

Enhanced Risk Aversion, But Not Loss Aversion, in Unmedicated Pathological Anxiety

Caroline J. Charpentier, Jessica Aylward, Jonathan P. Roiser, and Oliver J. Robinson

ABSTRACT

BACKGROUND: Anxiety disorders are associated with disruptions in both emotional processing and decision making. As a result, anxious individuals often make decisions that favor harm avoidance. However, this bias could be driven by enhanced aversion to uncertainty about the decision outcome (e.g., risk) or aversion to negative outcomes (e.g., loss). Distinguishing between these possibilities may provide a better cognitive understanding of anxiety disorders and hence inform treatment strategies.

METHODS: To address this question, unmedicated individuals with pathological anxiety ($n = 25$) and matched healthy control subjects ($n = 23$) completed a gambling task featuring a decision between a gamble and a safe (certain) option on every trial. Choices on one type of gamble—involving weighing a potential win against a potential loss (mixed)—could be driven by both loss and risk aversion, whereas choices on the other type—featuring only wins (gain only)—were exclusively driven by risk aversion. By fitting a computational prospect theory model to participants' choices, we were able to reliably estimate risk and loss aversion and their respective contribution to gambling decisions.

RESULTS: Relative to healthy control subjects, pathologically anxious participants exhibited enhanced risk aversion but equivalent levels of loss aversion.

CONCLUSIONS: Individuals with pathological anxiety demonstrate clear avoidance biases in their decision making. These findings suggest that this may be driven by a reduced propensity to take risks rather than a stronger aversion to losses. This important clarification suggests that psychological interventions for anxiety should focus on reducing risk sensitivity rather than reducing sensitivity to negative outcomes per se.

Keywords: Anxiety, Decision making, Emotion, Loss aversion, Memory, Risk aversion

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Anxiety disorders constitute a major global health burden (1). They are characterized by disrupted emotional processing, working memory, and decision making (2,3). Understanding impaired cognitive processing in anxiety disorders is important to identify targets for cognitive-based therapies for anxiety. Patients with anxiety frequently report difficulties concentrating and making decisions: demonstrating, for instance, increased risk avoidant behavior (4–7) (see Table 1 for a summary of findings). Risk here is defined as uncertain situations in which the outcome probabilities are known, contrary to ambiguity, which involves unknown probabilities. Models of economic decisions, such as prospect theory (8–10), suggest that decision making under risk, in particular the commonly observed preference for sure outcomes over risky outcomes with equal or higher expected value, can be explained by a combination two phenomena: the diminishing sensitivity to outcome value as value increases, resulting in risk aversion, and the tendency to weigh potential losses more than potential gains, resulting in loss aversion. No study to date has, however, clearly distinguished risk from loss aversion in anxiety.

Risk-taking behaviors in anxiety have been examined in a handful of studies. In one study (6), different groups of patients (anxiety disorder, mood disorder, learning disorder) and a group of healthy control subjects were administered a risk-taking questionnaire. Only anxious patients exhibited reduced levels of risk-taking relative to control subjects, suggesting that increased risk avoidance may be specific to anxiety. However, questionnaires are nonobjective and subject to well-established limitations including demand characteristics (11). In a modified version of the Iowa Gambling Task (7), patients with generalized anxiety disorder (GAD) exhibited increased avoidance of decks with accumulated low magnitude but consistent losses. However, the Iowa Gambling Task confounds multiple learning and decision-making processes and behavior could be explained by risk aversion, loss aversion, or learning. In another study (5), the authors addressed some of these concerns by administering a probabilistic gambling task that did not involve learning. Pathologically anxious individuals exhibited a strong reduction in their propensity to choose the riskier gambles relative to control subjects. However, once again, it cannot be determined from this design whether

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Table 1. Summary of Effects of Pathological Anxiety Disorders on Risky Decision Making

Study	Group	Task	Effect on Risk Taking: Patients vs. Controls
Maner <i>et al.</i> , 2007 (6), study 3	Anxiety disorders, mood disorders, learning/no Axis 1 disorders	RTBS (14-item version)	↓ in anxiety groups = in other groups
Mueller <i>et al.</i> , 2010 (7)	GAD	IGT (modified)	↓ (specific to decisions with small but consistent losses)
Giorgetta <i>et al.</i> , 2012 (5)	GAD, PAD	PGT (lotteries)	↓
Ernst <i>et al.</i> , 2014 (13)	GAD, SocPh, SAD (all adolescents)	Loss aversion	=
Galván and Peris, 2014 (14)	GAD, SocPh, SAD (children and adolescents)	Cups task (choice of safe vs. risky option)	↓ for losses = for gains
Butler and Mathews, 1983 (4)	GAD, MDD	Questionnaire	Overestimation of risk for negative events

Down arrow (↓) indicates decreased risk taking, and equals sign (=) indicates no effect.

