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Adolescent risk-taking under stressed and non-stressed conditions: Conservative, calculating and impulsive types

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Abstract

Purpose—Adolescent risk-taking may result from heightened susceptibility to environmental cues, particularly emotion and potential rewards. This study evaluated the impact of social stress on adolescent risk-taking, accounting for individual differences in risk-taking under non-stressed conditions.

Methods—Eighty-nine older adolescents completed a computerized risk-taking and decision-making battery at baseline. At follow-up, participants were randomized to a control condition, which repeated this battery, or an experimental condition, which included a social and cognitive stressor before the battery. Baseline risk-taking data were cluster-analyzed to create groups of adolescents with similar risk-taking tendencies. The degree to which these risk-taking tendencies predicted risk-taking by stress condition at follow-up was assessed.

Results—Participants in the stress condition took more risks than those in the no-stress condition. However, differences in risk-taking under stress were related to baseline risk-taking tendencies. We observed three types of risk-takers: conservative, calculated, and impulsive. Impulsives were less accurate and planful under stress, calculated risk-takers took fewer risks, and conservatives engaged in low risk-taking regardless of stress.

Conclusions—As a group, adolescents are more likely to take risks in “hot cognitive” than in “cold cognitive” situations. However, there is significant variability in adolescents’ behavioral responses to stress related to trait-level risk-taking tendencies.

Implications and contribution—Many, but not all, adolescents take more risks under social stress. Parents and clinicians should be aware that behavior is a function of both personality and environmental cues. Interventions may help adolescents recognize their risk-taking propensity and environmental “triggers” that undermine their attempts to control their behavior.

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Keywords

risk-taking; decision-making; stress; stress reactivity; cluster analysis; hot cognition

PURPOSE

By most measures, adolescents engage in more risk-taking than adults.^{1,2} Consequently, the three leading causes of death among older adolescents are related to decisions they make (motor vehicle crashes, homicide and suicide).⁴ The burden of risky choices is also evident in patterns of adolescent morbidity. For example, 20% of 18-25 year olds report substance dependence or abuse, and adolescents account for more than half of all new sexually-transmitted infections.⁴ Given the enormous toll of risky choices in adolescence on lifelong health and achievement, it is important to understand both the individual and situational determinants of adolescent risk-taking.⁵

In the past, some theories of adolescent risk-taking posited that risky choices were the result of cognitive immaturity.⁶ In the last decade, however, research has demonstrated that adolescents' decision-making skills are cognitively similar to adults'. The evidence suggests that adolescents appropriately perceive risk in dangerous situations and feel vulnerable to negative outcomes.^{7,8} If adolescents are capable of adult-like cognition, what accounts for apparent developmental increases in risk taking and concomitant morbidity and mortality? Contemporary views of risk-taking highlight the role of affective intensity and biobehavioral sensitivity to rewards in risk-taking behavior.^{3,9,10} Neuroimaging research has informed a "dual-systems" model of cognition during adolescence.^{3,11} Specifically, limbic structures in the brain that govern appetitive drives, reward, and novelty-seeking mature earlier than prefrontal areas that support cognitive and behavioral inhibition. Thus, until motivational systems and cognitive control systems are fully mature and functionally connected, adolescents may be likely to take more risks.^{3,11}

More than a century ago, the Yerkes-Dodson law proposed that arousal improves cognition up to a threshold, above which increased arousal impairs performance.¹² Recent research has confirmed that this "inverted U" relationship holds for arousal measured by levels of circulating glucocorticoids (e.g., cortisol).^{13,14} Further, the impact of stress on cognition may depend on the type of cognition; for example, high glucocorticoid levels have been found to impair memory for neutral information, but enhance emotional memory.¹⁵

