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Risk Propensity in Soldiers Post-deployment: A Series of Studies Exploring Contributing Factors to Risk-taking after a Combat Deployment

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14. ABSTRACT
Anecdotal reports and experimental evidence suggests an increase in risk-taking behaviors and risk propensity in Soldiers after a combat deployment. This series of studies explored the relationship between risk propensity post-deployment with post-traumatic stress disorder (PTSD), traumatic brain injury, combat experiences, perceptions of threats, and personality dimensions. The results suggest that risk propensity is influenced by PTSD, combat experiences, perceptions of deployment threat, and personality dimensions. Any discrepancies in results between the three studies in this series may be attributed to the amount of time since a subject's deployment, which varied between samples.

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Background

Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) have been supported by over one million deployed U.S. Soldiers in recent years. The conditions under which these Soldiers carry out their missions are both physically and psychologically stressful. Previous research shows a relationship between combat experience and mental health problems (e.g., Hoge et al., 2004; Hoge, Auchterlonie, & Milliken, 2006). A recent report published by the RAND Corporation (Tanielian & Jaycox, 2008) documented the psychological wounds of these deployments including posttraumatic stress disorder (PTSD), major depression (MD), and traumatic brain injury (TBI). According to this report, an estimated 300,000 Soldiers are currently suffering from either PTSD or MD and 320,000 Soldiers have a probable TBI. These injuries continue to receive a lot of attention from the public, media, and research community.

While deployed, Soldiers are under conditions of high physical, psychological, and emotional stress. Killgore, et al. (2008) hypothesized that the effects of prolonged exposure to emotional stressors may impact brain regions (specifically the limbic system) in such a way that Soldiers may have difficulty adjusting to a non-wartime environment upon returning from a deployment. For example, some evidence shows that Soldiers with PTSD have diminished activity in the limbic system and regions of the prefrontal cortex (Molina, Isoardi, Prado, & Bentolila, 2007), which might suggest low basal arousal levels. However, increased risk to engage in high risk behaviors may not be limited to Soldiers who are suffering from PTSD or other traumas.

Anecdotal evidence suggests that Soldiers returning from combat deployment engage in an increasing number of risky behaviors compared to that prior to deployment. These behaviors have implications for public health and safety (i.e., drunk driving accidents) as well as increase the likelihood of negative consequences such as injury to self for the post-deployment Soldier.

Combat experiences

Minimal research has investigated the relationship between risk propensity and combat experiences. In the Killgore et al. (2008) study, Soldiers reported their combat experiences immediately upon return from deployment and were again evaluated 3 months later using the evaluation of risks questionnaire (EVAR) and an assessment of emotional and mental health, substance use, and aggressive/violent behaviors. The results suggested that Soldiers who experienced more severe and intense combat were at a slightly greater risk to engage in high risk behaviors post-deployment. Even though the strengths of the relationships revealed in this study were weak, the results were statistically reliable, thus indicating a potentially strong impact on public health given the large number of veterans in our country. Also, the results show that the combat experiences that were related to an increase in risk propensity for some respondents, were reported by over half of the participants. In other words, violent and intense combat experiences were common to the respondents. It is unclear then, what other factors may influence one's susceptibility to increased risk propensity following combat exposure.

PTSD

According to the American Psychiatric Association (DSM-IV-TR, 2000), PTSD is categorized as an anxiety disorder that centers on a person, an event, and a specified timeline. The person has either experienced or witnessed a horrific event resulting in severe physical damage or threat. As a result, the person relives the event and manifests incapacitating symptoms resulting in social and professional dysfunction. Whether acute or chronic, the triggered recurrence of the event endures for a minimum of one month and is followed by persistent avoidance and heightened arousal. Research shows that combat exposure is linked to increased risk for mental health problems such as PTSD, MD, and substance abuse (e.g., Hoge et al., 2004; Prigerson, Maciejewski, & Rosenheck, 2002). Consequently, research suggests that service members who report more PTSD symptoms also report more risk taking behaviors (e.g., Fear et al, 2008).

TBI

Deployed Soldiers are at an increased risk for TBI, particularly mild TBI (mTBI). Research shows that patients with right-sided lesions tend to make riskier decisions and have a lack of concern for negative consequences (Rahman, Sahakian, Cardinal, Rogers, & Robbins, 2001). Gianotti et al. (2009) showed that decreased activity in the right prefrontal cortex indicates lower regulatory abilities and subsequently greater risk-taking behavior. Additionally, research shows that young adults with a history of head injury compared to those without exhibit a greater interest in risky behaviors (O'Jile, Ryan, Parks-Levy, Betz, & Gouvier, 2004).

