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Social anxiety, acute social stress, and reward parameters interact to predict risky decision-making among adolescents

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ABSTRACT

Risk-taking behavior increases during adolescence, leading to potentially disastrous consequences. Social anxiety emerges in adolescence and may compound risk-taking propensity, particularly during stress and when reward potential is high. However, the manner in which social anxiety, stress, and reward parameters interact to impact adolescent risk-taking is unclear. To clarify this question, a community sample of 35 adolescents (15–18 yo), characterized as having high or low social anxiety, participated in a study over two separate days, during each of which they were exposed to either a social stress or a control condition, while performing a risky decision-making task. The task manipulated, orthogonally, reward magnitude and probability across trials. Three findings emerged. First, reward magnitude had a greater impact on the rate of risky decisions in high social anxiety (HSA) than low social anxiety (LSA) adolescents. Second, reaction times (RTs) were similar during the social stress and the control conditions for the HSA group, whereas the LSA group's RTs differed between conditions. Third, HSA adolescents showed the longest RTs on the most negative trials. These findings suggest that risk-taking in adolescents is modulated by context and reward parameters differentially as a function of social anxiety.

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1. Introduction

Adolescence is a developmental period that is marked by the emergence of a number of risky, potentially hazardous behaviors, such as substance use, risky sexual activity, and reckless driving (e.g., DiClemente et al., 1996; Gullo & Dawe, 2008; Windle et al., 2008), all of which may lead to potentially disastrous outcomes (Hingson, Heeren, Winter, & Wechsler, 2005). All risky behaviors assume a level of conflict since they involve the weighting of potential risks vs. benefits. That is, although these behaviors may be expected to bring enjoyment (reward), they can also lead to devastating consequences. The subjective estimate of the risk/benefit ratio varies across individuals and contexts, and may also be modulated by the reward parameters (e.g., probability, magnitude).

Social anxiety, which is particularly prominent in adolescence (American Psychiatric Association, 2000), may be an important individual factor that can influence the perceived risks vs. benefits of certain situations (i.e., social interactions), which subsequently may impact an individual's propensity toward risky decision-making and risk-taking. Social anxiety involves fear and avoidance of social contexts that carry the potential for judgment or rejection by others. Accordingly, individuals with social anxiety are typically characterized as shy, behaviorally inhibited, and risk averse (e.g., Beidel & Turner, 1998). Presumably, this temperamental pattern should limit one's exposure to risky situations, such as joining substance-using peer groups (Fergusson & Horwood, 1999) or attending risky social events (Myers, Aarons, Tomlinson, & Stein, 2003).

However, an emerging line of research indicates that social anxiety can also be paradoxically associated with disinhibited or risk-prone behaviors, including aggression, unsafe sexual practices, drinking and abusing alcohol, and impulsive decision-making (Buckner, Eggleston, & Schmidt, 2006; Erwin, Heimberg, Schneier, & Liebowitz, 2003; Hanby, Fales, Nangle, Serwik, & Hedrich, 2012;

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Kashdan & Hofmann, 2008; Kashdan & McKnight, 2010; Kashdan, Elhai, & Breen, 2008; Kashdan, McKnight, Richey, & Hofmann, 2009; Rounds, Beck, & Grant, 2007; Schneier et al., 2010). These seemingly discrepant findings suggest that the relationship between social anxiety and risk-taking may be modulated by additional factors, such as features of the social context and/or the probability or magnitude of potential rewards.

With regard to the social context, evidence suggests that when socially anxious individuals encounter situations involving social threat (either real or perceived), their behavioral response might switch from a risk-averse to a risk-prone pattern. For example, Muris and colleagues (Muris, Luermans, Merckelbach, & Mayer, 2000; Muris, Merckelbach, & Damsma, 2000) reported that children and adolescents with social anxiety were more likely to perceive ambiguous social cues (e.g., a neutral facial expression) as threatening, and, when feeling threatened, to react with aggression (Muris, Merckelbach, & Walczak, 2002). One interpretation is that, when socially anxious individuals are unable to use their typical avoidance-related coping strategies, they may engage in risky behaviors (e.g., substance use, aggression) as an alternative strategy to cope with the real or imagined threat of social rejection.