In adolescence, there is greater hypothalamic pituitary adrenal (HPA) axis activity in general, whether under stressed or non-stressed conditions, suggesting that this is a time of particular stress reactivity.¹⁵ This may help explain why adolescents are particularly vulnerable to poor decision-making in so-called "hot cognitive" situations, which are characterized by emotional arousal, the presence of a desired reward, and/or social pressure.^{16,17} Whereas both adolescents and adults are motivated by rewards such as social approval or money, adolescents' ability to control their response to rewards may be more limited.^{1,17} Compared to adults, adolescents are more motivated by potential rewards, less sensitive to potential or actual negative feedback, and less likely to inhibit cognitive and behavioral responses to rewarding stimuli.^{1,17} Thus, in the context of social pressure or arousal, adolescents may be particularly vulnerable to making health-damaging choices. This finding converges with evidence from functional magnetic resonance imaging (fMRI) studies with 18-25 year olds that suggests that acute psychosocial and physical stressors alter activation in the prefrontal cortex, which is integral to attention, working memory, and response inhibition.^{18,19}

Few behavioral studies have directly examined the link between acute stress and risk-taking among adolescents.²⁰⁻²² Figner et al. found that 13-19 year olds exposed to a card-sorting task designed to invoke “hot cognitive” conditions took more risks than individuals exposed to a variant of the task designed to elicit “cold cognitive” conditions.²⁰ A handful of studies have examined the role of peers in risky driving. When teens drive alone in a driving simulator, their behavior is similar to adults; in the presence of peers, however, risk-taking increases markedly among adolescents but not adults.^{23,24} While it is unclear if peer effects on driving are a function of “showing off”, distraction, or both, fMRI studies suggest driving with peers is associated with activation of the brain's reward circuitry.²⁴

The current study extends previous research by examining the impact of stress on adolescent risk-taking by using each person as his/her own control. Individual factors such as personality are important predictors of risk taking.²⁵ Thus, using each person as his own control allowed us to account for individual differences in orientation toward risk behavior and task preference. We sought to describe adolescents' responses to acute stress by grouping them based on similar risk-taking tendencies.²⁶ First, we examined risk-taking tendencies under non-stressed lab conditions. Then, using an experimental manipulation, we evaluated whether adolescents were more likely to take risks in response to a developmentally salient stressor. We hypothesized: 1) stress would interfere with self-regulation and executive control such that the stressed group would take more risks than the non-stressed group; and 2) compared to their own performance under non-stressed conditions, participants would take more risks under stress.

METHODS

Participants

Participants were 89 18-21 year old (Mage: 19.8, SD: 1.1) undergraduates recruited from a competitive public university. Participants were recruited from a research subject pool for a study about decision-making. This participant group allowed us to compare individuals with similar levels of intellectual ability and achievement, factors that have been linked to decision-making and risk-taking.²⁷ The sample was 61% female, 28% White, 64% Asian/Pacific Islander, and 8% other/multiracial. This study was approved by the university's institutional review board. Participants were given a small prize and \$10 to \$40 for participating in each visit (depending on their actual winnings during laboratory tasks).

Design

At baseline, participants independently completed a computerized battery of risk-taking and decision-making tasks under non-stressed conditions in a room with 12 to 20 participants. Two weeks later, at follow-up, 75 returning individuals were group-randomized to a stress condition (n=50) or a control condition (n=25). (Those who did not return included three subjects who were asked not to return because a computer problem made their baseline data unusable.) The control condition repeated the same battery under non-stressed conditions to assess re-test effects on task performance; they completed no additional tasks.²⁰ The experimental condition involved a social/cognitive stress task immediately before the risk-taking and decision-making battery. The design allowed each participant to serve as his/her own control.

Stress Manipulation

Social Stress Task—A modified Trier Social Stress Test²⁸ was used as a social and cognitive stressor for participants randomized to the stress condition. At follow-up, participants were assigned to groups of three or four; group members were seated facing one another. Three to four groups competed against each other on a math task for an unspecified

prize. Participants began with the number 2008 and subtracted silently in their heads, by 13s, for 5 minutes, as fast as they could, entering their responses using the computer keyboard. The computer prompted them to start again if they made an error. Each computer displayed a graphic that was animated to reflect the subject's performance relative to their teammates (See Figure 1). Participants' actual performance was manipulated and displayed on their screen to appear that they lagged their teammates, invoking the perception of negative social evaluation.

