

ILLUSIONS OF UNIQUE INVULNERABILITY:
IMPACT OF BELIEFS ON BEHAVIOR

by

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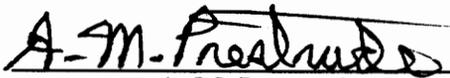
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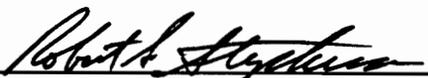
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(ABSTRACT)

People tend to maintain certain positive illusions about themselves and their futures that may be adaptive in buffering their self-esteem and feelings of efficacy from the effects of negative or threatening feedback. The illusion of unique invulnerability is the expectation that others will be the victims of misfortune and negative events more so than oneself. One possible implication of holding this belief is that, if a false sense of security is fostered, actual vulnerability to experiencing negative events that one has control over (for example, contracting lung cancer from smoking) might be increased if self-protective behaviors are decreased. The purpose of this study was to determine 1) what personality characteristics are related to this belief in unique invulnerability, 2) whether unique invulnerability is related to assumption of risk in behavior, 3) how accurately people assess the riskiness of their own behavior, and 4) how beliefs in unique invulnerability change over time and experience with risk.

Subjects were 164 male and female Reserve Officer Training Corps (ROTC) cadets, ages 17-20, engaged in rappelling down a tall structure, an inherently risky activity. A measure of unique invulnerability and several personality measures were administered before rappelling, and risk-relevant behavior was observed during rappelling. Personal safety ratings were obtained and the invulnerability measure was readministered after rappelling.

Results indicated that unique invulnerability was positively correlated with self-esteem ($p < .004$). For subjects' first rappels, unique invulnerability was negatively related to number of bounds to descend a 40 foot tower ($p < .01$), such that as invulnerability increased, number of bounds decreased. Although assumption of risk was operationally defined as taking fewer bounds, further analyses indicated that number of bounds might be more a reflection of physical competence than of riskiness. This finding suggested that greater beliefs in invulnerability were related to competent rappelling performance, while lesser beliefs in invulnerability were related to ultra-conservative behavior. Self-reports of safety were positively related to number of bounds for first rappels off a 40 foot tower ($p < .01$), and were related to instructor ratings of jump competence and safety for first and second rappels off a 40 foot tower ($ps < .05$). This suggests that as number of bounds became more conservative, and as instructor ratings improved, self-reports of safety increased. Finally, beliefs in unique invulnerability decreased after rappelling, both for subjects who rappelled ($p < .001$), and for control subjects who observed but did not rappel ($p < .05$).

Conclusions are that self-esteem is an important component of the illusion of unique invulnerability, that invulnerability is related to competent performance while engaging in risky activities like rappelling, that invulnerability is subject to change over time and experience, and that subjects can fairly accurately assess the objective safety of their behavior. Implications for theory and research on unique invulnerability are discussed, as well as limitations and future directions.

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Illusions of Unique Invulnerability:

Impact of Beliefs on Behavior

Overview

A large component of physical health and well-being is behavioral. Preventive health behavior is frequently urged to protect people from disease, accidents, and environmental hazards. Engaging in risky behaviors also impacts heavily on health. For example, smoking, driving while intoxicated or while not wearing a seat belt, and failing to practice "safe sex" can have drastic health consequences. Thus, understanding the psychological mechanisms of risky behavior has important implications for health and safety outcomes.

One way of understanding risky behavior is with respect to people's unrealistic optimism about future life events. There is widespread evidence in the literature that normal people believe their futures will be better than the average person's, that good things are more likely to happen to them, and that negative life events are more likely to happen to others (Taylor & Brown, 1988). Essentially, people tend to think they are relatively invulnerable, and expect others will be the victims of misfortune more so than themselves. One possible implication is that holding this belief strongly could lead to increased or unnecessary risk-taking. By lulling a person into a false sense of security, objective vulnerability may be increased if self-protective, precautionary, preventive behaviors are decreased. On the other hand, if people feel relatively invulnerable because they take precautions (e.g., wearing seat belts, dieting, exercising, not smoking), then this belief may be related to decreased risk-taking.

The notion that this illusion of unique invulnerability may have behavioral consequences has only recently been studied empirically, with somewhat mixed results (Burger & Burns, 1988; Gerrard, Gibbons, & Warner, 1991; Lebovits & Strain, 1990; Robertson, 1977; Weinstein, Sandman, & Roberts, 1991; Whitley & Hern, 1991).

Limitations of the existing research are that it has been based predominantly on self-report measures of behavior and relatively small sample sizes. This study expands previous empirical work by actually observing and measuring the behavior of a large sample engaging in an inherently risky activity, rappelling. Originally associated with mountaineering, rappelling serves as an end in itself for a few enthusiasts who devote leisure time to the descent of practice cliffs, buildings, and other tall structures (Mitchell, 1983). However, experienced rock climbers and mountaineers often view rappelling as a risky endeavor. One rock climbing handbook calls this "the most dangerous maneuver in mountaineering", to be used only as a last resort (Gregory, 1989).

By combining an inherently risky activity with an adolescent subject population, a group that notoriously exhibits unrealistic optimism, this scenario provided a unique opportunity to examine the relationship between holding beliefs of unique invulnerability and performing risky behaviors. Furthermore, since the subjects were ROTC cadets engaging in mandatory training, this research had the added advantage of studying subjects who did not self-select the risky activity in which they were involved. In contrast with members of a rappelling club, for example, who might all be high-invulnerability types, these subjects comprised a nice range of experience and interests.

Description of Unique Invulnerability

Illusion and Well-being

Early theorists in social cognition proposed that people monitor and interact with the world like naive scientists (Fischhoff, 1976). In this view, people collect information in an unbiased manner, integrate it logically, and generally reach sound, accurate decisions. Empirical evidence has shown that the social perceiver's actual decision-making process is quite different from these normative models, full of incomplete information gathering, shortcuts, biases, and errors (Nisbett & Ross, 1980; Tversky & Kahneman, 1974).

Taylor and Brown (1988) suggest that some of these mistakes and distortions of perception assume more general, consistent patterns, called illusions, with particular shapes and directions. Illusions have been operationalized in different ways. Feedback provided to a subject can be experimentally manipulated, and measures of the individual's perceptions or recall of that feedback can provide estimates of the person's accuracy and information about the direction (positive or negative) of any distortions. More subjectively, illusions are implied if self-evaluations show that the majority of people report that they are more or less likely than others to hold a particular belief (Taylor & Brown, 1988). For example, if most people believe that their future will be more positive than other people's futures, evidence for the existence of illusions about the future is provided. (After all, not everyone will have a bright future.) This latter example only provides information that an illusion exists at a group level, however, as any given person who rates his or her future as better than others may well be accurate.

Taylor and Brown (1988) report considerable overlap in findings from which three positive illusions consistently emerge. First, normal people seem to be very aware of their assets and strengths and less aware of their flaws and weaknesses. Researchers have found that (a) most people view themselves as better than the average person, and (b) most people view themselves more positively than others do. Secondly, people's beliefs in personal control over environmental occurrences are sometimes greater than can be justified. Finally, most people are optimistic about the future, especially their future when compared to others. Taylor and Brown (1988) conclude that instead of being serious flaws in information processing, these illusions may actually be highly adaptive under many circumstances. They maintain that a person who responds to negative feedback with a positive sense of self, a belief in personal control, and an optimistic view of the future will be happier, more caring, and more productive than a person who perceives this information accurately.

Illusion of Invulnerability

From her work on victimization, Janoff-Bulman (1989a) has found that the single most common response to negative life events, such as crime, disease, and accidents, is an intense feeling of vulnerability. Victimization shatters our illusions. Victims consistently report that they thought "it could never happen to them". Hence, Janoff-Bulman (1989a) characterizes the fundamental assumptions (illusions) shared by the majority of people in society as beliefs related to perceptions of invulnerability. Essentially, nonvictims operate on the basis of an "illusion of invulnerability". Three basic assumptions tied to people's estimates of their vulnerability are hypothesized: that the world is benevolent, that the world is meaningful, and that the self is worthy. A benevolent world is one in which primarily good things happen and other people are seen as generally good. A meaningful world is one in which events make sense, and people get what they deserve. Events are not randomly distributed, but are contingent on people's behavior. Worthiness of self involves seeing oneself as decent, competent, and praiseworthy. Using her World Assumption Scale, Janoff-Bulman (1989a) has verified empirically that nonvictims are biased toward viewing each of these categories of assumptions quite positively. She concluded that:

We believe that we are invulnerable, for we underestimate the likelihood of negative events and believe that any negative events that do occur will not happen to us, for such events are not randomly distributed, and, after all, we are good, decent, careful people (Janoff-Bulman, 1989a).

While Janoff-Bulman (1989a) generally agrees with Taylor and Brown's (1988) assertion that illusions are adaptive and can facilitate well-being, she cautions that one should not make these claims without recognizing that there are limits to this adaptiveness. She cites the example of the person who believes he is a competent, able swimmer but who is actually unable to swim, and notes that drowning is clearly maladaptive.

Perloff and Fetzer (1986) suggest some possible adaptive functions of perceived

invulnerability. First, perceptions of invulnerability may enhance self-esteem and subjective well-being in otherwise threatening situations. This illusion may also be adaptive because it promotes feelings of self control. Finally, this belief allows people to go about their everyday lives without being completely immobilized by fear. However, a couple of important maladaptive consequences are proposed as well. Such perceptions might ultimately increase a person's objective vulnerability by inducing a false sense of security and leading people to think that precautionary behaviors are unnecessary. A second maladaptive consequence involves people's ability to cope after they have actually been victimized. Perloff and Fetzer (1986) cite many sources that report that people who underestimate their own personal susceptibility to life crises may have more difficulty adjusting when crises occur.

Unrealistic Optimism

The illusion of invulnerability as defined by Janoff-Bulman (1989a) seems to be most similar to Taylor and Brown's (1988) illusion of unrealistic optimism, in which people are overly optimistic about future outcomes. Weinstein (1980) investigated several hypotheses relating to unrealistic optimism. The primary goal of this research was to test whether people believe that negative events are less likely to happen to them than to others, and whether they believe that positive events are more likely to happen to them than to others. In one study, college students estimated how much their own chances of experiencing 42 events differed from the chances of their classmates. Results provided evidence of unrealistic optimism for both positive and negative life events when two conditions were satisfied. First, the event had to be perceived as controllable, such that there were things a person could do to influence the event. Second, subjects must have had some degree of commitment or emotional investment in the outcome.

In a follow-up study, Weinstein (1982) examined the amount of optimistic bias associated with different health problems, and explored the relationship between unrealistic

optimism and motivation to take precautions. By focusing on 45 causes of illness and death, this study tested the applicability of Weinstein's (1980) previous findings to the health domain. Results of comparative judgments (similar to the judgments made in Weinstein, 1980) showed that the college students in this investigation tended to have a significant optimistic bias about their vulnerability to most health issues. Subjects generally believed that their own chances of experiencing harm were less than the chances of their peers, and this bias was most evident for problems perceived to be controllable. Also, a three-variable equation containing seriousness of the health problem, perceived probability, and own worry explained 83% of the variance in reported risk reduction motivation. This suggests that rational factors (beliefs about risk likelihood and severity) and emotional factors (worry) are important in motivating self-protective action.

To summarize Weinstein's research on unrealistic optimism, people tend to believe that their own risks of experiencing negative life events are below average. This phenomenon was shown for a wide range of positive and negative events, including future risks (Weinstein, 1980), and more specific illness-related events in the health domain (Weinstein, 1982). Weinstein (1982) also linked unrealistic optimism to self-protection motivation. This research is important because it verifies the existence of unrealistic optimism towards a variety of life events, and because it implicates these beliefs in motivation to perform self-protective behaviors. A few limitations with respect to this research must nonetheless be noted. First, data reported in the 1982 study are limited to self-reported interest in taking precautions, and self-reported interest may be greater than actual interest, and may not be related at all to actual pursuant behavior. Second, these studies are correlational in nature, limiting conclusions that can be drawn about cause and effect relationships. Finally, because this research used a specific sample of young, generally healthy college students, one must be cautious in generalizing to other groups. The degree of unrealistic optimism a person possesses may vary as a function of age,

socioeconomic background, and health status.

Processes Behind Unique Invulnerability

Social Comparison

A possible determinant of perceptions of invulnerability involves one's choice of comparison other (Perloff & Fetzer, 1986; Perloff, 1987). A basic principle of social comparison theory is that how we feel about ourselves depends in part on who we compare ourselves to (Wills, 1981). Perloff (1987) suggests that whether we view ourselves as more or less vulnerable than others to future victimization may depend in part on who those others are. Engaging in "downward comparisons", comparing oneself to others who are less fortunate and more at risk, may result in viewing oneself as relatively invulnerable. Both motivational and cognitive mechanisms may underlie these downward comparisons. From a motivational standpoint, comparing oneself to vulnerable others may serve an ego-defensive function by reducing anxiety and enhancing feelings of personal control (Perloff, 1987). A possible cognitive explanation is that reliance on a representativeness heuristic may yield inappropriate comparisons with unrealistic stereotypes (Weinstein, 1980). A discussion of this cognitive mechanism follows in a later section.

