The Role of Habituation in Risk-taking Escalation

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Abstract

Risk-taking is an integral part of human nature which incites rewarding exploration and facilitates individual growth. However, excessive risk-taking can lead to dire outcomes. Anecdotally, extreme risk-taking behaviors often begin as small, seemingly harmless, acts that snowball. Here we use a gambling task (Experiment 1) as well as Virtual Reality combined with GSR recording (Experiment 2) to provide empirical evidence for a gradual escalation of risk-taking and reveal a mechanism supporting it. Behaviorally, we show that the extent to which participants engage in risk-taking increases with repetition. Our pilot results show that reduced physiological arousal is sensitive to the history of risk-taking, consistent with habituation. The extent of physiological reduction was associated with the increase in risk-taking. These preliminary findings suggest a role for emotional habituation in risk escalation. The findings can inform the development of interventions to curb dangerous risk-taking and prevention programs for vulnerable populations.

Keywords: risk-taking; habituation; arousal; emotions; virtual reality.

Introduction

Risk-taking is a dominant aspect of human behaviour that is necessary for engaging in exploratory behavior in search of rewards. Excessive risk-taking, however, can lead to dire outcomes including financial loss and physical harm. According to the 'risk-as-feelings account', emotional responses to the potential costs (anxiety, fear) and benefits (excitement, thrill) of risk guide behaviour (Loewenstein et al., 2001). For example, when deciding whether to ride a rollercoaster, individuals may weigh the joy of the thrill against the fear of an accident. If the fear outweighs the excitement, individuals will be less likely to take the ride. Anecdotally, low risk behaviours are the antecedents of extreme risk-taking. Consider for instance children on a playground who first jump off low benches before proceeding to jump off the highest trees; gamblers who start by putting down small bets, slowly escalating to larger and larger sums over time.

Here we ask whether and how small acts of risk-taking snowball into extreme acts and characterize individual differences in risk escalation. Our hypothesis is that emotional habitation plays a role in risk escalation. Habituation is a form of non-associative learning in which a response to an object or event is attenuated following repeated exposure to it (Thompson & Spencer, 1966). For example, prolonged exposure to emotion-laden images results in attenuation of explicit (Bradley et al., 1993) and implicit (e.g., GSR; Bradley et al., 1993; Codispoti et al., 2006; amygdala activation; Phelps et al., 2004) emotional responses. As people repeatedly engage in risky behaviours, the emotional response to potential costs, which normally curbs risk-taking, will subside due to habituation. Thus, individuals will gradually engage in greater and greater risk. The risk itself will be perceived as smaller despite the underlying threat remaining the same.

Experiment 1: Risk-taking Escalates with Repetition

We first tested whether risk-taking escalates in a situation where subjects cannot learn from outcomes. To that end, we used a simplified version of a roulette

game in which a bet can be placed on one out of two stimuli. To enhance participants' engagement in the task, the picker wheel items varied across the 20 trials, and participants were led to believe that they were competing against an opponent. On each trial, the participant and their "opponent" took turns selecting an item from a picker wheel to place bets on and then decided how many bills from 1 to 50 they would like to bet on their item (Figure.1).

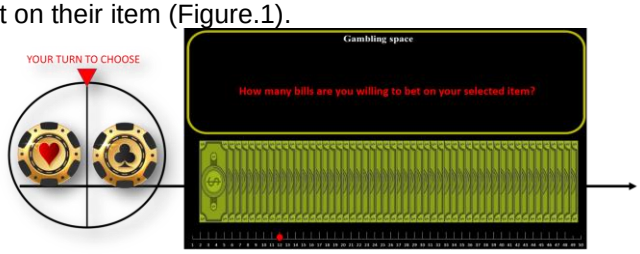

Fig. 1. An example trial of experiment 1.

To examine if risk-taking escalates, we conducted a Linear Mixed Model (LMM) predicting the number of bills wagered on each trial (Z-scored within each subject) from trial number as a fixed factor and random intercepts and slopes at the subject level. This revealed a significant increase in risk-taking across trials (β=0.03, t(57)=4.3, *P*<.001; Figure.2), providing support for the notion that risk-taking escalates.

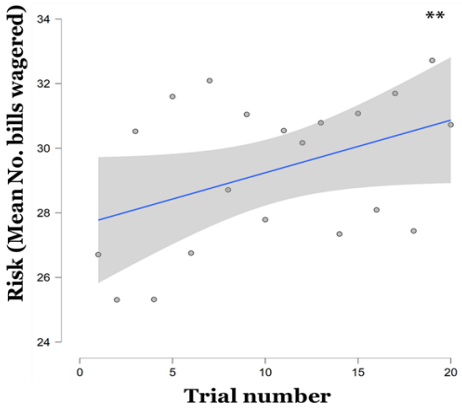

Fig. 2. Experiment 1. Risk, measured as the number of bills wagered, escalates over trials. Each dot represents the average risk across all subjects on each trial. The file line represents the confidence intervals. ***P*<.001.