After the math task, individuals had seven minutes to prepare a brief speech about what made them a good candidate for a research assistant position to be given in front of study investigators. They were told that their speech would be videotaped and assessed for body language and non-verbal cues. At the end of the speech preparation task, participants were told that due to technical problems, they would not give their speech. This approach allowed us to maintain a uniform period of "anticipatory stress" across participants²⁸, while still allowing participants to participate in groups. Participants then proceeded with the battery of decision-making and risk-taking tasks individually. All participants were able to complete the stress task; they were debriefed at the conclusion of the visit.

Salivary Cortisol Measurement—Saliva samples were collected during the visits to assess cortisol reactivity. Samples were collected 10 minutes after arrival (baseline), after the manipulation, if present (+20), 10 minutes post-stressor, and 35 minutes post-stressor. To limit diurnal effects, all study visits began at 1400h. Saliva was collected using Salivette cotton rolls (Sarsdedt, Nümbrecht, Germany) and stored at -20F before analysis. Free cortisol was measured using a commercially available immunoassay with chemiluminescence detection (IBL-Hamburg, Germany).

Measures

Risk-Taking

A score summarizing individuals' performance on three tasks was used as an indicator of risk taking tendencies and the cognitive underpinnings of decision-making (e.g., mental planning and cognitive impulsivity).

Behavioral Risk Taking—In the Balloon Analog Risk Task (BART)^{29,30} participants pump air into a computerized balloon as far as possible without exploding it. Subjects are paid for every pump of air. They can "cash out" before the balloon explodes and move to the next balloon. If it explodes, winnings for that balloon are forfeited. The task consists of 30 balloons, each with a different probability of exploding. The outcome is the average number of pumps across non-exploded balloons, with more pumps indicating more risk-taking. This task has good test-retest reliability and has been found to be a valid indicator of adolescent risk behavior, including substance abuse.^{29,30}

Mental planning—The Tower of London (TOL) is a well-accepted measure of mental planning.³¹ Participants move a set of colored rings stacked on pegs to match a "goal" arrangement in the fewest moves possible. Participants must plan their moves before moving the rings. In this study, performance on the TOL was operationalized in two measures: 1) the number of moves exceeding a perfect (i.e., minimal-move) solution; and 2) the total time spent planning before the first move.³² Outcomes (moves and planning time) were averaged across problems that required 7-moves to complete. We examined 7-move problems rather than those with fewer moves since these easier problems exhibited little variability. More moves are an indicator of poor problem solving accuracy and efficiency, while more planning time is associated with greater planfulness.³²

Cognitive impulsivity—The Cognitive Reflection Test²⁷ (CRT) assesses cognitive impulsivity and the ability to inhibit “intuitive” responses. This task consists of three questions, which invite an intuitive, but incorrect, answer. For example: “A bat and a ball cost \$1.10. The bat costs \$1.00 more than the ball. How much does the ball cost?” (Correct answer: 5 cents). Individuals who answer incorrectly, on average, are less patient and have greater risk preference.²⁷ This task was coded such that higher scores reflected greater cognitive impulsivity. The CRT was used only at baseline because of concerns that task familiarity would invalidate results at follow-up.

Analysis—We used cluster analysis to classify adolescents into clusters based on their performance on the risk-taking and decision-making measures under non-stressed conditions. Cluster analysis is a multivariate statistical procedure that organizes observations into homogeneous groups with respect to a set of characteristics (i.e., risk-taking tendencies).³³ We chose a person-centered analytic approach in contrast to a variable centered approach (i.e., one that aims to isolate the unique contribution of a predictor for an outcome, independent of other sources of variance).³³ This allowed us examine how constellations of variables function together to predict risk-taking, which provides a more accurate and holistic perspective.