Perloff and Fetzer (1986) identify a question that was unanswered by Weinstein (1980) and other researchers. Do people engage in downward social comparisons when judging their susceptibility to negative events, and if so, under what conditions? To examine the conditions under which nonvictims rate others as more vulnerable than they rate themselves, Perloff and Fetzer (1986) conducted a study in which comparative judgments were made of impersonal, vague comparison others, and of close others. They hypothesized that subjects' ratings of their own vulnerability would be lower than their ratings of the "average person", and that close friends and family members would be rated as equally invulnerable. Two justifications for these hypotheses were given. First, Perloff

and Fetzer (1986) expect people to resist acknowledging the susceptibility of their close others for the same reasons that they resist acknowledging their own personal risk--to reduce anxiety or fear. Secondly, the "average person" may be vague and ambiguous enough a target that people may be able to visualize a stereotype, a person who is especially vulnerable to victimization.

To test these hypotheses, Perloff and Fetzer (1986) asked 101 college students to estimate both their own vulnerability and another person's vulnerability to ten negative life events. The comparison target was the manipulated condition. A general pattern of results emerged in which subjects rated themselves as more invulnerable than the average person and the average college student. But when subjects compared themselves with friends or family, this illusion of unique invulnerability essentially disappeared (Perloff & Fetzer, 1986). A possible explanation for this finding is that when people are given a vague comparison target, they are able to engage in downward comparisons, comparing themselves to someone who is perceived to be worse off and more at risk. These downward comparisons are more difficult when the comparison target is a specific entity whose vulnerability is not so easily distorted (Perloff & Fetzer, 1986).

To investigate this possibility, Perloff and Fetzer (1986) conducted a follow-on study, in which 190 college students were asked to estimate the vulnerability of one of three comparison targets: (a) "the average college student", (b) "one of your friends", and (c) "your closest friend". If people find it easier to make downward comparisons to a vague, abstract target, it was hypothesized that subjects would rate both the average college student and "one of their friends" as more vulnerable than themselves, but would perceive their closest friend as equally invulnerable as themselves. In the "one of your friends" condition, subjects were also asked to explain what made them think of the particular friend they had in mind for each event. Based on anecdotal evidence from the first study, Perloff and Fetzer (1986) hypothesized that subjects would report selecting a friend who seemed

especially vulnerable to the specific event. Overall, subjects should make downward comparisons whenever the target allowed them to do so.

As predicted, subjects perceived both the average college student and one of their friends to be more vulnerable than themselves to the negative event, but they perceived their closest friend and themselves to be equally invulnerable (Perloff & Fetzer, 1986). Furthermore, when subjects were given a vague comparison target, they elected to think about a hypothetical college student or an actual friend who was perceived to be more vulnerable to the event in question than themselves.

Considered together, the results of Perloff and Fetzer's (1986) two studies suggest that people make downward comparisons whenever the vagueness of the target provides them leeway to imagine an other who is more at risk than they are, allowing them to consider themselves relatively less vulnerable. However, self-other differences in perceived risk disappear when people are forced to think about a specific person with whom they are familiar. That people will choose an especially vulnerable other when given the freedom to select any comparison target is theoretically important because it represents an extension of downward comparison phenomena. While previous research (Wills, 1981) has demonstrated downward comparisons with targets who were not familiar to subjects, Perloff and Fetzer (1986) have shown that downward comparisons also occur for targets who were identified as friends of the subjects.

Although quite comprehensive, some limitations of Perloff and Fetzer's (1986) research should be noted. First, vagueness of the target was confounded with closeness, such that specific targets were also closer to subjects than were vague targets. Future research is needed to systematically disentangle the effects of vagueness and closeness on facilitation of downward comparisons. Also, since only self-report measures were used, it is uncertain how subjective vulnerability (estimated by subjects) is related to subjects' objective vulnerability. One way to resolve this issue of bias versus realism is to look at

the actual behaviors in which subjects are or are not engaging as well as subjects' subjective judgments of vulnerability.

Cognitive Error

Inappropriate standard. Weinstein (1980) speculates unrealistic optimism arises because people compare themselves with an inappropriate standard--someone who does little or nothing to improve his prospects for a positive outcome. He tested the idea that people are unrealistically optimistic because they focus on factors that improve their own chances of achieving positive outcomes and fail to realize that others may have just as many factors in their favor (Weinstein, 1980). The experimental conditions in this study manipulated subjects' (120 female undergraduates) awareness of the factors that other people consider when estimating their chances of experiencing various events. Results indicated that providing information about the attributes and actions of others reduced the optimistic bias for negative events but did not eliminate it. This finding provides support for the idea that people tend to use inaccurate images of others when making comparative judgments (Weinstein, 1980).

From the results of this study, Weinstein (1980) proposed a mechanism for explaining unrealistic optimism. In making comparative judgments, it appears that people bring to mind any personal actions, plans, or attributes that might influence their chances of experiencing the event. If they perceive the event to be controllable and are committed to a certain outcome, most of the factors they generate will be ones that increase the likelihood of having a positive outcome. By comparing themselves to unrealistic stereotypes of people who do nothing to improve their chances, people conclude that their own prospects are better than average. However, Weinstein (1980) notes that since the optimistic bias persisted even in the face of accurate information, there must be more to unrealistic optimism than just inappropriate comparisons or possible bias in recall of relevant

attributes. Weinstein (1980) concludes by suggesting that future research must examine the relationship between unrealistic optimism and self-protective behavior. Do people who believe, unrealistically, that their personal attributes exempt them from risk engage in risky behaviors and ignore precautions more so than people who are less biased?

Weinstein (1982) articulates other cognitive mechanisms that may help explain unrealistic optimism. One type of cognitive error, egocentrism, causes people to have trouble adopting the perspective of others. Therefore a person may forget that the same factors that make her feel an event is unlikely to happen to her may also make other people feel that it is unlikely to happen to them (Weinstein, 1982). Also, belief in controllability of an event through personal actions leads people to think that an event is even less likely to happen to them, especially when comparing to a person who does nothing to reduce his risk. A different cognitive error could also produce optimistic biases. People may have mental stereotypes of typical victims. If people do not see themselves as fitting this image, they may conclude that the problem will not happen to them, even if they differ from the stereotype only in ways that are irrelevant to risk vulnerability (Weinstein, 1982). Such inappropriate comparisons stem from people's reliance on a "representativeness" heuristic, which involves assigning an individual to a particular category on the basis of whether his or her attributes resemble the characteristic features of that category (Tversky & Kahneman, 1974). The representativeness heuristic suggests that people will conclude that an event will not happen to them if they do not see themselves as fitting the stereotype, overlooking the possibility that few of the people who experience the event may actually fit the stereotype.

Focus on preventive behaviors. Gerrard, Gibbons, and Warner (1991) propose an explanation for people's tendency to underestimate their vulnerability to negative events that is similar to Weinstein's (1980). It may be that when people assess their vulnerability, they tend to focus on their preventive behaviors because these behaviors

are vivid and easily accessible. Because people do not usually have information about others' preventive behaviors, particularly with regard to sexual activity, they underestimate the frequency and effectiveness of this behavior. While similar to the downward comparison motivational explanation, this theory does not assume that the bias is motivated. Downward comparison assumes that the bias is motivated by defensive denial, self-esteem maintenance/enhancement, or some other mechanism.

To consider this possibility, a study was conducted in which 376 sexually active female Marines completed a questionnaire on perceived vulnerability to unplanned pregnancy and sexually transmitted disease in addition to questionnaires measuring their knowledge, attitudes, and sexual and contraceptive history (Gerrard et al., 1991). The goals of the study were threefold: to test Perloff and Fetzer's (1986) "social distance" hypothesis that close others would be considered as invulnerable as the self and that distant others would be considered relatively more vulnerable; to test one of Weinstein's (1980) basic assumptions about unrealistic optimism, that perceived invulnerability will be most evident in people who are committed to avoiding the problem and who think that the problem can be controlled; and to test this specific cognitive notion that when assessing their vulnerability as compared to the average risk, individuals focus on their preventive behaviors because they are more salient and accessible than other people's preventive behaviors.

Results generally supported the social distance effect (Gerrard et al., 1991). Subjects perceived themselves as significantly less likely to experience an unplanned pregnancy or to contract HIV than the average Marine woman and the average civilian woman their age. Further, subjects rated the average Marine woman as significantly less likely than the average civilian woman to contract HIV. Data also revealed that subjects who reported high control over unplanned pregnancy and high commitment to avoiding this event produced the largest self-other differences--optimistic bias. With regard to the study's third

goal, analyses showed that the effect of reviewing sexual partners and contraceptive behavior was to make preventive behaviors, rather than risk factors, more salient to subjects. The data indicated that review (vs no review) significantly decreased the perceived vulnerability of self, and had no impact on the perceived vulnerability of others. Gerrard et al. (1991) predicted this finding, hypothesizing that since subjects were not aware of other women's contraceptive behavior, but were aware of their own, review should decrease their perceived vulnerability to pregnancy but not affect their perception of others' vulnerability.

Gerrard et al. (1991) is significant because it replicated Perloff and Fetzer's (1986) and Weinstein's (1980, 1982) pattern of results showing evidence for an illusion of invulnerability toward negative events. Also, the phenomenon was verified in a much larger, much different population than populations used in previous research. Perhaps most importantly, Gerrard et al. (1991) demonstrated the effect of another mediating variable, review of risk factors and preventive behaviors, that had not previously been examined with respect to perceived invulnerability. Thus, another factor that future research must consider is the salience of subjects' own preventive behaviors compared with their awareness of others' preventive behaviors. Unfortunately, Gerrard et al. (1991) did not explain why they hypothesized underestimation instead of overestimation of others' preventive behaviors, as both inaccuracies would seem equally likely. As a result, the process behind the illusion of unique invulnerability remains somewhat murky.

Relationship of Unique Invulnerability to Behavior

Relative Invulnerability and Contraceptive Use

Burger and Burns (1988). Burger and Burns (1988) took a step towards addressing one of the limitations of Perloff and Fetzer's (1986) work by examining how the illusion of invulnerability correlates with actual behavior. They proposed that one

reason people may fail to use effective contraception methods is that they engage in a systematic distortion of their likelihood of being involved in an unwanted pregnancy relative to others. People may recognize that others get pregnant from sexual activity, but perceive their own chances as so slim as to not require the use of effective birth control. Burger and Burns (1988) designed a study to determine if sexually active female adults are influenced by beliefs of invulnerability when making decisions about their chances of becoming pregnant. The study also evaluated whether such a systematic distortion is related to failure to take precautions. They hypothesized that women would see themselves as less vulnerable to pregnancy than other women, and that the less vulnerable a woman felt, the less likely she would be to use effective contraception.

The results showed clearly that the 76 female undergraduates in the study exhibited the illusion of unique invulnerability (Burger & Burns, 1988). Average estimated likelihood that the subject would have an unwanted pregnancy was 9%, 27% for average females at the university, 43% for average American females of same age, and 46% for average American females of childbearing years. The self-other comparisons were significantly different for all three comparison groups. Also, the higher the illusion of invulnerability score, the less likely the subject was to use effective contraception when having intercourse.

These results provide support for the notion that female college students systematically distort their perceptions of becoming pregnant relative to others. These women seem to understand that having sex can lead to pregnancy, but tend to see this happening to someone else rather than to themselves. In considering the possibility that these women were overestimating other people's chances of becoming pregnant and accurately appraising their own, Burger and Burns (1988) note that the high rate of previous unwanted pregnancies in this sample (8 out of 34 sexually active women) suggests this is not the case.

In addition to extending previous evidence for perceptions of invulnerability to this new arena, Burger and Burns (1988) show that the more women endorsed beliefs of invulnerability, the less likely they were to use effective methods of contraception. This finding is important because it is an initial, successful attempt to bridge the gap between beliefs and behavior. A limitation of Burger and Burns (1988) study is that, because the data are correlational, they cannot rule out the possibility that the poor use of contraception comes first and that this causes the observed cognitions. This interpretation, that women who risk pregnancy may rationalize their behavior by telling themselves they are not likely to become pregnant, is consistent with Festinger's (1957) cognitive dissonance view which holds that people often bring their attitudes in line with their behavior. Also the final sample size was small, including only 34 sexually active women. Finally, behavior was not actually observed, but obtained through self-reports of contraceptive use.

