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Not all risk taking behavior is bad: Associative sensitivity predicts learning during risk taking among high sensation seekers

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ABSTRACT

Risk taking behavior can be both adaptive and maladaptive depending on context. The majority of studies on risk taking, however, focus on clinical populations and dangerous or harmful risk taking. Individual differences in learning during risk taking are rarely examined in relation to task performance. The present study examined risk taking and associated outcomes in an exploration-based instrumental learning task (Balloon Emotional Learning Task; BELT), which presented a series of balloons in which participants pump up for points. Consistent with prior work, sensation seeking predicted increased risk taking behavior. Importantly, however, a significant interaction between sensation seeking and associative sensitivity, an attentional construct defined as the frequency and remoteness of automatic cognitive activity, was found. Specifically, among individuals high in sensation seeking, associative sensitivity predicted fewer balloon explosions and an increase in points earned on the balloon condition with the most potential for feedback driven learning. Thus, these findings suggest that sensation seekers are a heterogeneous group, and secondary traits such as associative sensitivity moderate risk taking and learning according to context.

1. Introduction

Given their clinical and public health consequences, studies of risk taking have largely focused on potentially harmful risk taking behaviors, their negative consequences, as well as identifying individuals likely to engage in these behaviors. However, as Boyer (2006) noted, "Risk-taking behaviors are not entirely foolhardy... and may be the most rational course of action given one's priorities" (p. 336). For example, while foraging behavior may increase risks of predation (Godin & Smith, 1988), hungry animals are more likely to engage in such behavior in order to reduce the risk of starvation (Van der Veen & Sivars, 2000). Thus, as a group, risk takers may be heterogeneous. Discriminant function analysis of three different groups of risk takers found that rock climbers were high on sensation seeking, residents in a long-term drug treatment facility were high on antisocial function, while police and firemen decorated for safety were lower on both sensation seeking and antisocial function, as their risk taking served a prosocial function (Levenson, 1990). These results suggest that individual differences in risk taking behaviors may be, in part, related to the functional utility of risk taking behavior, and as a result, temperament correlates may not be easily identified via a "one size fits all" approach.

1.1. Individual differences in risk taking

Although self-report measures of individual differences in risk taking, such as those that assess temperament and personality, correlate with real world risk behavior (e.g., Schwebel, Severson, Ball, & Rizzo, 2006), the use of experimental behavioral tasks may be better able to assess real-world risk taking behavior and interrogate the neurobiology of risk behavior (Jentsch, Woods, Groman, & Seu, 2010). The Balloon Analogue Risk Task (BART; Lejuez et al., 2002) has been used widely as a laboratory analogue of individual differences in risk taking. Behavior on the BART is predicted by sensation seeking (SS) (Lejuez et al., 2002), though this task has largely been used to assess risk taking in clinical populations (e.g., Hopko et al., 2006; Lejeuz, Aklin, Jones, Richards, & Read, 2003).

Tasks that measure tendencies to explore and seek out opportunities need not be specific to clinical populations. Even in infancy, exploration of the environment is essential for learning and development (Piaget, 1954). BART-like tasks provide the opportunity to examine change across trials as a function of experience, allowing for the measurement of both individual differences in risk taking, and the relationship between risk taking and outcome on the task. For the BART, the stated goal is to achieve the highest payout at the end of the task. Learning can play a crucial role in success during this type of task. Participants receive immediate feedback (an additional point or a balloon explosion)

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following each press, which can guide future decision making under these conditions of risk. Gibson (1988) stated that exploring the world and learning about the world are "inextricably linked". Yet, heterogeneity in risk takers could be caused by how much they learn from their risk taking experience. The differences in the acquisition and use of relevant information may play an important role in moderating subsequent risk taking behavior. By examining how risk taking is altered in response to learning may provide a clearer picture of optimal versus suboptimal risk taking.

1.2. Learning and risk taking

Pickering and Gray (2001) stated that "the ability to detect and attend to salient stimuli may be particularly relevant in [stimulus–response] learning tasks in which the subject has to learn which stimulus features are predictive of the responses required..." (p. 115). The ability to make meaning from the associations in one's environment has clear evolutionary advantages, and like many cognitive processes, is expected to vary across the population. Associative sensitivity (AS), an attentional construct defined as "frequency and remoteness of automatic cognitive activity" (Evans & Rothbart, 2007), has not been examined in relation to learning. The similar Big Five construct of Openness to Experience (see Evans & Rothbart, 2007), has been described as attentiveness to inner feelings, sensitivity, and intellectual curiosity (Costa & McCrae, 1992). In fact, AS has been theorized to be the attentional disposition that "links" Openness to actual extraction of actionable information (see Van Egeren, 2009). Implicit learning (the automatic detection of associations in the environment) has shown moderate positive associations with Openness (Kaufman et al., 2010), though we propose that AS is likely to better predict such learning. Thus, we anticipate that both individual difference traits (i.e., SS [sensitivity to rewards] and AS [sensitivity to stimulus–response associations in the environment]) would be relevant in unique ways to risk taking behavior over time.