There are a variety of clustering methods. The most appropriate method depends on the nature of the data.^{34,35} The analyst chooses parameters (e.g., how many clusters to form) that influence the clusters derived. We used k-means, a non-hierarchical method, to specify the number of clusters in the analysis. The resulting clusters represent groups of adolescents with a common pattern of risk-taking. We investigated age and demographic differences among clusters. We then compared individuals’ risk performance at baseline (i.e., non-stressed conditions) to their behavior at follow up (either under stressed or non-stress conditions, depending on the condition). We examined the extent to which adolescents in each cluster exhibited changes in risk-taking between baseline and follow-up.

Cortisol Analysis—Total cortisol output across the study visit was summarized using area under the curve trapezoidal formulas with respect to ground (AUC_g).³⁶ T-tests and ANOVA were used for cross-sectional comparisons of cortisol output between groups. Statistical analyses were performed with Stata version 11 (StataCorp, College Station, TX) and SAS versions 9.2 and 9.3 (SAS Institute Inc., Cary, NC).

RESULTS

Cluster Descriptions

Using baseline task performance, we first specified a four-cluster solution and compared it to two-, three-, five-, and six-cluster solutions. The three-cluster solution best fit the data conceptually and statistically (R-square = 0.62). Descriptive statistics for the variables used in the cluster analysis are reported by cluster in Table 1. Group comparisons revealed statistically significant differences for each of four domains (i.e., accuracy—number of moves on the TOL, planfulness—planning time before the first TOL move, risk-taking—average pumps of air across balloons, and cognitive impulsivity—based on the CRT) across the clusters. We named the clusters based on their characteristics at baseline, prior to looking at their behavior at follow-up.

Of the three emergent clusters, the smallest cluster (n=25) was characterized by high accuracy (i.e., low extra moves on the TOL), low planfulness (i.e., less time spent planning the first TOL move), low risk-taking (i.e., fewer balloon pumps on the BART), and moderate cognitive impulsivity. The characteristic that distinguished this cluster was how few pumps members of this cluster made (i.e., low risk-taking). For this reason, we called

this cluster “conservative” risk-takers. Greatest accuracy and planfulness coupled with the lowest cognitive impulsivity and high risk-taking described the next largest cluster ($n=26$). We termed this cluster “calculated” risk takers. The largest cluster ($n=38$) was defined by poor accuracy, low planfulness, high risk-taking, and high cognitive impulsivity. Accordingly, we called this cluster “impulsive” risk takers. The demographics of each cluster are reported in Table 2. At baseline, the clusters were similar with respect to age, and ethnicity. However, the impulsive cluster had lower proportion of females, so models controlled for sex.

Randomization & Effectiveness of Stress Manipulation

The stress and control groups were similar with respect to age, sex, race and baseline cortisol. There was a significant effect of the stressor on cortisol output at time 2 (AUC_g Mean_{stress} 331 vs. mean_{control} 193.6, $t(69)=3.35$ $p<0.001$), suggesting that the stress manipulation was effective in inducing a HPA stress response. We evaluated cortisol reactivity to each laboratory visit separately, by risk-taking group. A small number of subjects provided insufficient saliva and were excluded. There were no significant cortisol differences by risk-taking group at either visit (baseline: $F(2,85)=0.93$, $p=0.40$; follow-up: $F(2, 68)=0.55$, $p=0.58$). This suggests that the risk-taking groups responded similarly to the stressor; thus, differences in risk-taking between the groups were not simply a function of differing HPA activation.

Task performance by stress condition

To assess how task performance varied by stress condition, we compared baseline and follow-up for respondents in each of the two conditions (Table 3). Given the longitudinal nature of these data, there was some loss to follow-up, resulting in 75 returning participants (84%). An attrition analysis demonstrated that those who did not return were similar demographically to those who participated at time 2.