Whitley and Hern (1991). Although Burger and Burns's (1988) hypotheses were confirmed, their results raise several questions (Whitley & Hern, 1991). First, do the observed perceptions of differential risk mean that individuals see themselves as overly invulnerable or that they perceive others as overly vulnerable? Also, does Perloff and Fetzer's (1986) finding that invulnerability is extended to one's best friend apply in the pregnancy risk context? Whitley and Hern (1991) conducted a study of 180 never-married female undergraduates to address these unresolved issues.

Results indicated no difference in likelihood of pregnancy ratings for self and best friend (approximately 11%), but both these ratings were less than that for the average female student (38%), which was less than that for the average woman (45%). By consulting the extant literature, Whitley and Hern (1991) determined that the actual population likelihood of pregnancy for college women is approximately 10%, and 13% for the average American woman. Comparing the obtained mean likelihood of pregnancy ratings with population estimates revealed that subjects accurately estimated the pregnancy

risk for themselves and for someone they knew well, but overestimated it for more general groups of women. This runs counter to Burger and Burns' (1988) conclusion that women distort their own chances of becoming pregnant. A .56 correlation between perceived invulnerability and pregnancy protection was calculated in the current study. This also contradicts Burger and Burns (1988) who reported a -.33 correlation.

Previous findings that risk estimates for oneself and one's best friend are lower than estimates for average others were replicated. But rather than indicating an illusion of invulnerability to pregnancy, Whitley and Hern's (1991) data suggest that subjects realistically assess their own pregnancy risk and the relationship between their contraceptive practices and pregnancy risk. In contrast, subjects overestimate the likelihood of pregnancy for average others by more than 300% relative to base population rates. This study is significant because it validates the existence of the invulnerability phenomenon, but questions the link between holding these beliefs and engaging in risky behavior. It also points out that the process behind the illusion of unique invulnerability may involve overestimating others' risk rather than underestimating one's own risk, as has previously been proposed (Gerrard et al., 1991).

Perceived Susceptibility/Vulnerability

Recent research has examined the link between perceived susceptibility to risk and self-protective behavior using widely different types of risks in various applied domains: automobile safety, industrial safety, and safety in the home. Perceived susceptibility is clearly related to unique invulnerability but is not identical, since unique invulnerability is a relative concept (self compared with others) while susceptibility is an absolute concept.

Robertson (1977) surveyed a national random sample of 1,017 new-car buyers to assess their attitudes toward automatic crash protection. The polling was accomplished by telephone interview. Included with questions about other issues (such as whether they

avored mandatory seat belt laws) was a question regarding perceived vulnerability. Respondents were asked whether they thought their "chances of being killed or injured in a car crash" were greater than, the same, or less than "people like yourself". 6% chose the "greater than" response, 40% chose "less than", and 45% chose "the same" (Robertson, 1977). These results do not show the familiar pattern of perceived invulnerability, as almost half the sample said that their risks were the same as other people's risks of being injured in a car accident. Yet the trend is in the right direction with 6% indicating greater vulnerability and 40% indicating less vulnerability. Also, no statistically significant associations were found between perceived vulnerability and buyer preferences for crash protection and buyer willingness to pay for increased protection. But note that compared with unique invulnerability research, the measure of invulnerability used here was rather gross.

The sample used in this study consisted of individuals who expressed the intention of buying a new car within the next three years. The strength of this study is that it attempted to assess whether people were "willing to put their money where their mouth is"--that is, whether people would act on their beliefs about personal vulnerability--in a "real life" situation. However, one obvious limitation of Robertson's (1977) research is that he measured only *predicted* behavior and preferences. Subjects were not going through the actual thought processes involved in buying a new car. It is possible that reporting future behavior may be different from reporting actual behavior in a way that obviates the connection between perceived vulnerability and self-protective actions.

Lebovits and Strain (1990) evaluated whether asbestos workers who smoke cigarettes, thereby increasing an already-existent risk of cancer, differ from asbestos workers who choose not to smoke. Analysis of the data revealed that current smokers felt significantly more likely to develop a smoking-related disease than past smokers, present smokers felt significantly more likely to develop chronic bronchitis than never smokers did,

and 75% of past smokers felt that their chances of developing cancer was likely compared to 48% of never smokers (though this last effect was not statistically significant).

Whether these results reflect the previous trend of optimistic bias is questionable, since subjects seemed to assess their actual risks relative to others fairly accurately. However Lebovits and Strain (1990) conclude that current smokers did not feel significantly more vulnerable to *major* life-threatening illnesses such as cancer and coronary heart disease, and that these data may reflect a denial process. They propose that asbestos workers who smoke may have adapted a chronic coping strategy for denial of their asbestos disease vulnerability that carried over to their perceived vulnerability to specific life-threatening diseases. These workers were able to acknowledge a perceived vulnerability only to less-threatening illness such as chronic bronchitis (Lebovits & Strain, 1977). While this study represents another important step in examining perceived invulnerability in "real world" populations, the results are somewhat inconsistent. It should be noted that Lebovits and Strain (1990) did not assess relative or comparative perceptions of invulnerability since instructions did not include a comparison other, as previous studies did.

In a field experiment, Weinstein et al. (1991) tested the hypothesis that perceptions of personal susceptibility are important in decisions to test one's home for radioactive radon gas. Subjects were residents of New Jersey who lived in areas with high radon risk. The experimental condition was designed to emphasize strongly the likelihood of finding high home radon levels and to personalize this warning by referring to the specific area in which the respondent lived. The minimal-treatment condition contained only a general suggestion that testing was a good idea in New Jersey. Thus, this study attempted to actually manipulate perceived vulnerability. Subjects completed a preintervention survey, then received the intervention (a telephone call followed up with a personal letter and a radon test kit order form), and completed a post intervention survey two months after the

intervention. The results indicated that the manipulation did have a significant impact on perceptions of personal susceptibility (Weinstein et al., 1991). Risk perceptions of the subjects who received the explicit warning condition increased significantly from pretest to posttest. Also, perceptions of personal susceptibility predicted both radon test kit orders and testing intentions. However, the experimental treatment had no direct impact on behavior or behavioral intentions.

Purpose of Current Research

Evidence from social cognition research clearly suggests that people appear to have the capacity to distort reality in a direction that promotes an optimistic view of the future. Despite empirical support for this phenomenon, this perspective currently has some shortcomings. An implied justification for research on illusions of invulnerability is that having these beliefs may increase one's objective vulnerability by decreasing the perceived need to engage in self-protective behavior. But the link between perceived invulnerability and assumption of risk in subsequent behavior is not well established and requires empirical documentation. The current data that address the possible impact of beliefs of invulnerability on behavior are inconsistent. Methodologically, reliance on self-report measures is typical of research in this area. Studies that actually observe behaviors relevant to risk assumption are greatly needed to add convergent validity to results obtained thus far.

The purpose of the current research was to extend previous work on unique invulnerability and to address some of the limitations mentioned above. One goal was to establish empirically whether holding beliefs of relative invulnerability relates to behavior and affects assumption of risk while rappelling. This was accomplished through direct observation of behavior, in addition to obtaining self-reports of behavior. One hypothesis was that subjects who perceived themselves as relatively more invulnerable would behave more riskily (less safely) while rappelling than subjects who perceived themselves as relatively less invulnerable. A related goal was to determine whether self-reported behavior

correlates with actual assumption of risk. Such results would address the validity of previous inferences about unique invulnerability that have been based primarily on self-report data. This was an empirical question for which there was no specific hypothesis. A third goal was to explore whether perceptions of relative invulnerability change after experience with a risky activity. No more than speculation about this issue has been found in the literature. It was hypothesized that perceived invulnerability to negative events associated with rappelling would be diminished after rappelling, because subjects would have seen that other subjects had more or less the same risk factors and outcomes as they did. Perceived invulnerability to general negative life events, on the other hand, was predicted to remain fairly stable over time.

A final goal was to examine the interrelationships among unique invulnerability and various related constructs. This is an interesting theoretical question, although no previous studies have reported this type of analysis. Because there was no precedent to suggest what constructs might be related, measures were selected for inclusion based on a review of the theoretical explanations for the illusion of unique invulnerability found in the literature. This was a deductive process, and due to the lack of precedent, all hypotheses regarding convergent and discriminant validity were admittedly speculative, as most could have gone either way.

Four constructs were selected that were expected to be convergent with unique invulnerability. It seemed reasonable that the more people were concerned with death and serious injury, the more vulnerable they would feel towards experiencing such negative events. Hence, death anxiety was predicted to be negatively correlated with unique invulnerability. Taylor and Brown's (1988) discussion of illusions and well-being prompted the relevance of two other constructs to unique invulnerability: optimism and self-esteem, both of which were predicted to be positively correlated with invulnerability. Weinstein (1980) provided further evidence for the importance of unrealistic optimism in

understanding invulnerability, and Janoff-Bulman (1989b) supported the relevance of self-esteem, in that one of her proposed vulnerability-related assumption is worthiness of self. Finally, because Janoff-Bulman (1989b) proposed that assumptions about the world are directly relevant to feelings of vulnerability, a measure of world assumptions was expected to be positively related to unique invulnerability.

Three constructs were selected that were expected to be discriminant with unique invulnerability. Because rappelling is a physical activity and may be viewed by naive participants as physically demanding, a priori ratings as to the likelihood of possible rappelling outcomes may have more to do with perceived physical ability than with perceived invulnerability. Also, a person may have high or low physical self-efficacy and still feel invulnerable. Thus, physical self-efficacy was predicted to be unrelated to unique invulnerability. Zuckerman (1983) has proposed that sensation seeking, the willingness to take physical risks for the sake of such experiences, has a genetic, biological basis, whereas no such hereditary link has been hypothesized for unique invulnerability. Furthermore, seeking sensation is not necessarily the same as failing to protect oneself. People who perceive themselves as uniquely invulnerable are not necessarily high sensation seekers. Therefore, sensation seeking was expected to be unrelated to unique invulnerability. Finally, while it seemed logical that the general fear a person feels might affect ratings of outcome expectancies, the sharp jolt of fear that is experienced only upon encountering a threatening situation was not expected to affect likelihood ratings made prior to and outside of the fearful situation (rappelling). This contemporaneous fear may, nonetheless, affect task performance. Hence, immediate fear was predicted to be unrelated to unique invulnerability.

Method

Subjects

Subjects were 164 Reserve Officer Training Corps (ROTC) cadets, male and female, ages 17-20, entering their freshman year at Virginia Polytechnic Institute and undergoing summer military training. Rappelling training was mandatory for all incoming ROTC cadets. However, participation in this study was on a strictly voluntary basis, with each freshman cadet given the opportunity to decline without fear of negative consequences. No cadets declined to participate.

Table 1 shows the number of subjects who participated in each phase of the study. Ninety six percent of subjects took the pre-test. Seven subjects missed the pre-test because they arrived late for the ROTC summer training. Seventy five percent of the full sample participated in the rappelling training. 41 subjects did not rappel, 28 due to time constraints beyond their control, and 13 who declined the opportunity. Ninety three percent of the full sample took the post-test. Eleven subjects missed the post-test because they were not in their dormitory rooms when the post-test was administered. None of the reasons for nonparticipation seemed to introduce systematic bias into the data, except for the voluntary decision not to rappel. Therefore, subjects who did rappel, could not rappel, and elected not to rappel were considered as separate groups during analyses.

Table 1

Subject Participation

Participation Level	Subjects	
	Number	%
Pre-test, Rappel, and Post-test	116	71
Pre-test and Rappel only	1	<1
Rappel and Post-test only	5	3
Pre-test and Post-test only	31	19
Pre-test only	9	5
Rappel only	1	<1
Post-test only	<u>1</u>	<u><1</u>
ROTC freshmen class (total)	164	100

Materials

Pre-measure. The pre-measure was composed of the following eight measures. (Reference Appendix B for a copy of the consent form, and Appendix C for the pre-measure package.)

The invulnerability scale measured perceived invulnerability to negative life events in general (e.g., "Having a heart attack"), and to specific negative events associated with rappelling (e.g., "Spraining an ankle or breaking a bone"). The scale consisted of two parts: self ratings, in which subjects indicated the likelihood on a 7-point Likert scale (1="Not at all likely" to 7="Extremely likely") that they would experience certain negative events, and other ratings, in which subjects indicated the likelihood that the "average ROTC cadet of your sex at Virginia Tech" would experience the same ten events. The two parts were counterbalanced during administration. The scale was analyzed via difference scores, calculated by subtracting self ratings for each event from the corresponding other ratings. A positive score reflected perceived relative invulnerability towards that event. The scale was also analyzed by calculating the mean of self ratings only, resulting in a measure of perceived personal vulnerability. The invulnerability scale was created specifically for use in this study, and therefore has not been administered previously. However, the general negative life events were adapted from Weinstein (1980, 1984) and Perloff and Fetzner (1986) whose research shows that they reliably evoke perceptions of invulnerability in college students.