Deployment threat

Finally, it has been suggested that some post-deployment risk taking behavior may be attributed to a shift in cognitive appraisal of risks or one's ability to accurately perceive risks in the environment (Bell, Amoroso, Wegman, & Senier, 2001). Specifically, if deployment is retrospectively perceived as very risky or dangerous, then the perceived risk of negative consequences of risky behaviors, such as drinking and smoking post-deployment, is lower than the actual risk level associated with those activities. Given the lack of longitudinal studies in the literature, it is unclear if this skew in risk perception returns to baseline over time.

Research objectives

In order to explore the relationships between combat exposure, perceived threat, TBI, PTSD, and risk propensity, three experiments were conducted. Given the limited experimental evidence of changes in risk propensity across the deployment cycle, two preliminary efforts were undertaken to explore informal hypotheses in preparation for a large scale study. In experiment 1, risk propensity was compared among three groups of Soldiers post-deployment: a control group, a group with diagnosed PTSD, and a group with a dual diagnosis of PTSD and mTBI. A correlational design was employed in experiment 2 to explore relationships among injury, combat experiences, perceived threat, and risk propensity. Finally, as part of a larger study, data

were collected pre- and post-deployment. A number of individual differences, as well as characterization of objective and subjective combat experiences, were assessed as part of this larger study.

Preliminary experiment 1

Research objectives

The primary objective of this study was to explore differences in risk propensity in Soldiers post-deployment between those with a dual diagnosis of mTBI and PTSD, a diagnosis of PTSD only, mTBI only, and healthy controls.

Methods

Participants

Participants were a total of 48 U.S. Army Soldiers (45 active-duty, 3 reservist) receiving medical treatment from a local medical facility. The mean age was 35.33 (ranging from 20 to 58) years and the mean education level was 14.5 years (e.g., 12 years = high school diploma). Of the 48 participants, 38 were male, 10 were female, 25 were Caucasian, 5 were African American, 2 were Asian American, 10 were Hispanic American, and 6 reported other. Volunteers did not receive any compensation for participation.

Procedure

The study protocol was reviewed and approved by the William Beaumont Army Medical Center (WBAMC) Institutional Review Board (IRB) which was accepted by the U.S. Army Medical Research and Materiel Command (USAMRMC) IRB. The study employed a quasi-experimental, between-subjects design to evaluate the differences in risk propensity between injured Soldiers post-deployment and those not injured. Participants completed this survey as part of a larger study. Surveys were completed on a computer as part of a larger test battery.

Measures

The Evaluation of Risks Questionnaire (EVAR) is a 24-item visual analogue scale questionnaire that has been used effectively to measure individual variability in risk assessment in previous research (e.g., Killgore et al., 2008). There are three sub-scales of the EVAR; *need for control, risk/thrill seeking,* and *self-confidence*.

Results

Participants fell into one of four categories; *control* (n = 23), *PTSD only* (n = 13), *mTBI only* (n = 2), *PTSD and mTBI* (n = 7). The *mTBI only* group was excluded from the formal analysis

given the extremely small size of this group. Given the large discrepancies in group sample sizes and small sample sizes, non-parametric statistical tests were used to analyze the data. Specifically, Kruskal-Wallis and Mann-Whitney *U* tests were conducted.

To evaluate the results of the EVAR, the total and three sub-scale (*risk/thrill seeking, need for control,* and *self-confidence*) scores were calculated. A Kruskal-Wallis test was used to determine whether there were any differences in distributions between the groups for each sub-scale and total score. This analysis yielded significant results for the *self-confidence,* $\chi^2(2, N = 46) = 11.67$, $p = 0.003$, and *need for control,* $\chi^2(2, N = 46) = 7.63$, $p = 0.022$ subscales (figure). Subsequent Mann-Whitney *U* tests were conducted and showed significant differences between group medians. Specifically, median *self-confidence* scores for the *control* group were greater than those for the *PTSD* group, $U(39) = 78.00$, $p = 0.002$, and those for the *PTSD and mTBI* group, $U(30) = 31.00$, $p = 0.015$. Median *need for control* scores were lower for the *control* group than the *PTSD* group, $U(39) = 280$, $p = 0.005$.