1.3. Aims and hypotheses

The current study modified the BART to provide a tool to examine changes in risk taking behavior depending on implicit contextual information. The modified task, Balloon Emotional Learning Task (BELT), contained two stable (certain) and one variable (uncertain) balloon condition. The inclusion of balloon conditions with fixed explosion points allowed for a more direct examination of learning such parameters via task experience, as the fixed information can better guide subsequent risk taking behavior, as opposed to 'ill-defined' tasks such as the BART (see Pleskac, 2008). Conditions were denoted by balloon color with initially unknown meaning to participants in order to facilitate measurement of individual differences in tracking the balloon condition and differentiation of behavior from the beginning to the end of the task. The current task is well-suited for assessing risk taking and learning for the following reasons: (1) rather than measuring a single behavioral response to a single stimulus (e.g., Corr, Pickering, & Gray, 1995), participants determine the number of presses to make (that is, to "push the limit" of each balloon trial), thus providing a laboratory measure of risk taking and (2) the inclusion of three balloon conditions provides the ability to capture separable risk taking and learning outcomes.

We hypothesized that SS would predict risk taking (i.e., pumps, balloon explosions) as found in previous research on the BART (Lejuez et al., 2002). However, we also anticipated that sensations seekers would be a heterogeneous group. Therefore, based on Pickering and Gray's (2001) predictions regarding individual differences in associative learning, we hypothesized that AS would moderate the association between SS and task outcome.

2. Method

2.1. Participants

Seventy-six (26 male, 50 female) undergraduates from a large public university in the Western United States who received partial class requirements for participation. Participants were required to be at least 18 years of age or older and English speaking. This sample ranged in age from 18–26 years old (M = 20.15, SD = 1.70). One participant was excluded as an outlier due to scores falling beyond three standard deviations from the mean.

2.2. Tasks and measures

2.2.1. Balloon Emotional Learning Task (BELT)

All participants completed a computerized associative learning task in which participants would press a button to "pump up" balloons and earn points for each balloon (i.e., more pumps earned more points). Too many pumps would result in balloon explosions, which occurred at an initially unknown number of pumps, resulting in the loss of all points for that trial. Balloons appeared in three colors with different response contingencies, counterbalanced across participants. Pink balloons exploded at 19 pumps (certain-long), orange balloons exploded at 7 pumps (certain-short), and blue balloons exploded variably at 7 pumps, 13 pumps, or 19 pumps distributed equally across each third of the task (uncertain). There were 27 trials, and balloon color was distributed evenly across the task. Participants were not told that colors signified different response contingencies, but were explicitly told that not all balloons pop at the same point. Thus, the task involved associative instrumental learning because participants could make cause-effect determinations by altering their own behavior through learning how balloon color relates to task structure. In this way, the task is 'defined' given that the underlying task structure can be determined, unlike other risk taking tasks (e.g., BART).

2.2.2. Adult Temperament Questionnaire – short form (ATQ; Rothbart, Ahadi, & Evans, 2000)

This 77 item self-report measure of temperament obtains five general factors of temperament. Likert-scale ratings ranging from 1 (extremely untrue) to 7 (extremely true) were obtained on each item, and scales were composed of the mean of all items. For the present study we used the AS scale (example item: "I sometimes seem to understand things intuitively"). Previous work has found that the ATQ is correlated with individual difference traits measured using other well-validated instruments (e.g., Derryberry, Reed, & Pilkenton-Taylor, 2003), and the AS scale has been shown to have good internal consistency (.85) (Evans & Rothbart, 2007).

2.2.3. UPPS-P impulsivity scale (Lynam, Smith, Whiteside, & Cyders, 2006)

This 59 item self-report measure assesses several domains of impulsivity. Likert-scale ratings ranging from 1 (agree strongly) to 4 (disagree strongly) were obtained on each item, and scales were composed as the sum of the items. In the present study, we used the SS scale, which has been shown to have excellent internal consistency (.90) and demonstrated discriminate validity from other factors of impulsivity (Whiteside & Lynam, 2003).