Factor analyses were conducted on the self-other difference scores from the invulnerability measure. Three factors emerged: one for general life events, one for specific rappelling events, and one comprised of two items that did not seem to be meaningfully related to each other ("Attempting suicide" and "Having your rope break mid-way down the tower"). Three indices were formed based on these findings: a general

invulnerability index (consisting of the four items that loaded on the general factor), a specific invulnerability index (consisting of the four items that loaded on the specific factor), and an overall invulnerability index that included the eight items used in the previous two indices. The two spurious items were not included in subsequent analyses. Internal reliabilities for each of these indices were calculated at .62, .71, and .62, respectively. Factor analysis of the post-measure invulnerability data matched results for the pre-measure. Internal reliabilities for the post-measure general, specific, and overall invulnerability indices were slightly higher than for the pre-measure data: .73, .72, and .68, respectively. Finally, internal reliabilities for the pre-measure general, specific, and overall self-rating indices of personal vulnerability were .56, .84, and .65.

The Death Anxiety Scale (Lonetto and Templer, 1983) measured anxiety about death and serious injury. The DAS consisted of 15 items (e.g., "I am very much afraid to die"), and subjects were asked to indicate whether the statements were true or false as applied to them. The DAS was scored by assigning a score of one to each item reflecting anxiety, and then taking the mean across all items, with a score closer to one indicating a greater fear of death. A Kuder-Richardson reliability coefficient of .76 was reported, but Cronbach's alpha for this sample was calculated at .67.¹

The Life Orientation Test (Scheier and Carver, 1985) measured dispositional optimism, and was designed to assess the favorability of a person's generalized outcome expectancies. The LOT consisted of twelve items (e.g., "I always look on the bright side of things"). Subjects indicated how much they agreed with each statement on a 5-point scale (0="Strongly agree" to 4="Strongly disagree"), with higher mean scores reflecting greater dispositional optimism. Cronbach's alpha was previously reported at .76, and was calculated at .77 for this sample.

The Self-esteem Scale (Rosenberg, 1965) measured the favorability of attitude toward oneself, with high self-esteem indicating that the individual respects himself and considers

himself worthy. The SES consisted of ten statements (e.g., "I take a positive attitude toward myself"), and subjects were asked the degree to which they agreed with each statement on a 4-point scale (1="Strongly agree" to 4="Strongly disagree"). High mean scores reflected high self-esteem. Reproducibility of the SES was previously reported at 93%, scalability of the items at 73%, and scalability of individuals at 72%. Cronbach's alpha for this sample was calculated at .87.

The World Assumptions Scale (Janoff-Bulman, 1989b) measured people's basic assumptions along eight dimensions: the benevolence of the world, the benevolence of people, justice, controllability, randomness, self-worth, self-controllability, and luck. The WAS consisted of 32 items (e.g., "Human nature is basically good"), four statements for each of the eight proposed assumptions. Subjects rated agreement along a 6-point scale (1="Strongly agree" to 6="Strongly disagree"), with high mean scores indicating that subjects hold these world assumptions strongly. Reliabilities for each of the eight subscales have previously ranged from .66 to .76. For this sample, Cronbach's alpha for each of the eight subscales ranged from .64 to .88, and was .87 for the overall scale.

The World Assumptions Scale (WAS) was unique in that it was the only pre-measure with defined subscales. Janoff-Bulman (1989b) reported eight different subscales within the 32-item WAS. A factor analysis was conducted to see whether this same structure was applicable for the current data set, and to insure that the most relevant subscales were maintained. The analysis produced eight factors, supporting Janoff-Bulman's subscales for the most part. The only discrepancy was that two subscales (Benevolent World and Benevolent People) fell out under the same factor, and one factor was determined primarily by one item. Because the reliability for the overall WAS was so high, an index of the unitary scale was used in subsequent analyses. Additionally, a WAS-Invulnerability index was created by combining responses to items corresponding to the three subscales that seemed most theoretically relevant to the construct of unique invulnerability: self-worth,

control, and self-controllability. The internal reliability of this index was .75.

The Physical Self-efficacy Scale (Ryckman, Robbins, Thornton, and Cantrell, 1982) measured perceived physical competence, and feelings of confidence in displaying physical skills to others. The PSE consisted of 22 items (e.g., "I have excellent reflexes"), and subjects rated agreement with each statement along a 6-point scale (1="Strongly agree" to 6="Strongly disagree"). Higher mean scores reflected greater physical self-efficacy. Internal reliability was previously reported at alpha equal to .81, and was calculated at .76 for this sample.

In general, the Sensation Seeking Scale (Zuckerman, 1990) measures the need for varied, novel, and complex sensations and experiences, and the willingness to take physical and social risks for the sake of such experiences. The Intention-Thrill and Adventure Seeking (I-TAS) subscale of the SSS was administered in this study, because it specifically reflects the desire to engage in physical activities involving elements of speed, danger, novelty, and defiance of gravity. The I-TAS consisted of 22 items (e.g., "Parachute jumping"), and subjects indicated on a 3-point scale the degree to which they would consider engaging in each of the activities in the future (1="No desire to do this", 2="Probably will not do this", 3="Will do this if I have the chance"). High mean scores indicated maximal thrill and adventure seeking tendencies. Internal reliability was previously reported at .89, and was calculated at .85 for this sample.

The fear thermometer (Walk, 1956), administered immediately prior to subjects' first rappels, measured the fear the subject felt "right at the moment". The scale was administered by asking subjects to place a mark across a sketch of a thermometer-like figure, divided into 10 equal segments, to indicate how much fear was currently being experienced. The distance from the base of the thermometer to the mark made by the subject yielded a numerical index ranging from 1 to 10, with numbers closer to ten indicating greater levels of fear.

Behavioral observation. The following supplies and equipment were used to observe and measure subjects' performance during rappelling training: two videocameras and videotapes, with two cameramen; 8 research assistants; data collection sheets, which were used by the research assistants; and a fear thermometer scale, which was administered to subjects immediately prior to their first rappel (see Appendix C). The research assistants were trained on the data recording procedures during the second summer session using a videotape which was developed in cooperation with the ROTC staff. The tape showed a variety of rappels, similar to what would be encountered during data collection. Anchors for all the behavioral measures were represented. The cameramen were staff members from the Air Force ROTC office, and were trained on the use of the video equipment by the experimenter on the morning of data collection.

Post-measure. Two days after the rappelling training session, a follow-up questionnaire containing the original invulnerability scales as well as a measure of perceived jump safety was administered. The jump safety measure asked subjects to reflect back on each rappel they accomplished, and rate the safety of each rappel on a 7-point scale (1="Extremely unsafe" to 7="Extremely safe"). Subjects were also given a debriefing sheet that explained the full nature of the study and provided a contact in case they had questions. Reference Appendix D for the post-measure, and Appendix E for a copy of the debriefing sheet.

Design and Procedure

Pre-test before rappelling training. On the morning of August 19, 1991, in a large lecture hall on campus, subjects were asked to participate in a research project concerned with the impact of people's beliefs about themselves on military training. The experimenter presented herself as an Air Force officer currently assigned as a graduate student in the Department of Psychology at Virginia Tech. Subjects were told that their

participation was strictly voluntary, and were asked to sign a consent form if they were willing to participate (see Appendix B).

The pre-measure was given to subjects to assess their beliefs regarding invulnerability prior to engaging in the risky activity, rappelling. This measure also assessed related beliefs, including dispositional optimism, world assumptions, general fear, physical self-efficacy, sensation seeking tendencies, and self-esteem (see Appendix C). Subjects were given approximately 30 minutes to complete the pre-measure, and all subjects finished in that amount of time.²

Data collection during rappelling training. On August 23, 1991, the experimenter and 8 research assistants observed the subjects accomplish a total of one to four rappels each off a 20 and a 40 foot tower. The rappelling session was conducted by ROTC upperclass cadets and staff at the rappelling tower on campus. Each individual cadet was involved in the activity for approximately two hours, and subjects rotated through in shifts with the other members of their cadet companies. Subjects were identified by last name and social security number. Several behavioral measures were recorded on data sheets, and the entire rappelling session was videotaped to allow post-hoc reliability checks of the behavioral data.

During the training, research assistants recorded behavioral data from a variety of positions. One assistant was located on top of each tower (the 20 and 40 foot), two at the base of each tower, one administered the fear thermometer, and one roved to gather subject identification information. Additionally, one videocamera was placed at the base of each tower. The experimenter supervised the entire operation, which proceeded at a very rapid pace, but without any serious hitches.

The behavior of interest, rappelling, involves descending a tower by holding onto a rope attached to the top of the tower. The descent is properly accomplished by pushing or "bounding" out from the tower, falling several feet, braking one's progress by tightening

on the rope, landing back on the wall, and continuing this series of steps until reaching the ground. A field book of mountaineering and rock climbing (Lyman, 1975) states that the key to rappelling safely lies in making every move slowly and carefully. Rappellers should go down the rope smoothly, avoiding the "commando-jump" style of the movies. Such antics strain the anchor and the rope, and may cause them to fail. One also risks spraining or breaking an ankle by swinging back into the tower wall too quickly or forcefully. In essence, the descent should be made as smoothly and continuously as possible. Long leaps, fast drops, and sudden stops should be avoided.

Appendix F lists the behavioral measures recorded. These measures were selected for use through extensive discussion with ROTC rappelling instructors as to what behaviors constituted assumption of risk--"choosing to do something dumb or unsafe" while rappelling. This was not easy to quantify. Some of the behaviors listed in Appendix F seemed to directly capture assumption of risk (e.g., number of bounds to descend the tower, decision to rappel). Others (e.g., instructor rating) seemed to be related to risk via overall performance, but probably reflected other things as well, like confidence, fear, physical competence. The instructors and the experimenter had trouble disentangling unsafe behavior from overall jump performance; generally a "poor" jump was also considered an unsafe jump. By including both safety-specific and general measures of performance, the experimenter hoped to capture all aspects of "assumption of risk".

One of the behavioral measures was a subjective rating of the quality and safety of each rappel. These ratings were made by the cadre members conducting the rappelling training. Specifically, two cadet instructors were stationed on top of each tower, one assigned to each of two ropes. Following each rappel, the instructors evaluated the rappel as either a 1 ("excellent"), a 2 ("average"), or a 3 ("poor"), and these ratings were recorded by the research assistants. All instructors were briefed in advance by the experimenter and the officer in charge of the training, and were verbally provided a standardized set of

criteria for making these ratings.

Post-test after rappelling training. On the evening of August 25, 1991, the invulnerability scale was readministered to subjects to assess whether beliefs regarding invulnerability changed over time after experiencing the risky activity. An additional question was included to see how safely subjects thought they performed each of their rappels. Subjects completed this follow-up questionnaire in their dormitory rooms, and had as much time as required to complete it. The questionnaire was administered and collected by the upperclass cadets in charge of the various cadet companies. Subjects were instructed not to talk or interact with their roommates until they had finished the questionnaire.

After subjects finished the post-measure, they were each given a debriefing sheet to read at their leisure. The debriefing sheet thanked subjects for their participation, and explained that by providing data about the extent of the relationship between illusions of invulnerability and assumption of risk, they helped further the general understanding of people engaging in risky behaviors and provided clues for improving health outcomes for these individuals.

Reliability Checks

Data coding. All the pre-measure, post-measure, and behavioral data were coded by an undergraduate research assistant, using a codebook developed by the experimenter. Approximately 10% of the data were also coded independently by the experimenter to check the accuracy of the initial data entry. Additionally, the experimenter reviewed all "questionable" behavioral data (e.g., missing subject's name or social security number) to insure that no jump data was attributed to the wrong subject or incorrectly labeled as missing. Results showed that only one data point in 15 records, consisting of 197 data points each, was incorrectly entered.

A reliability check of the rappelling data (number of bounds) was performed to assess whether observations made in real time matched observations made of the videotaped jumps. A research assistant and the experimenter independently observed 40 rappels (approximately 15% of the total sample), 20 off each tower, distributed throughout the entire rappelling session. Results indicated that the experimenter agreed with 90% of the real-time observations, the assistant with 87% of the real-time observations, and the experimenter with the 89% of the research assistant's observations. Thus, the real-time recording of the behavioral data appeared to be of acceptable accuracy. This analysis did reveal a consistent problem with one of the observers, however, and the data for which that observer was responsible were recoded from the videotapes. Overall, 75 rappels were recoded from the videotapes by a trained research assistant.

Finally, all rappels were reviewed by the experimenter, via the videotapes, to screen out jumps that were significantly affected by walking or falling. If a subject either walked or fell down a significant portion of the tower (a third to a half of the 20 foot tower, or more than a fourth on the 40 foot tower), that rappel was labeled a "walk" or a "fall", and was excluded from subsequent analyses. In total, 16 rappels were designated "walks", and 11 were designated "falls". This designation was necessary since walking or falling affected number of bounds taken to descend the tower, clearly confounding the number of bounds measure.