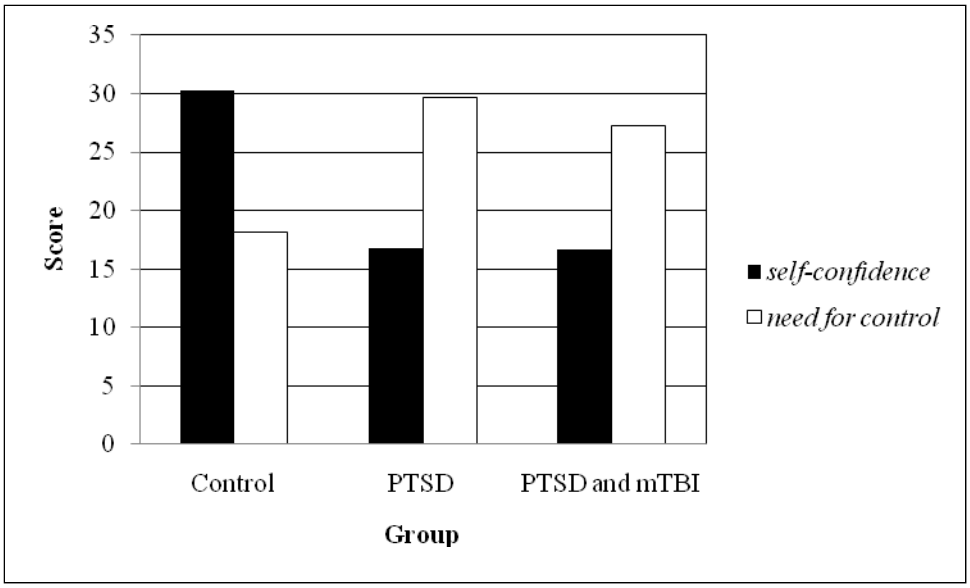

Figure. Median *self-confidence* and *need for control* scores by group.

Discussion

The results of this study provide preliminary support of differences in risk propensity between those with and without psychological injury post-deployment. Specifically, those diagnosed with PTSD (without an mTBI) scored significantly higher on *need for control* than the controls. This finding suggests that the controls are less likely to confront dangerous situations in a quick and assertive manner, to believe that one's opinions are always right, and to have less preference for structured work. Alternatively, the control group scored higher on *self-confidence* than the other

two groups suggesting that the controls are more self-assured, confident, and have a greater preference for adventure than the *PTSD only* and *PTSD and mTBI* groups.

Preliminary experiment 2

Research objectives

The findings of experiment 1 support the hypothesis that PTSD is related to risk propensity post-deployment which is one of the overall hypotheses with respect to predictors of risky behaviors. A secondary overall hypothesis is that perceptions of threat during a deployment is a predictor of risk propensity and potentially more so than severity of combat exposure. Thus, the objective of this second preliminary study was to assess whether the subjective experience with regard to danger during a deployment explains a portion of the variance in risk propensity post-deployment more so than an objective count of combat experiences.

Methods

Participants

Participants were 11 U.S. Army Soldiers assigned to a warrior transition battalion. One participant was excluded from the analysis because he had not deployed in approximately 19 years. Ten of the participants had returned from a combat deployment in the past year. The mean age was 37.5 (ranging from 21 to 53) years and the mean education level was 13.6 years (e.g., 12 years = high school diploma). Of the 10 included participants, 8 were male, 4 were Caucasian, and 6 were Hispanic. Three of the participants reported having sustained a TBI and 4 had PTSD. Volunteers did not receive any compensation for participation.

Procedure

The study protocol was review and approved by to the USAMRMC IRB. The study employed a correlational design to evaluate the predictive validity of perceptions of combat-deployment related threat and injury (PTSD and TBI) to post-deployment risk propensity and health risk behaviors. Participants completed the set of surveys on-line. To access the survey, participants were required to enter the username and password given them via electronic mail. This security measure was undertaken to minimize the likelihood of an unsolicited respondent.