Experiment 2: Does Physiological Habituation Underly Risk Escalation?

The aim of Experiment 2 is to examine (i) if reduced physiological arousal over time underlies risk escalation and (ii) whether individual differences in risk escalation are domain general. To that end, we used a Virtual Reality (VR) game (Richie's Plank Experience) which stimulates physiological risk. VR technology offers a unique opportunity to simulate highly realistic and emotionally engaging scenarios in a safe and controlled environment, allowing us to measure risk-taking behaviors in an ecological setting without endangering participants. In VR, participants are immersed in a reality that closely mimics real-life situations, requiring their brains to perceive and react as if they were facing real-life scenarios. The multi-sensory perceptual experience in VR tricks the brain into perceiving the scenario as real and thus provides us with a behavioral model that closely resembles real-life behaviors.

Arousal levels were recorded using a Shimmer wristband that indexes Galvanic Skin Response (GSR). On each of the 15 trials, participants began on the ground level inside an elevator. The elevator then took them up several hundred feet to a plank (anticipation phase), on which they could then walk (Figure. 3). For each subject, we tested our hypotheses from trial 1 to trial X, with trial X being the last trial where participants attempted to reach the end of the plank (i.e., walked the maximum distance possible).

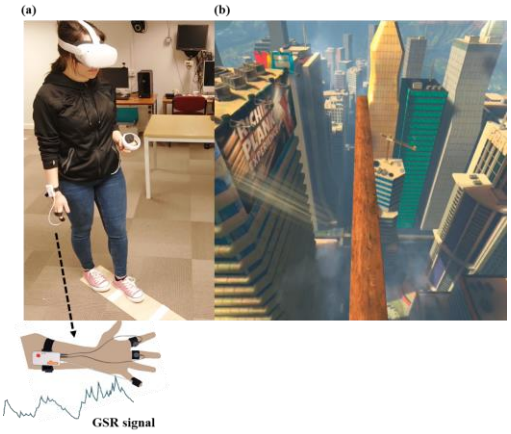

Fig.3. (a) VR experimental setting and measurement of GSR with Shimmer wristband. (b) A virtual scene from the VR Richie's Plank Experience.

Here we present preliminary pilot results (N=10) from an ongoing experiment (we expect the final N to be 55). For all subjects we observed a strong positive correlation between risk and trial number, as indicated by a Pearson correlation, with an average correlation coefficient (r) of 0.8, t(6)=13,P<.001 (Figure 4a), suggesting that risk-taking escalates. 70% of subjects also showed a moderate to strong negative association between GSR and trial number, with an average correlation of -0.27, t(6)=-2.9, P<.05 (Figure.4b), suggesting that physiological arousal tends to decline over repetition. The decline in GSR was associated with an increase in risk-taking as observed by a positive correlation between the rate of GSR reduction from one trial to the next (GSR_{t-1}- GSR_t) with the rate of risk

escalation from one trial to the next ($Risk_t$- $Risk_{t-1}$) in all but one subject (Mean correlation=0.08, N.S.)

To examine if individual differences in risk-taking are domain-general, we will assess whether the rate of risk escalation in the VR task is correlated with the rate of risk escalation in the gambling task once the full sample is collected.

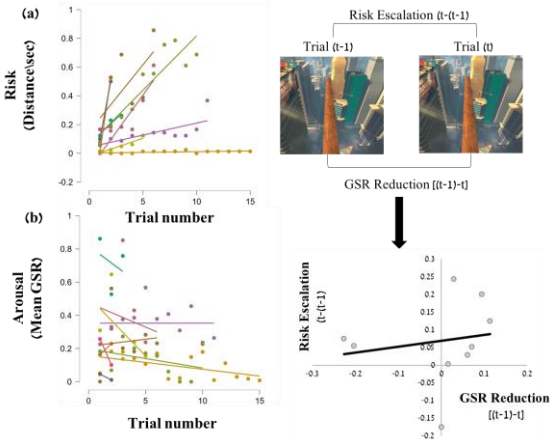

Fig.4. (a) Risk (distance per second) increases across trials. (b) Arousal levels (Mean GSR) during anticipated risk decrease across trials. Each line represents a different subject. (c) An example participant showing that rate of GSR reduction is associated with rate of risk escalation.

Summary

The results provide empirical evidence for the escalation of risk-taking. We show that risky behaviors tend to start small and then increase over time, even in environments where outcomes are controlled. Preliminary results suggest that emotional habituation to risk, as reflected in reduced physiological arousal, may play a role in the process of risk escalation. These findings underscore the potential danger of engaging in seemingly small risky acts, as they can gradually escalate to more dangerous behaviors.

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