Formation of indices. Indices were formed for the Death Anxiety Scale, Life Orientation Test, Physical Self-Efficacy Scale, Self-Esteem Scale, Sensation Seeking Scale, World Assumptions Scale, World Assumptions-Invulnerability Subscale, invulnerability scales, and personal vulnerability scales by taking the means of subjects' responses to all items in each particular measure. For all indices, a higher number or score indicated a stronger endorsement of the belief being assessed. For example, a high score on the Self-Esteem Scale meant that the subject had high levels of self-esteem.

Results

Interrelationship Among Pre-measures

The relationships of the various pre-measures to the invulnerability indices (self-other difference scores) were calculated via correlational analysis (Pearson's r), and are presented in Table 2. It was hypothesized that death anxiety, optimism, self-esteem, and world assumptions would be related to invulnerability, providing convergent validity, and that physical self-efficacy, sensation seeking, and immediate fear would not be related, providing discriminant validity. Results showed that optimism was correlated with overall invulnerability and self-esteem with general and overall invulnerability as predicted, but death anxiety and world assumptions were not. (One note is that although the World Assumptions Scale did not correlate with invulnerability, the self-worth subscale of the WAS was related to overall invulnerability, $r=.229$, $p<.01$, and to general and specific invulnerability, $r=.161$ and $.179$, $p<.05$.) Physical self-efficacy was correlated with overall invulnerability, sensation seeking with specific invulnerability, and immediate fear with general and overall invulnerability, although they were predicted to be unrelated.

To correct for experiment-wise error in these comparisons, the Bonferroni t procedure was conducted (Keppel, 1982). Bonferroni correction (experiment-wise error set at .10) for 24 comparisons would necessitate any specific comparison be $p<.004$ to be considered reliable. Only the correlation between overall invulnerability and self-esteem met this reliability criterion.

A similar analysis was conducted to compare the relationships of the various pre-measures to invulnerability self-scores alone (see Table 3). Results showed that self-esteem, world assumptions, and optimism were correlated with general, specific, and overall invulnerability, and death anxiety with specific and overall invulnerability as predicted. Physical self-efficacy, sensation seeking, and immediate fear were not reliably

related to general invulnerability, as expected. However, physical self-efficacy and fear were correlated with specific and overall invulnerability, and sensation seeking with specific invulnerability, although they were predicted to be unrelated. To correct for experiment-wise error in these comparisons, the Bonferroni t procedure was conducted. Bonferroni correction (experiment-wise error set at .10) for 24 comparisons would necessitate any specific comparison be $p < .004$ to be considered reliable. All correlations met this reliability criterion except for correlations with general invulnerability, and the correlations between world assumptions and fear with specific invulnerability, and fear with overall invulnerability.³

Table 2

Relationships Between Relative Invulnerability and Related Constructs

INV	Predicted Convergent					Predicted Discriminant		
	DAS	SES	WAS	WASI	LOT	PSE	SSS	FEAR
General	-.118	.219**	-.085	.056	.092	.136	.038	-.211*
Specific	-.028	.123	.138	.151	.154	.136	.178*	-.115
Overall	-.107	.240***	.016	.132	.161*	.184*	.134	-.226*

*p < .05

**p < .01

***p < .004

INV=Invulnerability Indices

DAS = Death Anxiety Scale

SES = Self-Esteem Scale

WAS = World Assumptions Scale

LOT = Life Orientation Test

PSE = Physical Self-Efficacy Scale

SSS = Sensation Seeking Scale

WASI=World Assumptions (invulnerability)

Fear = Fear Thermometer

Table 3

Relationships Between Likelihood-for-Self Scores and Related Constructs

SS	Predicted Convergent					Predicted Discriminant		
	DAS	SES	WAS	WASI	LOT	PSE	SSS	FEAR
GINV	.038	-.163*	-.171*	-.202*	-.223**	-.124	.057	.099
SINV	.353***	-.348***	-.218**	-.366***	-.295***	-.412***	-.258***	.238**
OINV	.265***	-.345***	-.262***	-.383***	-.349***	-.361***	-.137	.215*

* $p < .05$ ** $p < .01$ *** $p < .004$

SS=Self-Score Indices

GINV=General Invulnerability

SINV=Specific Invulnerability

OINV=Overall Invulnerability

DAS = Death Anxiety Scale

PSE = Physical Self-Efficacy Scale

SES = Self-Esteem Scale

SSS = Sensation Seeking Scale

WAS = World Assumptions Scale

WASI=World Assumptions (invulnerability)

LOT = Life Orientation Test

Fear = Fear Thermometer

Relationship Between Pre-measures and Behavior

Due to time constraints beyond their control, subjects varied widely in the overall number of jumps taken, which ranged from one to four jumps total. Therefore, behavioral measures were analyzed separately for first jumps, second jumps, and third jumps, and for jumps off the 20 foot and 40 foot towers. Also, three groups of subjects were considered: subjects who could not rappel due to time constraints (n=28), subjects who chose not to rappel (n=13), and subjects who did rappel at least once (n=116).

Of the various behavioral measures obtained (see Appendix F), number of bounds and decisions regarding participation seemed to best address amount of risk assumed, while instructor rating of jump performance seemed to be more an indicator of jump quality. Thus, behavior was broadly viewed in terms of both competence and safety. However, instructor ratings were undoubtedly based in part on jump safety. A correlational analysis of number of bounds and instructor ratings revealed that rating on the first jump was correlated with number of bounds on the first jump ($r=-.310$, $p<.01$), rating on the second jump with number of bounds ($r=-.169$), and rating on the third jump with number of bounds ($r=-.407$, $p<.05$). So as bounds go up, indicating safer rappels, ratings go down (get better), indicating that ratings are in fact based in part on jump safety.

Nature of the behavior. The number of bounds variable was characterized a priori in the following way. For rappels off the 20 foot tower, less than two bounds during descent was defined as "risky", two bounds as "average", and three or more bounds as "conservative". For rappels off the 40 foot tower, less than four bounds was considered "risky", four bounds "average", and five or more bounds "conservative". These definitions were arrived at through extensive discussions with members of the rappelling instructor cadre regarding what constituted reasonable (average) performance for a naive subject group, and what characterized unsafe (risky) and ultra-safe (conservative) behavior.

The instructor rating variable, as mentioned earlier, was a subjective rating of the competence and safety of the rappel on a scale of one to three (1="Excellent", 2="Average", and 3="Poor").

For first jumps off the 20 foot tower (n=97), the mean number of bounds was 3.02 (SD=1.52), and the mean instructor rating was 1.88 (SD=.59). For first jumps off the 40 foot tower (n=19), mean number of bounds was 4.41 (SD=1.46), and mean instructor rating was 1.67 (SD=.69).

For second jumps off the 20 foot tower (n=22), mean number of bounds was 3.00 (SD=1.36), and mean instructor rating was 1.8 (SD=.58). For second jumps off the 40 foot tower (n=65), mean number of bounds was 3.92 (SD=1.99), and mean instructor rating was 1.91 (SD=.60).

For third jumps off the 40 foot tower (n=25), mean number of bounds was 3.83 (SD=1.93), and mean instructor rating was 1.88 (SD=.73).

First jump. Data from the 20 foot tower revealed that general invulnerability was negatively correlated with instructor rating (see Table 4). That is, the more invulnerable the subject felt, the better rating of jump quality he or she received. Invulnerability was not reliably correlated with number of bounds.

For the 40 foot tower, invulnerability was not significantly correlated with ratings of jump quality. General and overall invulnerability were negatively correlated with number of bounds. Thus, as beliefs in relative invulnerability increased, number of bounds decreased.

Second jump. For second jumps off both the 20 and 40 foot towers (Table 5), invulnerability was not reliably correlated with instructor rating or number of bounds.

Third jump. All third jumps (n=25) were taken off the 40 foot tower (Table 6). Invulnerability was not significantly related to either instructor rating or number of bounds.

Table 4

Relationships Between Invulnerability and Jump 1 Outcome Measures

Pre-Measure	20 Foot Tower (n=97)		40 Foot Tower (n=19)	
	Rating	# Bounds	Rating	# Bounds
GINV	-.222*	.054	.043	-.499*
SINV	.028	-.022	.049	-.329
OINV	-.152	.028	.072	-.645**

*p < .05

**p < .01

GINV=General Invulnerability

SINV=Specific Invulnerability

OINV=Overall Invulnerability

Table 5

Relationships Between Invulnerability and Jump 2 Outcome Measures

Pre-Measure	20 Foot Tower (n=22)		40 Foot Tower (n=65)	
	Rating	# Bounds	Rating	# Bounds
GINV	.152	-.237	-.169	.095
SINV	-.189	-.132	.158	.036
OINV	-.014	-.314	-.040	.089

* $p < .05$

** $p < .01$

GINV=General Invulnerability

SINV=Specific Invulnerability

OINV=Overall Invulnerability

Table 6

Relationships Between Invulnerability and Jump 3 Outcome Measures

Pre-Measure	40 Foot Tower (n=25)	
	Rating	# Bounds
GINV	-.034	.130
SINV	-.141	-.262
OINV	-.076	-.082

*p < .05 **p < .01

GINV=General Invulnerability

SINV=Specific Invulnerability

OINV=Overall Invulnerability

Regression analyses. Simultaneous regression analyses were conducted to investigate how much unique variance the pre-measures that correlated with performance for each jump could explain in predicting ratings and number of bounds. All pre-measure variables found to be related to the criterion behavioral measures in zero-order correlations were simultaneously entered into the regression models. The analyses were conducted primarily to determine whether invulnerability accounted for unique variance in predicting jump performance when the effects of non-invulnerability variables were controlled for.

For first jumps off the 20 foot tower, the following pre-measures were significantly correlated with jump performance: optimism with number of bounds ($r=-.21$, $p<.05$), and physical self-efficacy and general invulnerability with instructor rating ($r=-.25$ and $-.22$, $ps<.05$). A model constructed of physical self-efficacy, optimism, and general invulnerability accounted for significant variance in predicting number of bounds, $R^2=.12$, $F(3, 90)=4.00$, $p<.01$, with physical self-efficacy (Beta=.32, $t=2.7$, $p<.01$) and optimism (Beta=-.39, $t=-3.3$, $p<.002$) accounting for unique variance. The same model significantly predicted instructor ratings, $R^2=.11$, $F(3, 90)=3.62$, $p<.02$. General invulnerability accounted for unique variance (Beta=-.19, $t=-1.8$, $p<.07$), as did physical self-efficacy (Beta=-.29, $t=-2.4$, $p<.02$).

For first jumps off the 40 foot tower, the following pre-measures were significantly correlated with number of bounds: general and overall invulnerability ($r=-.50$, $p<.05$ and $r=-.65$, $p<.01$). Death anxiety and fear thermometer were moderately correlated with number of bounds ($r=-.25$ and $-.46$) and instructor rating ($r=.39$ and $.35$), so were also included in this model. Physical self-efficacy and optimism were included to be consistent with the model used for first jumps off the 20 foot tower. A model constructed of optimism, physical self-efficacy, fear, death anxiety, and overall invulnerability accounted for marginally significant variance in predicting number of bounds, $R^2=.62$, $F(5, 8)=2.6$, $p<.11$, with overall invulnerability accounting for unique variance (Beta=-.59, $t=-2.6$,

$p < .03$). The model did not significantly predict instructor ratings ($F < 1$).

Because invulnerability was not correlated with number of bounds or instructor ratings for second rappels off the 20 and 40 foot towers, regressions were not conducted.

Decision to rappel. Planned comparisons were conducted for the two between-group contrasts that seemed most relevant to the decision to rappel. First, subjects who could not rappel were compared with subjects who did rappel. Because the former group was functionally a control group, no differences in pre-measure scores were expected between these groups. Next, subjects who chose not to rappel were compared with subjects who did rappel. In this comparison, differences between groups in terms of pre-measure scores seemed to be more likely. The specific prediction was that subjects who decided to rappel would have higher invulnerability scores than subjects who decided not to rappel.

Comparisons involving control subjects who could not rappel with subjects who did rappel showed that none of the pre-measure scores were significantly different between these groups, as predicted.

Comparisons involving subjects who chose not to rappel with subjects who did rappel revealed that overall and specific invulnerability were the only pre-measure indices that differed significantly between these groups (see Table 7). In terms of overall invulnerability, subjects who chose not to rappel ($M = .56$) were reliably different from subjects who rappelled ($M = .96$), indicating that subjects who elected not to rappel held lesser beliefs in relative overall invulnerability than subjects who did rappel. In terms of specific invulnerability, subjects who chose not to rappel ($M = .08$) were reliably different from subjects who did rappel ($M = .55$), indicating that subjects who decided not to rappel held lower beliefs in relative specific invulnerability than subjects who did rappel. The two groups did not differ significantly in general invulnerability, although the means were in the same direction as for overall invulnerability ($M = 1.04$ for subjects who chose not to rappel,

and $M=1.37$ for subjects who did rappel).