Measures

Participants completed the EVAR as in experiment 1. In addition, they completed the Combat Experiences Survey (CES), a 7-item survey that results in the frequency of combat experiences during a deployment; the Risky Behavior Inventory, a survey composed of 14 questions regarding smoking behavior, alcohol use, and the Driving Behavior questionnaire (Parker et al., 1995); the Invincibility Belief Index (IBI), a 20-item questionnaire assesses how susceptible one

feels they are to adverse and positive outcomes yielding a total score of perceived invincibility and three subscale scores (*impunity*, *boldness*, *adroitness*; Killgore, Kelley, & Balkin, 2010); and the Deployment Risk and Resilience Inventory (DRRI). The original DRRI was developed by Drs. Daniel King, Lynda King, and Dawne Vogt (2003) for the purpose of studying deployment-related experiences of military veterans. The full inventory is composed of 13 sub-scales assessing pre-deployment/pre-war factors, deployment/war-zone factors, and post-deployment/post-war factors. The manual for administration and scoring guidelines indicates that the inventory was designed such that users could implement only the sub-scales in which they are interested. Thus, in this study, only the deployment concerns sub-scale (perceived threat) was administered. Also, given that currently improvised explosive devices (IED) are a larger threat than nuclear, biological, or chemical (NBC) attacks, any questions which referred to NBC threat were reworded as IED threat.

Results

A correlational analysis revealed significant relationships between scores on the deployment risk survey and the combat experiences survey with measures of risk propensity. Additionally, scores of measures of perceived invincibility and risk propensity correlated with reported risky behaviors (table 1).

Table 1.
Significant results of correlational analyses ($N = 10$).

Measure 1	Measure 2	*r* value	*p* value
DRRI	CES	0.689	0.027
	IBI-*Impunity*	0.640	0.046
	EVAR-*Risk seeking*	0.669	0.034
	EVAR-*Need for control*	-0.752	0.012
CES	EVAR-*Need for control*	-0.669	0.034
IBI-Total score	Frequency of speeding	0.658	0.039
	Quantity of alcohol drank	0.685	0.029
IBI-*Boldness*	Frequency of speeding	0.661	0.037
	Frequency of drinking	0.760	0.011
	Quantity of alcohol drank	0.896	< 0.001
	Frequency of feeling need to cut down drinking	0.707	0.022
EVAR-*Need for control*	Frequency of speeding	-0.730	0.016
EVAR-*Self-confidence*	Frequency of feeling need to cut down drinking	0.720	0.019

Discussion

The findings of experiment 2 support the hypothesis that there are relationships between perceptions of deployment threat and risk propensity post-deployment. Specifically, these relationships are in the hypothesized direction that as perceptions of threat increase so does one's propensity to take risks. Also, subjective threat perception was correlated with a greater realm of risk propensity measures compared to objective quantity of combat experiences. Measures of perceived invincibility and risk propensity also correlated in the hypothesized directions with reported risky behaviors. Specifically, the greater one's perceived invincibility, the greater the frequency of speeding and quantity of alcoholic drinks consumed during a normal drinking episode. Interestingly, the results suggest that the more bold and confident one is, the greater frequency of feeling the need to cut down on drinking alcohol. Caution should be exercised when interpreting these results given the small sample size. However, the results support further research regarding subjective perceptions of a deployment in addition to quantity of combat experiences and PTSD.

Experiment 3

Research objectives

Given the results of the preliminary studies, the objective of this final experiment was to assess the relationships between post-deployment risk taking and subjective perceptions of threat, combat experiences, PTSD, and TBI in a large sample of Soldiers tested both pre-and post-deployment. A secondary aim of this study was to assess the role of individual differences (e.g., personality, age) in post-deployment risk taking. Data were collected as part of a larger study.

Methods

Participants

Volunteers were recruited from a combat brigade of a U.S. Army Infantry Division. Approximately 30 days prior to a 12-month deployment, 492 Soldiers completed the task battery; 387 of them returned to complete the task battery again, approximately one month post-deployment (79% retention rate). Permanent change of station, leave status, medical evacuation, or behavioral problems prior to the testing window prevented some Soldiers from availability for post-deployment testing. There was a 62% response rate from the combat brigade at pre-deployment testing. Of the datasets obtained, 319 pre-deployment and post-deployment datasets were confidently matched.