GAD, generalized anxiety disorder; IGT, Iowa Gambling Task; MDD, major depressive disorder; PAD, panic attack disorder; PGT, probabilistic gambling task; RTBS, risk-taking behaviors scale; SAD, separation anxiety disorder; SocPh, social phobia.

avoidance of these gambles is driven by enhanced aversion to risk, aversion to losses, or a combination. Finally, patients with anxiety tend to overestimate the risk of negative events (4), but it is unclear whether this might also extend to the positive domain. In sum, prior work assessing risk-taking behavior in anxiety is unclear.

There is also a strong hypothesis that loss aversion should increase with anxiety, given the associated negative biases in emotional and attentional processes, as well as the heightened sensitivity to large negative outcomes (2,12). However, somewhat surprisingly, there are no published studies to date examining loss aversion in relation to anxiety in adult participants. One study looked at this question in adolescents (13) and found no difference in loss aversion between anxious and healthy adolescents. In other studies (5,14) the gambling tasks used did not allow dissociating risk from loss aversion.

Here, we therefore adapted a previously published gambling task (15,16) to clearly separate risk and loss aversion and explore performance in a group of healthy and unmedicated anxious individuals. By modeling participants' behavior with a computational model derived from prospect theory, we were

able to adequately estimate and separate these processes, hypothesizing that relative to healthy control subjects, pathologically anxious individuals would exhibit both increased risk and loss aversion.

METHODS AND MATERIALS

Participants

Unmedicated individuals meeting criteria for GAD ($n = 29$) and matched healthy volunteers ($n = 26$) were recruited by advertisement. Data from 4 anxious and 3 control participants were excluded because of insensitivity to value in the gambling task (3 anxious, 1 control subject) or more than 10% of missed trials (1 anxious, 2 control subjects), making loss and risk aversion impossible to model. Final analyses included 25 pathologically anxious individuals (20 women, 5 men, mean age 25.2 ± 4.90 years [mean \pm SD]) and 23 healthy control subjects (18 women, 5 men, mean age 25.74 ± 6.55 years; Table 2). Participants provided written informed consent and were paid for their participation. The study was

Table 2. Demographics, Questionnaire Scores, and Participants' Characteristics

	Pathologically Anxious Individuals ($n = 25$)	Healthy Controls ($n = 23$)	t_{46}	p
Women:Men	20:5	18:5	—	—
Age, Years, Mean (SD)	25.20 (4.90)	25.74 (6.55)	-0.33	.75
Verbal IQ WTAR Score Out of 50, Mean (SD)	42.56 (4.42)	41.74 (5.75)	0.58	.57
STAI Trait Anxiety Score, Mean (SD)	55.24 (8.10)	30.00 (5.01)	12.85	<.001
BDI Score, Mean (SD)	16.96 (9.19)	1.57 (3.17)	7.62	<.001
Age of Onset of Anxiety, Mean (SD)	18.08 (5.99)	—	—	—
Number of Years With Anxiety, Mean (SD)	7.12 (5.85)	—	—	—
Current Major Depressive Episode, n (%)	13 (52)	—	—	—
Past Medication (Anxiolytic or Antidepressant), n (%)	2 (8)	—	—	—
Hospitalized for Anxiety or Depression, n (%)	1 (4)	—	—	—
Past Suicide Attempts, n (%)	1 (4)	—	—	—

Current diagnoses of other anxiety disorders within the anxious group (at the time of study) included: panic disorder ($n = 5$), panic attacks (not meeting criteria for panic disorder; $n = 3$), posttraumatic stress disorder ($n = 3$), agoraphobia ($n = 2$), obsessive-compulsive disorder (OCD; $n = 1$), compulsions and/or obsessions (not meeting criteria for OCD, $n = 6$), bulimia ($n = 1$), binge eating (not meeting criteria for bulimia; $n = 2$). Social anxiety and specific phobias were not assessed.

BDI, Beck Depression Inventory; STAI, State-Trait Anxiety Inventory; WTAR, Wechsler Test of Adult Reading.

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