First, we examined mean differences by stress condition for each measure of risk-taking/decision-making. In the non-stressed group, accuracy and risk-taking were similar at baseline and follow-up. Planfulness decreased significantly at follow-up, which may reflect practice effects (see Table 3). In the stress condition, accuracy was similar between baseline and follow-up. Planfulness decreased significantly in the stressed group, but the change was similar to that of the non-stressed group, so is likely related to practice effects. Participants in the stress group demonstrated significantly more risk-taking at follow-up than they did at baseline. We then adjusted for baseline performance and reported least squares results by condition (see Table 3). Accounting for their performance at baseline, participants in the stress condition were less accurate than those in the non-stressed condition (i.e., 1.8 extra moves on the TOL). This was a medium-sized effect (Cohen's $d=0.27$).

Task performance by stress condition and cluster membership

We compared least square means of follow-up performance for respondents in non-stressed and stressed conditions within each cluster (Table 4). Conservative group members had similar accuracy and risk-taking, regardless of stress condition. There was a medium-sized effect of stress on planning among conservatives (Cohen's $d=0.33$); stress was associated with *more* planning time before the first TOL move. This was not statistically significant, however, suggesting a lack of statistical power. In the calculated risk-taking group, there were medium to large effects of stress on task performance. In this group, stress trended toward less accuracy, and less planning time on the TOL (Cohen's d of 0.52 and 0.4, respectively), but these comparisons were also likely underpowered. Calculated group members took statistically significantly fewer risks under stress (Cohen's $d=0.44$). In contrast, impulsive risk-takers were statistically significantly less accurate and less planful

relative to their non-stressed impulsive peers (these were medium to large effect sizes: Cohen's $d=0.55$ and $d=0.31$, respectively). The number of pumps did not differ significantly under stress for impulsive risk-takers, although it is in the direction of taking greater risk.

DISCUSSION

Consistent with our first hypothesis, we found that adolescents exposed to a social evaluation/cognitive stressor exhibited less planning and more risk-taking compared to those not exposed to a stressor. Consistent with our second hypothesis, we observed that, overall, there was a medium-sized effect of stress on risk-taking, after accounting for baseline (non-stressed) level of risk-taking, although our small sample size resulted in lack of statistical power. Despite our small sample, using each person as his/her own control revealed that variability in adolescents' responses to stress was related to baseline orientation toward risk-taking. This suggests that adolescent risk-taking under stress is a function of both individual orientation toward risk-taking and environmental cues. By accounting for within-subject change in response to differing levels of environmental stress, our findings extend previous research that has characterized group differences in adolescent risk-behavior in terms of risk evaluation and personality.²⁶

We observed that follow-up responses were often consistent with the risk-taking typology we assigned at baseline; that is, the typologies we identified were often robust enough to withstand individual variability within the cluster. Stress appears to exaggerate baseline characteristics, rather than make people act in ways that are inconsistent with their non-stressed behavior. For example, among conservative group members, stress elicited a medium-sized effect in the direction of *more planning*, although this did not reach significance. Increased planning time may have reflected a desire to maintain their preferred conservative approach. In contrast, calculated risk-takers took significantly *fewer* risks under stress, and trended toward better accuracy and less planning time. It may be that calculated risk takers actually “thrive” under stress; for them, these environmental cues motivate better performance.