Procedure

This study was reviewed and approved by the USAMRMC IRB and conducted in compliance with federal regulations regarding protection of human subjects in research. Approximately one month after returning home from a combat deployment, volunteers arrived at the test site in groups ranging in size from 1 to 100. Volunteers were seated at an individual computer station. First, the principal investigator read the consent form to the volunteers. The consent form indicated participation was voluntary and any questions that the volunteer did not feel comfortable answering could be skipped. To further protect anonymity, a waiver of written consent was granted by the USAMRMC IRB. Therefore, any volunteers who chose not to participate were then given the option to dismiss themselves or to remain at the computer for the testing session as if they were participating. After completing the tasks in random order, participants were dismissed.

Measures

Participants completed the EVAR, CES, IBI, and DRRI as employed in preliminary experiment 2. In addition, participants completed the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ), an assessment of five dimensions of personality: impulsive sensation seeking, neuroticism-anxiety, aggression-hostility, activity, and sociability (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). The 17-item PTSD Checklist (Bliese, Wright, Adler, Cabrera, Castro, & Hoge, 2008) and Brief TBI Screen (Schwab et al., 2007) were also administered.

Results

To evaluate the relationships between post-deployment risk propensity and subjective perceptions of threat, combat experiences, PTSD, personality factors, and TBI, first correlational matrices were conducted. Dependent variables which correlated with risk propensity post-deployment were entered into simple and multiple stepwise linear regression models as predictors. Given that the relationships between these variables are largely unexplored in a combat deployment context, stepwise linear regression models were deemed appropriate.

Correlation matrix

A correlational analysis indicated significant relationships between six risk propensity factors (IBI-Total, IBI-Impunity, IBI-Boldness, EVAR-Risk, EVAR-Self confidence, EVAR-Need for control) and individual differences (personality dimensions, age, combat experiences) as summarized in table 2.

Table 2.
Significant results of correlational analyses.

Measure 1	Measure 2	*r* value	*N*	*p* value
IBI-Total	Age	-0.141	240	0.028
	Neuroticism	-0.150	229	0.023
	EVAR-*Risk seeking*	0.182	258	0.003
	EVAR-*Self confidence*	0.140	258	0.025
	EVAR-*Need for control*	0.189	258	0.002
IBI-*Impunity*	Neuroticism	-0.207	249	0.001
IBI-*Boldness*	Age	-0.179	248	0.005
	EVAR-*Risk seeking*	0.265	267	< 0.001
	EVAR-*Self confidence*	0.173	267	0.005
	EVAR-*Need for control*	0.246	267	< 0.001
EVAR-*Risk*	Age	-0.307	284	< 0.001
	PTSD score	0.210	287	< 0.001
	ZKPQ-impulsive sensation seeking	0.556	262	< 0.001
	ZKPQ-activity	0.214	270	< 0.001
	ZKPQ-aggression-hostility	0.513	269	< 0.001
	Combat experiences score	0.163	265	0.008
EVAR-*Self confidence*	Age	-0.166	284	0.005
	ZKPQ-impulsive sensation seeking	0.435	262	< 0.001
	ZKPQ-activity	0.300	270	< 0.001
	ZKPQ-aggression-hostility	0.331	269	< 0.001
	ZKPQ-sociability	0.282	264	< 0.001
	ZKPQ-neuroticism-anxiety	-0.149	266	0.015
EVAR-*Need for control*	Age	-0.142	284	0.017
	ZKPQ-impulsive sensation seeking	0.334	262	< 0.001
	ZKPQ-activity	0.230	270	< 0.001
	ZKPQ-aggression-hostility	0.350	269	< 0.001
	Combat experiences score	0.122	265	0.047

Regression analyses

IBI-Total

A multiple stepwise linear regression model showed that neuroticism was the only significant predictor of total invincibility score, $\beta = -0.188$, $t(214) = -2.501$, $p = 0.013$. The model was significant and accounted for 6.2% of the variance, $R^2 = 0.062$, $F(5, 209) = 2.761$, $p = 0.019$.

IBI-*Impunity*

A simple linear regression model showed that neuroticism was the only significant predictor of impunity scores, $\beta = -0.207$, $t(248) = -3.331$, $p = 0.001$. The model was significant and accounted for 4.3% of the variance, $R^2 = 0.043$, $F(1, 247) = 11.098$, $p = 0.001$.

IBI-*Boldness*

A multiple stepwise linear regression model revealed that the four correlated measures entered into the model did not prove to be significant predictors. However, the model was significant and accounted for 8.4% of the variance, $R^2 = 0.084$, $F(4, 243) = 5.583$, $p < 0.001$.