Decision to rappel off 40 foot tower. While all subjects were encouraged to participate in rappelling off the 20 foot tower, subjects decided for themselves whether or not to tackle the 40 foot tower. T-tests comparing subjects who chose not to rappel off the 40 foot tower ($n=11$) with subjects who did rappel off the 40 foot tower ($n=105$) indicated that the groups were not significantly different in terms of invulnerability (see Table 8).

Effects of prior rappelling experience. Subjects were asked on the initial questionnaire if they had ever rappelled before. T-tests comparing subjects who had rappelled previously ($n=46$) with naive subjects ($n=98$) revealed that the two groups differed only with respect to sensation seeking, $t(141)=-2.10$, $p<.04$, and immediate fear, $t(105)=2.88$, $p<.005$. Subjects who had rappelled before were higher sensation seekers, and reported much less fear prior to the first jump than subjects who had never rappelled before. Scores on all the other pre-measures were not significantly different.

No significant effects of prior rappelling experience on instructor ratings or number of bounds were found. However, the nonsignificant trend was for subjects who had rappelled before to take more bounds than those who hadn't rappelled before ($M=5.33$ and $M=3.15$, $p<.15$, for third jumps off the 40 foot tower).

Table 7

Relationships Between Invulnerability and Decision to Rappel

	Group <u>M</u> (SD)			Comparison (t-value)	
	Control (n=28)	No Jump (n=13)	Jump (n=116)	C vs J (df=142)	NJ vs J (df=127)
GINV	1.65 (.94)	1.04 (1.20)	1.37 (.97)	1.35	-1.08
SINV	.60 (.74)	.08 (.85)	.55 (.75)	.30	-2.05*
OINV	1.13 (.62)	.56 (.76)	.96 (.63)	1.22	-2.05*

* $p < .04$

M=Mean

(SD)=Standard deviation

GINV=General Invulnerability

SINV=Specific Invulnerability

OINV=Overall Invulnerability

Table 8

Relationships Between Invulnerability and Decision to Jump Off 40 Foot Tower

	<u>M</u> for No (SD) (n=11)	<u>M</u> for Yes (SD) (n=105)	t-value	Probability (df=114)
GINV	1.59 (.64)	1.35 (1.00)	.80	.43
SINV	.77 (.75)	.53 (.75)	1.02	.31
OINV	1.18 (.50)	.94 (.64)	1.23	.22

M=Mean

(SD)=Standard deviation

GINV=General Invulnerability

SINV=Specific Invulnerability

OINV=Overall Invulnerability

Relationships Between Pre-measures and Post-measures

Change in invulnerability over time. To assess whether beliefs in invulnerability are stable over time and over experience with rappelling, t-tests were conducted to compare invulnerability at the time of the pre-measure and at the post-measure (see Table 9). For subjects who could not rappel ("Control"), general invulnerability decreased from pre- to post-measure. However, specific invulnerability did not change from pre- to post- assessment. For subjects who did rappel ("Jump"), both general and specific invulnerability in the post-measure decreased. For subjects who chose not to rappel ("No Jump"), no significant changes in invulnerability were found, although the trend was for both general and specific invulnerability to decrease (only five subjects in this group qualified for the analysis by having completed both the pre- and the post-measure). It is interesting to note that specific invulnerability scores reversed themselves on the post-test for subjects who decided not to rappel. That is, these non-jumpers actually rated themselves as relatively vulnerable to rappelling-specific negative events on the post-measure (pre- $M=.10$, post- $M=-.70$).

A repeated measures analysis of variance was conducted to compare pre- and post-invulnerability scores (within-subject factor) for subjects who could not rappel and subjects who did rappel (between-subjects factor). For general invulnerability, there was no main effect for group ($F < 1$), but there was a main effect for time, $F(1)=4.68$, $p < .03$. Thus, overall means were not significantly different across groups, but pre-test general invulnerability scores were significantly higher than post-test scores for both groups. No interaction effect was evident ($F < 1$). For specific invulnerability, there was no main effect for group ($F < 1$), but there was a main effect for time, $F(1)=5.5$, $p < .02$. Means were not significantly different across groups, but pre-test specific invulnerability scores were higher than post-test scores for both groups. Again, there was no interaction ($F < 1$).

Table 9

Relationships Between Pre-measures and Post-measures of Invulnerability

Group	<u>M</u> for Pre- (SD)	<u>M</u> for Post- (SD)	t-value
General Invulnerability			
Control (n=23)	1.57 (.92)	1.21 (1.03)	2.03***
Jump (n=115)	1.38 (.97)	1.20 (1.07)	1.72*
No Jump (n=5)	1.25 (1.08)	.95 (.96)	.91
Specific Invulnerability			
Control (n=23)	.478 (.60)	.283 (.62)	1.00
Jump (n=115)	.552 (.75)	.274 (.66)	3.41****
No Jump (n=5)	.100 (.29)	-.700 (1.95)	.95

* $p < .10$

** $p < .05$

*** $p < .001$

M=Mean

(SD)=Standard deviation

Control=Could not rappel

No Jump=Chose not to rappel

Jump=Did rappel

What changes over time? Having determined that relative invulnerability changed over time in this sample, the question was raised as to what changes--self ratings, other ratings, or both. Paired comparisons were conducted to investigate this issue. For measures of both general and specific vulnerability, differences between self scores for pre-test and post-test were compared. Results showed that for general vulnerability, self scores increased significantly over time, $t(142)=-3.35, p<.001$ (\underline{M} -pre=1.8, \underline{M} -post=2.0). Other scores did not change significantly over time, $t<1$ (\underline{M} -pre=3.2, \underline{M} -post=3.2). For specific vulnerability, self scores increased over time, $t(142)=-3.58, p<.0001$ (\underline{M} -pre=1.6, \underline{M} -post=1.8). Other scores did not change significantly over time, $t<1$ (\underline{M} -pre=2.1, \underline{M} -post=2.1). These results seem to suggest that what changed over time was primarily self scores. That is, subjects saw themselves as slightly more vulnerable to negative events on the post-measure, but did not change their estimations of others' likelihood of experiencing negative events from pre- to post-measure.

Given this, it is reasonable to wonder whether an index of invulnerability comprised of self scores by themselves might be just as good or better a predictor of jump performance than an index of self-other difference scores. A correlational analysis of self-score indices of invulnerability (pre-measure) with behavioral outcome measures revealed that for jump 1, self scores did not correlate significantly with either instructor ratings or number of bounds, whereas relative invulnerability did (see Table 4). So for the first jump, relative invulnerability seemed to be a much more useful, predictive construct. For the second jump, neither self-scores nor relative invulnerability correlated significantly with behavioral outcomes (see Table 5). However, for the third jump, self-scores for specific invulnerability correlated with ratings ($r=.45, p<.05$) and number of bounds ($r=-.49, p<.05$). Specific relative invulnerability was related in the same direction, $r=.14$ (ratings) and $r=-.26$ (bounds), but non-significantly. So for the third jump, self-scores may have been better predictors of jump performance than relative invulnerability scores.

Relationships Between Behavior and Post-measures

Several analyses were conducted to assess whether responses to the post-measure correlated with behavior during rappelling. Again, these analyses were performed separately for each jump.

First jump. A correlational analysis of behavior and post-measures for first jumps off the 20 foot tower revealed that number of bounds was positively correlated with specific invulnerability (see Table 10). So the more bounds taken to descend the tower, the higher specific invulnerability reported on the post-test. It appears that the more safely subjects behaved in their initial experience with rappelling, the more relatively invulnerable they felt to future risk in that specific activity. A second finding was that the decision to eventually attempt the 40 foot tower was negatively related to specific invulnerability. Thus, subjects who decided to go off the 40 foot tower reported lower beliefs in specific invulnerability after rappelling than subjects who decided not to jump off the 40 foot tower.

Partial correlation of these behavioral and post-measure variables controlling for the effects of the general and specific invulnerability pre-measures indicated that decision to go off the 40 foot tower was negatively correlated with specific invulnerability on the post-test ($r = -.30, p < .01$). Partial correlation for number of bounds was not significant ($r = .24$).

For first jumps off the 40 foot tower, safety ratings were negatively correlated with ratings of jump quality, such that the better the rating, the safer subjects thought they rappelled. Also, safety was positively related to number of bounds, so that the more bounds subject took in descending the tower, the safer they reported having rappelled.

Partial correlation controlling for the general and specific invulnerability pre-measure produced no significant results, although the trend was for ratings to be negatively related to safety reports ($r = -.59$), and number of bounds to be positively related to safety reports ($r = .50$). Hence, the better the rating and the greater the number of bounds taken, the safer

subjects reported their performance of the jump. This seems to indicate that subjects were relatively accurate in assessing the safety of their behavior post hoc.

Second jump. Correlational analysis of the second jump off the 20 foot tower yielded no significant results (see Table 11).

Partial correlation controlling for general and specific invulnerability pre-measure indicated that instructor rating was positively correlated with safety reports ($r=.561$, $p<.01$), such that the poorer their ratings, the safer subjects reported having behaved. In contrast to results for the first jump, these subjects seem to be much less objective in their post hoc assessments of their behavior.

For second jumps off the 40 foot tower, instructor rating was negatively correlated with safety ratings. That is, the better ratings subjects received on this jump, the safer they thought they had been in accomplishing the jump.

Partial correlation revealed that ratings of jump quality were negatively related to specific invulnerability ($r=-.306$, $p<.01$). Partial correlation for instructor rating with safety report was nonsignificant ($r=-.28$).

Table 10

Relationships Between Jump 1 Outcome Measures and Post-measures

Post-Measure	Rating	20 Foot Tower (n=101)		40 Foot Tower (n=19)	
		# Bounds	Dec40	Rating	# Bounds
SAFE	-.154	.127	.057	-.552*	.608**
OINV	-.052	-.029	-.124	.322	-.302
GINV	-.057	-.152	.023	.228	-.188
SINV	-.007	.200*	-.283**	.296	-.305

*p < .05 **p < .01

DEC40=Decision to go off 40 foot (0=no, 1=yes)

SAFE=Self Safety Rating

OINV=Overall Invulnerability

GINV=General Invulnerability

SINV=Specific Invulnerability

Table 11

Relationships Between Jump 2 Outcome Measures and Post-measures

Post-Measure	20 Foot Tower (n=26)			40 Foot Tower (n=65)	
	Rating	# Bounds	Dec40	Rating	# Bounds
SAFE	.162	.060	.225	-.271*	.197
OINV	.211	-.327	-.023	-.108	-.038
GINV	.328	-.388	.014	.007	-.015
SINV	-.037	-.085	-.067	-.226	-.046

* $p < .05$

** $p < .01$

DEC40=Decision to go off 40 foot (0=no, 1=yes)

SAFE=Self Safety Rating

OINV=Overall Invulnerability

GINV=General Invulnerability

SINV=Specific Invulnerability

Discussion

Summary of Results

Interrelationships among pre-measures. It was hypothesized that optimism, world assumptions, self-esteem, and death anxiety (general fear) would be related to relative invulnerability, providing convergent validity for this construct. This hypothesis was partially supported, in that optimism and self-esteem were positively related to relative invulnerability. This finding makes sense because both self-esteem and optimism relate directly to two of Taylor and Brown's (1988) proposed illusions: unrealistically positive views of the self and of one's future relative to others' (relative invulnerability). However, there was no evidence that death anxiety and world assumptions were related to invulnerability. Thus, the data did not support the prediction that general fear of the future, especially with respect to death, was associated with beliefs in relative invulnerability. Taylor and Brown (1988) suggest that the adaptive function of illusions is that they act as buffers against negative or threatening feedback, allowing people to maintain positive views of self, feelings of personal control, and optimistic views of the future. Perhaps it is reactions to more specific feedback and threats that motivate the illusion of unique invulnerability (see below). With regard to world assumptions, it is possible that the World Assumptions Scale with its eight factors may be too broad a measure to correlate with a specific belief in relative invulnerability. Note, however, that the more specific self-worth subscale of the WAS was positively related to invulnerability, in partial support of the prediction.

Correlations with self-score indices fully supported these hypotheses regarding convergence. There are at least two possible explanations for this discrepancy between self ratings and self-other difference scores. First, overall reliability for difference scores might have been attenuated compared with reliability for self-scores, because difference scores are

calculated by combining two different measures, each with less than perfect reliabilities. Self ratings are based on only one measure, making them inherently more reliable. Second, making self ratings was more similar to the method used in all the other pre-measures (eg, evaluating the self), whereas making other ratings involved a degree of method variance (eg, evaluating another). This suggests that the method variance and decreased reliability associated with self-other difference scores may have been problematic in comparing relative invulnerability to other measures.