In addition to social threat, the potential rewards associated with risk-taking may also contribute to tipping the risk/benefit ratio in favor of benefits, which would promote the adoption of risky behaviors. For example, among socially anxious individuals, stronger beliefs that potentially risky situations (e.g., substance use) have the potential for substantial rewards (e.g., enhancing social standing) have been linked with more frequent engagements in social interactions, as well as increased risky sexual behavior, aggression, and substance use (Kashdan et al., 2008). Additionally, individuals with high social anxiety are more likely to report wanting to drink because of the positive reinforcement (i.e., to enhance positive affect and experiences), but not negative reinforcement (i.e., to reduce negative affect) aspects of alcohol consumption, relative to people with low social anxiety (Kashdan et al., 2008). Moreover, the degree to which individuals endorse drinking specifically for these rewarding aspects is associated with alcohol-related problems (Buckner et al., 2006). Thus, socially anxious individuals seem to be particularly sensitive to the potential for rewards (positive reinforcement) associated with risk-taking. Consequently, when they believe the potential for reward to be high, they display more risky behaviors than would normally be expected based on traditional characterizations of social anxiety as being associated with risk-avoidance. Despite the apparent importance of rewards in determining if and when socially anxious individuals will take risks, to the best of our knowledge, no studies to date have systematically manipulated reward parameters (e.g., probability, magnitude) to quantify their influence on risky decision-making among individuals with social anxiety across varying social contexts.

As a first step in this direction, we recently used an experimental approach to examine risk-taking behavior in real-time as a function of social context (i.e., acute social stress) among individuals characterized by their social anxiety status, but without manipulating reward parameters (Reynolds et al., 2013). Adolescents with high social anxiety took more risks (on the Balloon Analog Risk Task) when exposed to social stress compared to a low-stress, control context. Conversely, adolescents with low social anxiety failed to show any increase in risk-taking during the social stress vs. the control context. Although this study supports the notion that in certain contexts (i.e., overt, inescapable social stress), social anxiety may actually be a risk factor rather than a protective factor for engaging in risky behavior, it remains unclear how the characteristics of potential rewards further differentiate risky decision-making between anxious vs. non-anxious individuals. The present study addresses this gap.

Using a within-subjects design, adolescents, characterized as having low or high social anxiety, performed a risk-taking task twice on two separate days. On one day, participants were exposed to a social stress condition, and on the other day to a low-stress control condition. The risk-taking task utilized was the Wheel of Fortune Task (WOF; Ernst et al., 2004). This task assesses risky decision-making by manipulating the magnitude and probability of rewards orthogonally across trials. The goal of this study was to examine the effects of social anxiety, acute social stress, and reward parameters on risky decision-making among adolescents.

Based on the reviewed literature, we hypothesized that, relative to low social anxiety (LSA), high social anxiety (HSA) would be associated with more "inhibited" or risk-avoidant tendencies (longer reaction times and fewer risky decisions) in the control condition. However, in the social stress condition, HSA would be associated with increased risky behaviors (shorter reaction times and more risky decisions). In addition, we expected that the probability and magnitude of potential rewards would modulate these findings. Generally, a higher probability or magnitude of reward would intensify these group differences as a function of the stress condition.

2. Method

2.1. Participants

This study was conducted as part of a larger investigation of adolescent anxiety and risk-taking behavior (Reynolds et al., 2013). Thirty-nine English-speaking participants, aged 15–18 years old (*Mean* = 16.0; *SD* = 1.1), were recruited from the greater metropolitan Washington, DC area. Most of these participants were also included in the published study by Reynolds et al. (2013). All study sessions were conducted at the University of Maryland College Park. Of the 39 participants recruited, four participants had missing data due to technical difficulties and were excluded from the analyses. The final sample of 35 participants (11 male) was 25.7% Caucasian ($n = 9$), 60% African American ($n = 21$), and 14.3% mixed race or other ($n = 5$).

2.2. Procedure

Permission to conduct research was obtained from the University of Maryland Institutional Review Board (IRB). Informed consent/assent was acquired from all participants and their legal guardian prior to initiating study procedures. Participants completed the study in two sessions, scheduled 3–14 days apart. Each session included one of two experimental conditions. One session involved a social stress condition, while the other session involved a low-stress, control condition (see Section 2.3 below for descriptions of experimental conditions). Session order was randomized across participants to control for order effects. Computer tasks designed to assess decision-making and risk-taking were administered once at each session. Here, we focus on the monetary WOF computer task (Roy et al., 2011).

2.3. Experimental conditions

2.3.1. Social stress session

Each session began with a baseline assessment of various affective states, including, but not limited to, anxiety (see Section 2.4.2). In the social stress session, participants were told that they would give a 3-min speech in front of a group of judges after completing computer tasks. They were informed that the judges would evaluate and provide feedback on their performance. As part of the instructions, participants were shown a video with actors representing other adolescent participants giving speeches in front of