EVAR-*Risk seeking*

A multiple stepwise linear regression analysis revealed that the model was significant and accounted for 45.4% of the variance, $R^2 = 0.454$, $F(6, 209) = 28.976$, $p < 0.001$. Specifically, the four predictors were age, $\beta = -0.164$, $t(215) = -2.968$, $p = 0.003$; impulsive sensation seeking, $\beta = 0.368$, $t(215) = 6.171$, $p < 0.001$; activity, $\beta = 0.122$, $t(215) = 2.321$, $p = 0.021$; and aggression-hostility, $\beta = 0.341$, $t(215) = 5.843$, $p < 0.001$.

EVAR-*Self confidence*

A multiple stepwise linear regression analysis revealed that the model was significant and accounted for 36.3% of the variance, $R^2 = 0.363$, $F(6, 219) = 20.814$, $p < 0.001$. Specifically, the five predictors were neuroticism-anxiety, $\beta = -0.274$, $t(225) = -4.399$, $p < 0.001$; sociability, $\beta = 0.129$, $t(225) = 2.093$, $p = 0.038$; impulsive sensation seeking, $\beta = 0.262$, $t(225) = 4.105$, $p < 0.001$; activity, $\beta = 0.233$, $t(225) = 4.170$, $p < 0.001$; and aggression-hostility, $\beta = 0.293$, $t(225) = 4.818$, $p < 0.001$.

EVAR-*Need for control*

A multiple stepwise linear regression analysis revealed that the model was significant and accounted for 21.5% of the variance, $R^2 = 0.215$, $F(5, 211) = 11.548$, $p < 0.001$. Specifically, the three predictors were impulsive sensation seeking, $\beta = 0.204$, $t(216) = 2.877$, $p = 0.004$; activity, $\beta = 0.215$, $t(216) = 3.419$, $p = 0.001$; and aggression-hostility, $\beta = 0.258$, $t(216) = 3.880$, $p < 0.001$.

Discussion

The results of experiment 3 indicate that while combat experiences and PTSD scores correlate with some measures of risk propensity post-deployment and account for a proportion of the variance in the regression models, the measures that accounted for the most variance in risk propensity when entered into a model are personality factors. The results suggest that risk propensity post-deployment is influenced by not only PTSD and combat experiences but also that personality dimensions predict risk taking likelihood after a combat deployment.

General discussion

Taken together, the results of the three experiments described in this report each provide support for a different factor to contribute to risk taking after a combat deployment. Specifically, experiment 1 suggests that PTSD contributes to greater risk propensity in combat veterans whereas experiment 2 supports the hypothesis that aspects of risk propensity are influenced more so by subjective perceptions of threat during a deployment than by objective combat experiences. The results of experiment 3, however, conflict with these findings and suggest that personality dimensions rather than PTSD symptoms, combat experiences, or subjective perceptions predict risk propensity.

One possible explanation for these findings is that the limited sample sizes in the first two preliminary studies yielded unstable statistical findings. Thus, the findings did not match those of experiment 3, which sampled a sufficient number of participants. A secondary explanation is that all four of the constructs found to be related to risk propensity are influential to varying degrees and more sophisticated modeling techniques are necessary to unveil the interrelationships. At present, the authors of this study are working to model the data from experiment 3 using structural equation modeling techniques. A final reasonable explanation for this data pattern is that time since deployment is an important factor which contributes to risk propensity, PTSD, personality, and perceptions. Experiment 3 was conducted 30 days post-deployment whereas in experiments 1 and 2 participants were surveyed within one year post-deployment. As time progresses, memories and emotions change due to a number of influences (e.g., PTSD treatment, counseling, stability at home). These changes have implications for not only risk taking but also perceptions of invincibility and personality dimensions. This gap could be addressed in the future with a longitudinal study of Soldiers extending out at least one year after a combat deployment.

Conclusions

The collective results of this series of experiments indicate four constructs as factors influencing risk propensity after a combat deployment, namely combat experiences, perceptions of deployment threat, PTSD, and personality dimensions. Although the results of the three experiments may appear contradictory, it is suspected that the varying amount of time since a participant's deployment between the experiments drove the differences in results. Also, the small sample sizes in the preliminary experiments are likely a contributing factor to the differences.

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