Impulsives comprised the largest group in this study; their behavior was most consistent with the idea that stress increases risk-taking and reduces inhibition. These adolescents were significantly more impulsive and less planful and trended toward more risk-taking. Overall, impulsives' behavior provides preliminary and modest support for the “dual systems” model of cognition, which posits that the asynchrony between limbic and prefrontal development in the brain biases adolescents toward greater impulsivity and risk-taking.^{3,11} With a larger sample, we could confirm that the salience of monetary rewards increases under social evaluative stress. We did, however, demonstrate that participants' cognitive efficiency was reduced, consistent with neuroimaging studies that suggest acute psychosocial stress decreases cognitive control by reducing activity in the dorsolateral prefrontal cortex.¹⁸ While we found stress to be deleterious to decision-making when we examined stress and non-stressed groups, this masks considerably variability in response to stress based on adolescent's baseline behavior. Thus, our findings highlight the importance of situating the dual systems model in the context of broad individual variability in limbic reactivity, cognitive control, and risk preference.

We observed that common characteristics of the adolescent environment including social evaluation, peer pressure, and monetary rewards can modulate risk behavior. Consistent with previous research on peer influence,^{23,24} the presence of peers may have amplified the arousal that increases risk-taking. Social stressors are particularly salient in adolescence given the developmental need to fit in. The stressor employed in the current study was designed to invoke the kinds of stress that adolescents might encounter in everyday risk-

taking situations, i.e., social evaluation by peers, as well as the desire to convey an image of competence in an unfamiliar situation. Our results suggest that peer evaluation may play an important, and potentially unique, role in risk-taking under stress.

Limitations

Studies of decision-making and risk-taking in the lab suffer from threats to ecological validity and cannot capture some aspects of real-world decision-making.⁸ However, lab studies do provide an opportunity to control the decision-making environment and to generate hypotheses that can be tested in real-world environments. Further, our small sample size left us underpowered to detect some effects of stress, so larger confirmatory studies are an important next step. The sample of older adolescents and young adults in this study was drawn from volunteers at a competitive university. Our results may not generalize to younger adolescents, older emerging adults, or those who are less academically talented. It is possible that our results underestimate the true population-level impact of stress on risk-taking, given that our participants are comparatively accustomed to cognitive stressors, and are resilient enough to have enrolled in a top university. Notably, even among these accomplished older adolescents, a brief social stressor undermined cognitive inhibition and increased risk-taking in many individuals.

Implications

This study demonstrates that a sizeable proportion of adolescents take more risks in the context of a common social stressor. However, there is a subset of adolescents who take fewer risks. This highlights that for adolescents as for adults, stress does not universally undermine decision-making. Similarly, risk-taking is an important part of healthy adolescent development. The goal, of course, is to shield adolescents from catastrophic errors in judgment that have enduring effects on their wellbeing. To aid in this effort, parents, clinicians, and prevention professionals should be aware that adolescent decision-making competence is highly linked to the characteristics of the decision-making environment. In addition, risk-taking tendencies under non-stressed conditions can provide clues about those most likely to take risks under stress. Our results point to the potential utility of interventions that help adolescents recognize their own risk-taking type and the environmental “triggers” (e.g., peer influence) that undermine their efforts to control their behavior. Adolescents with an impulsive orientation toward risk-taking may particularly benefit from strategies to recognize and manage their arousal during decision-making.

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Figure 1.
Illustration of computerized feedback on math task, stress condition

Table 1

Risk-taking and decision-making task variables at baseline, by cluster[†]

Measures:	Risk Group Assigned at Baseline						Effect Size F-test 95% CI
	Conservative (n=25)		Calculated (N=26)		Impulsive (n=38)		
	LS mean	SE	LS Mean		LS Mean	SE	
Mental Planning							
TOL – moves exceeding perfect (#)	6.7	0.9	6.7	0.9	12.3	0.8	*** (11.8, 60.2)
TOL - time spent planning before first move	19.6	2.0	39.8	2.0	20.6	1.7	*** (32.5, 106.8)
Behavioral Risk Taking							
BART – average number of pumps	26.3	1.8	42.7	1.8	42.1	1.6	*** (26.3, 93.6)
Cognitive Impulsivity							
CRT – number incorrect	1.5	0.2	0.9	0.2	2.2	0.1	*** (17.3, 73.3)

*p < 0.05, ** p < 0.01

Least-square means control for sex.

p < 0.001

[†]Fewer extra moves denotes greater accuracy. Greater time spent before initiating the first move reflects greater planfulness. More balloon pumps indicates greater risk-taking proclivity. Higher CRT scores reflect greater cognitive impulsivity.