The second part of this hypothesis was that physical self-efficacy, sensation seeking and immediate fear would not be related to relative invulnerability, providing discriminant validity for this construct. Results did not support this hypothesis, as all three constructs were correlated with some aspect of invulnerability. In explaining this finding, it is important to point out that virtually all of the pre-measures were related to one another. That is, it appears that all the non-invulnerability scales tapped convergent constructs. Since physical self-efficacy, sensation seeking, and fear were all related to optimism and self-esteem, which were in turn related to invulnerability, it is not surprising that the former constructs were related to invulnerability as well. It is interesting that sensation seeking was related only to rappelling-specific invulnerability, suggesting that sensation seeking may be more a factor in undertaking specific risky activities, and not so much a general approach to life. Also, the finding that immediate fear was negatively correlated with invulnerability supports the above idea that beliefs in invulnerability buffer against specific threats as opposed to more general fears. That is, subjects who held stronger beliefs in invulnerability reported being less afraid before accomplishing their first rappels, suggesting that their beliefs in invulnerability may have buffered their fear.

Correlations with self-score indices supported these hypotheses regarding discriminant validity for general invulnerability, but not for specific and overall invulnerability. Data from this more reliable measure suggest that physical self-efficacy,

sensation seeking, and immediate fear are indeed discriminant from a person's general beliefs in invulnerability, but are related to specific beliefs in invulnerability when people are engaging in risky physical activities, like rappelling.

Overall, these findings suggest that optimism and self-esteem, self-efficacy, and self-worth are important components of the illusion of unique invulnerability. Also, the theory that this illusion is adaptive because it helps buffer people from the anxiety of negative or threatening feedback is supported.

Relationships between pre-measures and behavior. It was hypothesized that subjects who felt relatively more invulnerable to experiencing negative events would behave more riskily while rappelling. The data partially support this hypothesis. The decision to rappel, which entailed greater assumption of risk than deciding not to rappel, was related to higher beliefs in overall and specific invulnerability. Also, for first rappels off the 40 foot tower, higher levels of relative invulnerability were related to taking fewer bounds down the tower, a behavior that may have entailed greater risk than taking more bounds. (Although examination of the mean number of bounds, $M = 4.41$, $SD = 1.46$, indicates that no subject took less than 3 bounds, which was the operational definition of "risky".) Better ratings were associated with greater beliefs in invulnerability. A possible explanation is that higher levels of invulnerability may have buffered subjects against the initial fear they felt before the first rappel, allowing them to perform more competent rappels. That high invulnerability was related to both fewer bounds and better ratings seems to indicate that these subjects may have been behaving more competently than low invulnerability subjects, who were behaving more tentatively and conservatively.

Invulnerability was not related to either jump rating or number of bounds after the first jump. Instead, physical self-efficacy became the most consistent correlate with ratings and number of bounds for second and third rappels. Higher levels of efficacy related to better ratings for second jumps off the 40 foot tower ($r = -.28$, $p < .05$), and greater number

of bounds for second jumps off the 20 and 40 foot towers ($r=.48$, $p<.05$ and $r=.31$, $p<.05$). These results suggest that after one previous experience, physical self-efficacy seems to take over as the primary correlate of jump competence and safety. It seems counterintuitive that subjects who believe themselves to be physically efficacious would actually behave more conservatively (take more bounds) than less physically competent subjects. One possible explanation for this finding is that subjects higher in physical self-efficacy, who are more comfortable with their physical ability, are more willing to follow instructions--strive to do the activity "right" by taking the prescribed number of bounds on each tower. This explanation is supported anecdotally by a quote from a high school football coach who said, "The best compliment I can give any athlete is that he's coachable--by coachable I mean that an individual tries to execute what the coach wants him to" (R. J. Wagner, personal communication, May 3, 1982). In contrast, subjects lower in physical self-efficacy may realize after their first rappel that the activity is really not that dangerous, and may see this as an opportunity to prove their physical prowess to their peers by "beating the mean"--getting to the bottom of the tower in the fewest bounds possible. A final note on this topic is that subjects with previous rappelling experience tended to take more bounds than naive subjects. This is consistent with the idea that physical confidence, at least with respect to rappelling, results in subjects performing the activity as much "to the letter" as possible, trying not to deviate from the prescribed number of bounds.

Regression analyses generally supported the above conclusions by revealing that invulnerability, optimism, and physical self-efficacy were the only pre-measures that accounted for significant variance in predicting number of bounds, and invulnerability and physical-efficacy the only constructs that predicted instructor ratings.

Overall, these findings suggest that the illusion of unique invulnerability is related to the decision of whether or not to engage in a risky activity, and once the activity is

undertaken, is related to the initial safety of behavior.

Relationships between pre-measures and post-measures. It was hypothesized that specific invulnerability would decrease after rappelling, because subjects would have the opportunity to see that others had the same risks and outcomes as they did. General invulnerability was hypothesized to remain fairly stable over time. Data supported the first part of this hypothesis. Repeated measures analysis of variance showed that specific invulnerability scores decreased for all subject groups from pre- to post-test. This finding makes sense because, even though all subjects did not have the opportunity to rappel themselves, all subjects thought they would have the chance to rappel and observed others rappelling. So even indirect experience with rappelling seems to be enough to make subjects more realistic in their assessments of relative invulnerability to rappelling-specific risks. Of particular interest was the result that indicated subjects who chose not to rappel showed the greatest decrease in specific invulnerability, actually reversing their scores to reflect relative vulnerability on the post-test. It appears that these subjects went through a more extensive assessment of risk in deciding not to rappel, and ended up deciding they were more at risk than others for suffering a mishap during rappelling.

The hypothesis that general invulnerability would remain stable over time was not supported, as general invulnerability decreased from pre- to post-test for all groups. A possible explanation for these findings is that another factor, besides rappelling, was impinging on subjects' beliefs in invulnerability. When subjects took the pre-measure, they had just arrived at Virginia Tech, ready to enter the prestigious Corps of Cadets and begin their first year of college--quite lofty achievements. However, when they took the post-measure a week later, they had just been through possibly the most rigorous week of their lives, the boot camp-style indoctrination into the Corps of Cadets. While subjects were probably feeling somewhat special and efficacious at the time of the pre-measure, it is conceivable that they were feeling a little defeated or humbled during the post-measure.

For a week, upperclass cadets had been making them feel like they were not very special at all, and that they were barely making it through the program. If this reasoning is plausible, it is not surprising that general invulnerability decreased for all subjects.

Results regarding changes in invulnerability over time also suggest that what changes over time is estimates of risk for self, while estimates of others' risk remains fairly constant. This finding supports the theory that the process behind illusions of unique invulnerability is related to underestimation of own risk (Burger & Burns, 1988; Gerrard et al., 1991), as opposed to overestimation of others' risk (Whitley & Hem, 1991).

Overall, no definitive conclusions can be drawn as to the stability of the illusion of unique invulnerability over time and experience with a risky activity. The experience of going through ROTC indoctrination confounded any effects due specifically to the experience of rappelling. However, these findings do contribute to an understanding of the process behind the illusion of unique invulnerability by suggesting that own risk is underestimated, as opposed to other risk being overestimated.

Relationships between behavior and post-measures. A final area of interest was whether behavior during rappelling would be related to the post-measures. Greater number of bounds was related to higher levels of post-test specific invulnerability, while deciding to rappel off the 40 foot tower was related to lower post-test levels of specific invulnerability. This suggests that the safer subjects rappelled, the more they were able to maintain their beliefs in specific invulnerability after rappelling. They had effectively minimized their risk by behaving safely, so their perceptions of relative risk did not change as much as for others who had not behaved as safely. On the other hand, subjects who decided to assume greater risk by tackling the 40 foot tower discovered that their objective risk on that behavior was the same as everyone else's, in fact greater than for people who did not rappel or who only rappelled off the 20 foot tower. This realization may have forced them to modify their beliefs in unique invulnerability. Subjects who did not

accomplish the 40 foot jump may have thought their risks were less than others because they purposely limited the amount of risk they encountered. If they compared their own risk to people who went off the 40 foot tower, it makes sense that they concluded they would be more invulnerable to mishap.

A specific question was whether post hoc safety ratings would reflect actual assumption of risk during rappelling. The data showed that better instructor ratings of jump quality and greater number of bounds were related to higher subject safety ratings. These findings suggest that subjects were fairly accurate in their post hoc assessments of the objective safety of their behavior.

An important caveat applies to all the preceding analyses of behavior and safety ratings. Although some significant relationships emerged between the actual safety of subjects' rappels and their self-reported safety, two factors may have limited this finding. The first is that objective safety was fairly high for all subjects. This rappelling training was a highly constrained, tightly controlled activity conducted by trained professionals. Not a single injury occurred, although we know from examining the pre-measures of invulnerability that subjects perceived injury was a likely possibility. Nonetheless, the range of actual safety for all rappels accomplished was fairly narrow, and in the direction of being very safe. Second, although these analyses suggest that safety ratings varied in relation to instructor ratings and number of bounds, the range of safety ratings was also fairly narrow, with most subjects rating themselves towards the "Extremely Safe" end of the scale (overall response mean of 6.25 on a scale of 1 to 7). The bottom line is that although subjects may have perceived the activity to be risky, and may have been relatively accurate in assessing their risk, the actual risk involved was constrained. This restriction of range may have artificially deflated the magnitudes of r-values.

Overall, these findings suggest that, at least for this study, subjects' self-reports

concerning the safety of their behavior are fairly objective and accurate. This implies that self-report methodology, used quite extensively in the investigation of the illusion of unique invulnerability, may be quite acceptable in terms of assessing the safety of some behaviors that are not readily observable.

Alternative Explanations

Conceptually, this study was interested in investigating risk-taking. Rappelling is an inherently risky activity, but an important question is whether or not the behavioral measures used were actually assessing assumption of risk. An alternative explanation is that number of bounds and decisions regarding participation may have reflected physical competence rather than assumption of risk.

Instead of assuming that number of bounds tapped risk-taking, let us look more inductively at what variables, besides invulnerability, correlated with number of bounds. Most importantly, there was a negative correlation between instructor rating and number of bounds. That is, analyses showed that as number of bounds increased, instructor ratings improved, implying that number of bounds might be an index of quality of performance. Physical self-efficacy was also correlated with number of bounds for second rappels off the 20 and 40 foot towers ($r=.48$ and $.31$, $ps<.05$). To the extent that perceived physical competence, measured via the Physical Self-efficacy Scale (PSE), reflects actual physical competence, the finding that physical self-efficacy was related to number of bounds supports the explanation that number of bounds may be tapping competence versus riskiness.

Suggesting that number of bounds is related to competent behavior is not inconsistent with Taylor and Brown's (1988) theory concerning the functional value of illusions. By buffering people's anxiety in threatening situations, the illusion of unique invulnerability may facilitate more competent performance. This conclusion is supported by results of a

t-test conducted to compare high- and low- invulnerability subjects in terms of number of bounds. Subjects were dichotomized into two groups, high- and low-invulnerability, based on a median split between pre-test specific invulnerability scores. For first jumps off the 40 foot tower, subjects low in specific invulnerability bounded more ($M=5.17$, $SD=.75$) than subjects high in specific invulnerability ($M=4.00$, $SD=1.61$), $p<.12$. Considering that three to four bounds on the 40 foot tower was operationally defined as appropriate, this finding suggests that subjects low in relative invulnerability behaved ultra-conservatively, while subjects high in invulnerability behaved competently.

Is Unique Invulnerability Really an Illusion?

It is reasonable to ask whether the "illusion" of unique invulnerability is really an illusion, or if it is based in reality. Taylor and Brown (1988) acknowledge that illusions about the future are operationally difficult to establish because no one knows what the future will bring. They argue that if it can be shown that most people believe that their future is more positive than that of most other people, or more positive than objective base rate data can support, then evidence supportive of illusions about the future is provided (Taylor & Brown, 1988).

Based on this notion that everyone's future cannot be better than everyone else's, data from this sample showed that an illusion of invulnerability was definitely occurring at the group level (e.g., the sample of freshmen ROTC cadets). That is, in terms of overall invulnerability, ninety five percent of all subjects thought that negative events were more likely to happen to someone else than to themselves. But we have no way of knowing, for any individual or subgroup within the larger group, whether perceptions of invulnerability were illusory. It is possible that subjects who reported higher levels of invulnerability were accurate--that their chances of experiencing mishap while rappelling were in fact lower than chances for other cadets. These subjects may have been objectively more competent or

experienced, and thus their perceptions may have been based on reality.

