral development.

By associative learning, we refer to processes through which events or stimuli become linked to other events or stimuli. For example, stimuli, such as odors and other sensory information, can become coupled with feelings of value or danger through repeated pairings in conditioning experiments (Watson & Rayner, 1920; Wilson & Sullivan, 1994). This conditioning, which is one form of associative learning, can then influence future behavior across a number of different domains (Rescorla, 1988). Impairments in the ability to form associations with new stimuli, or change previous associations, could hinder the potential of an individual to make predictions about, and appropriately adapt to, their environment (and the individuals within an environment).

Aspects of general learning systems appear to be key components for complex social behaviors

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key components for complex social behaviors (Behrens, Hunt, Woolrich, & Rushworth, 2008). As an example, learning occurring from the absence of

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an expected negative outcome is associated with

dynamic social interactions. Indeed, past research