Table 2
Demographics of risk-taking clusters at baseline (non-stressed) and follow-up (either stress or control condition)

	Baseline			Follow-up		
	Conservative (N=25)	Calculated (n=26)	Impulsive (n=38)	Conservative (n=22)	Calculated (n=21)	Impulsive (n=32)
Stress condition - %	n/a	n/a	n/a	71%	68%	63%
Sex - %						
female	44	54	26	45	52	25
Mean Age (SD)	19.9 (1.0)	19.8 (1.1)	19.8 (1.1)	20.0 (1.0)	19.7 (1.2)	19.7 (1.1)
Ethnicity (%)						
Asian	60	65	66	64	62	69
White	32	31	24	32	33	19
Other	8	4	10	5	5	12

Column percentages may not add due to rounding

Note: there were no significant differences in the proportion of participants in the stress vs. control condition across risk-taking groups at either time point (Baseline $F(2,85)=0.93$, $p=0.4$; Follow-up: $F(2,68)=0.55$, $p=0.58$).

Table 3

Task performance means and least-square means by stress condition

	Non-Stressed Condition		Stressed Condition		Non-Stressed Condition Follow-up mean adjusted for baseline mean ⁺	Stressed Condition Follow-up mean adjusted for baseline mean ⁺	Cohen's d ⁺⁺
	Baseline Mean	Follow-up Mean	Baseline Mean	Follow-up Mean			
Mental Planning							
TOL – moves exceeding perfect (#)	10.0	8.6	9.1	9.9	8.3	10.1	0.27
TOL - time spent planning before first move	25.6	20.1	*	19.6	**	19.7	0.03
Behavioral Risk Taking							
BART – average number of pumps	41.5	44.2	37	43.9	**	44.4	0.12

*** p < 0.001

d = ABS(LSMean_group1 - LSMean_group2) / Σ where $\Sigma = (\sigma_{\text{pooled}} / ((1/n_{\text{group1}}) + (1/n_{\text{group2}})))$

CRT was not given at the second visit because it was feared that the answers would not be valid after subjects had seen the problems at the first visit.

* p < 0.05

** p < 0.01

⁺ Adjusted (least-square) means control for baseline performance

⁺⁺ Medium effect sizes (>0.25), and large effect sizes (>0.40) are bolded.³⁷

Table 4

Task performance least-square means by stress condition and cluster membership

	Conservative				Calculated				Impulsive			
	Non-Stressed		Stressed		Non-Stressed		Stressed		Non-Stressed		Stressed	
	LS mean	n	LS mean	Cohen's d	LS mean	n	LS mean	Cohen's d	LS mean	n	LS mean	Cohen's d
Mental Planning												
TOL – number of moves exceeding perfect	7.2	19	7.5	0.05	7.4	16	5.6	0.52	9.8	14.2	0.55	* 28
TOL - time spent planning before first move	16.4	20	20.7	0.33	30.7	18	25.4	0.40	16.7	15.1	0.31	* 30
Behavioral Risk Taking												
BART – average number of pumps	37.9	40	40	0.16	47.3	20	44.6	0.44	43.9	47.2	0.27	32

values pertain to overall model

Note: Least Square Means control for time 1 risk performance

Note: Sample sizes vary slightly by task because of technical glitches.

++ Medium effect sizes (>0.25), and large effect sizes (>0.40) are bolded³⁷; $d = \text{ABS}(\text{LSMean_group1} - \text{LSMean_group2}) / \Sigma$, where $\Sigma = (\sigma_{\text{pooled}}^2 / ((1/n_{\text{group1}}) + (1/n_{\text{group2}})))$

* $p < 0.05$