Ultimately, this issue cannot be completely resolved, but some of the results of this study hint at possible answers. Physical self-efficacy was moderately correlated with overall invulnerability, and strongly correlated with self-esteem which was strongly related to invulnerability. This suggests that perceived physical competence may be a component of beliefs in unique invulnerability. Thus, assuming that perceived physical competence is positively related to actual physical competence, invulnerability could be, in part, reality-based.

On the other hand, subjects who rappelled previously were not different from naive subjects in terms of invulnerability, suggesting that prior experience with rappelling was not a basis for beliefs in relative invulnerability. Also, regression analyses revealed that invulnerability accounted for unique variance in predicting jump performance, above and beyond that predicted by physical self-efficacy. Finally, for subjects who rappelled, beliefs in unique invulnerability decreased after rappelling, indicating that even for subjects who rappelled competently, objective experience with the risky activity reduced beliefs in invulnerability. Moreover, specific invulnerability for subjects who could not rappel did not change significantly from pre- to post-test, suggesting that the illusion was maintained in the absence of experiential evidence. These three findings seem to support the position that unique invulnerability may be illusory.

Limitations

One obvious complication was that subjects experienced many significant (and perhaps risky) events during the week between the pre-test and the post-test besides the risk-relevant activity, rappelling. This limited the conclusions that could be drawn about the relationships between invulnerability measures before and after rappelling.

Another limitation was the restriction of range of a few key variables and of the actual

risk involved. As described in the previous section, subjects' safety ratings and objective safety were both constrained towards the "extremely safe" end of the continuum. Number of bounds on the 20 foot tower showed relatively small variation, although bounds on the 40 foot tower comprised a much wider range. Instructor ratings tended towards "average" with relatively few "poor's" given. Wider ranges of these variables might have permitted more sensitive investigation of effects.

Along these same lines, developing measures of risk assumption was somewhat problematic. The difficulty in separating risk assumption from other factors, like physical competence and confidence, in determining jump performance has already been described. Additionally, it was difficult to operationalize what constituted assumption of risk in this context in which subjects had little control over their own behavior, due to the rigor of the military training environment. If the operational definitions of risk assumption could have been cleaner and tighter, results might have been more conclusive.

Subjectiveness of instructor ratings may have been a problem, even though all instructors were briefed on how to standardize ratings. Instructors rotated positions frequently, making it impossible to compare inter-rater reliabilities. Also, because rating was a mix of jump quality and safety, it may be that some instructors weighted safety more heavily in assigning their ratings, while others weighted jump quality and finesse more heavily.

Peer pressure may have been a complication. In the context of ROTC indoctrination week, many cadets were probably pressured to conform and to do things they might not otherwise have done. The impression that is made on the upperclass cadets and on cadet peers during the first week is lasting, and freshman cadets are loathe to be labeled as "wimps" or stigmatized in any way. Thus, peer pressure may have affected decisions to rappel, and even behavior during rappelling, in the direction of being more risky and "gutsy". Rappelling, in this context, is a group-influenced activity more so than for other

behaviors looked at in previous research (e.g., contraceptive use). Consequently, group identity may have been a relevant factor.

Time constraints affected the conduct of the rappelling training such that two cadets were able to rappel a total of four times, most cadets were able to rappel two or three times, and many cadets were only able to rappel once. This lack of standardization of experience forced analyses to consider one jump at a time. The analyses might have been more powerful if all subjects had experienced the same number of rappels off the same towers, and the data could have been aggregated in that way.

Finally, several of the analyses conducted involved a large number of comparisons, which may have inflated the possibility of Type 1 errors. Bonferroni corrections were conducted for all analyses of interrelationships among the pre-measures to control for experiment-wise error. Nonetheless, some of the correlations may be spurious, and as a result, the nature of support for some hypotheses may be overstated.

Future Directions

The correlational data obtained in this study provide preliminary support for a link between beliefs in unique invulnerability and assumption of risk in behavior. At least during initial contact with a risky activity, rappelling, these results suggest that relative invulnerability is related to risk taken while engaging in the activity. It is important to know whether such a link exists. It could be, as Taylor and Brown (1988) contend, that holding beliefs in unique invulnerability is adaptive, allowing people to live more happy, caring, productive lives by allowing them an optimistic outlook on the future. This theory was at least partially supported by evidence that suggested that beliefs in invulnerability were related to more competent performance. Thus, by buffering people's anxiety in threatening situations, the illusion of unique invulnerability may facilitate more competent behavior. Or it could be that having these beliefs may increase one's objective vulnerability

and risk by decreasing the perceived need to engage in self-protective behavior. This position was also partially supported by data that showed that the decision to engage in the risky activity was related to beliefs in invulnerability.

There is a need for experimental evidence to help further our understanding of the relationship between relative invulnerability and behavior. Such evidence could be obtained, for example, by experimentally manipulating levels of relative invulnerability and assessing subsequent risk assumption. Previous research has identified two possible methods for manipulating relative invulnerability: by changing the nature of the comparison other (Perloff & Fetzer, 1986), and by manipulating review of personal risk factors or assets that relate to experiencing specific negative events (Gerrard et al., 1991). A measure of risk assumption that might be readily observed and quantified in the laboratory involves a gambling paradigm, in which people decide how relatively risky they want to be in terms of winning or losing money.

Similarly, there is a need for more studies that actually observe subjects' risk-relevant behavior to insure that findings regarding the relationship between invulnerability and behavior are not spurious, artifacts of self-report methodologies. A key component of this study was behavioral observation. Unfortunately, as mentioned in the previous section, the measures of risk assumption were somewhat problematic, and the range of actual risk and behavioral outcomes rather limited. Behavioral observation studies with more definitive measures of risk assumption and with greater ranges of risk and outcomes would, again, contribute to our understanding of the impact of holding beliefs in unique invulnerability on behavior.

Finally, this study attempted to address the question of how experience with a risky activity affects illusions of unique invulnerability. The attempt was complicated by significant events other than the risk-related event going on in the lives of the subjects. However, this issue is important because if it is true, as these data indicate, that

invulnerability is related to initial risk-relevant behavior, subsequent behavioral outcomes may very well be associated with changes in beliefs in relative invulnerability. That is, just as these beliefs may be linked to initial behavior, preliminary contact with a risky activity may change our beliefs, which could in turn differentially affect our subsequent assumption of risk. If the relationship between beliefs in relative invulnerability and behavior is transactional, it is essential to know how our beliefs change over time and experience with risk, and how long-lasting or transient are these effects.

References

- Burger, J. M., & Burns, L. (1988). The illusion of unique invulnerability and the use of effective contraception. Personality and Social Psychology Bulletin, *14*, 264-270.
- Festinger, L. A. (1957). A theory of cognitive dissonance. Evanston, Illinois: Row, Peterson.
- Fischhoff, B. (1976). Attribution theory and judgment under uncertainty. In J. H. Harvey, W. J. Ickes, & R. F. Kidd (Eds.), New directions in attribution research. New Jersey: Erlbaum.
- Gerrard, M., Gibbons, F. X., & Warner, T. D. (1991). Effects of reviewing risk-relevant behavior on perceived vulnerability among women Marines. Health Psychology, *10*, 173-179.
- Gregory, J. F. (1989). Rock sport. Harrisburg, PA: Stackpole Books.
- Janoff-Bulman, R. (1989a). The benefits of illusions, the threat of disillusionment, and the limitations of inaccuracy. Journal of Social and Clinical Psychology, *8*, 158-175.
- Janoff-Bulman, R. (1989b). Assumptive worlds and the stress of traumatic events: Applications of the schema construct. Social Cognition, *7*, 113-136.
- Keppel, G. (1982). Design and analysis: A researcher's handbook (pp. 145-150). Englewood Cliffs, NJ: Prentice-Hall.
- Lebovits, A. H., & Strain, J. J. (1990). The asbestos worker who smokes: Adding insult to injury. Health Psychology, *9*, 405-417.
- Lonetto, R., & Templer, D. I. (1983). The nature of death anxiety. In C. D. Spielberger and J. N. Butcher (Eds.), Advances in personality assessment (pp. 14-174). Hillsdale, New Jersey: Lawrence Erlbaum.
- Lyman, T. (1975). The field book of mountaineering and rock climbing. New York, New York: Winchester Press.

- Mitchell, R. G. (1983). Mountain experience: The psychology and sociology of adventure. Chicago: University of Chicago Press.
- Nisbett, R., & Ross, L. (1980). Human inference: Strategies and shortcomings of social judgment. New Jersey: Prentice-Hall.
- Perloff, L. S. (1987). Social comparisons and illusions of invulnerability to negative life events. In C. R. Snyder & C. E. Ford (Eds.), Coping with negative life events: Clinical and social psychological perspectives. New York: Plenum Press.
- Perloff, L. S., & Fetzer, B. K. (1986). Self-other judgments and perceived vulnerability to victimization. Journal of Personality and Social Psychology, 50, 502-510.
- Robertson, L. S. (1977). Car crashes: Perceived vulnerability and willingness to pay for crash protection. Journal of Community Health, 3, 136-141.
- Rosenberg, M. (1965). Society and the adolescent self-image. New Jersey: Princeton University Press.
- Ryckman, R. M., Robbins, M. A., Thornton, B., & Cantrell, P. (1982). Development and validation of a Physical Self-Efficacy Scale. Journal of Personality and Social Psychology, 42, 891-900.
- Scheier, M. F., & Carver, C. S. (1985). Optimism, coping, and health: Assessment and implications of generalized outcome expectancies. Health Psychology, 4, 219-247.
- Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. Psychological Bulletin, 103, 193-210.
- Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. Science, 185, 1124-1131.
- Walk, R. D. (1956). Self-ratings of fear in a fear-invoking situation. Journal of Abnormal and Social Psychology, 52, 171-178.
- Weinstein, N. D. (1980). Unrealistic optimism about future life events. Journal of Personality and Social Psychology, 39, 806-820.

- Weinstein, N. D. (1982). Unrealistic optimism about susceptibility to health problems. Journal of Behavioral Medicine, 5, 441-460.
- Weinstein, N. D. (1984). Why it won't happen to me: Perceptions of risk factors and susceptibility. Health Psychology, 3, 431-457.
- Weinstein, N. D., Sandman, P. M., & Roberts, N. E. (1991). Perceived susceptibility and self-protective behavior: A field experiment to encourage home radon testing. Health Psychology, 10, 25-33.
- Whitley, B. E., & Hern, A. L. (1991). Perceptions of vulnerability to pregnancy and the use of effective contraception. Personality and Social Psychology Bulletin, 17, 104-110.
- Wills, T. A. (1981). Downward comparison as a coping mechanism. In C. R. Snyder & C. E. Ford (Eds.), Coping with negative life events: Clinical and social psychological perspectives. New York: Plenum.
- Zuckerman, M. (1983). A biological theory of sensation seeking. In M. Zuckerman (ed.), Biological bases of sensation seeking, impulsivity, and anxiety (pp. 37-76). Hillsdale, New Jersey: Erlbaum.
- Zuckerman, M. (1990). Preliminary manual for Form VI of the sensation seeking scale (SSS VI). Obtained from the author: Department of Psychology, University of Delaware, Newark, Delaware 19716.

Footnotes

¹ Because the internal reliability of the Death Anxiety Scale (DAS) was marginal, a factor analysis was conducted to assess whether the DAS was measuring more than one construct. Results indicated that actually six different factors were being tapped. Of these, two factors seemed most theoretically relevant to invulnerability. One factor corresponded roughly to general future outcomes (eg, "I feel that the future holds nothing for me to fear"), and another to specific future outcomes (eg, "I am really scared of having a heart attack"). Two indices were formed based on the items that loaded on each of these two factors. Reliability coefficients for the general and specific future indices were .55 and .44 respectively. Neither of these indices correlated significantly with overall invulnerability ($r = -.05$ for general future index, $r = -.04$ for specific future index). Based on these results, neither of these subscale indices were used in subsequent analyses.

² A pilot test of the survey instrument was conducted during the second summer session to check factors like length and ease of comprehension. Results showed that 15 graduate and undergraduate student subjects enrolled in an advanced psychology course had no trouble understanding the directions, responding to the questions, or completing the questionnaire in less than 30 minutes.

³ Correlations between all the non-invulnerability pre-measures were calculated, and are presented in Table 12 (Appendix A).

Appendix A

Relationships Between Pre-measures

Table 12

Relationships Between Pre-measures

	DAS	PSE	SES	SSS	WAS	WASI	LOT	FEAR
DAS	1.00							
PSE	-.424***	1.00						
SES	-.437***	.693***	1.00					
SSS	-.320***	.286***	.288***	1.00				
WAS	-.107	.427***	.389***	.192*	1.00			
WASI	-.292***	.559***	.697***	.266***	.701***	1.00		
LOT	-.449***	.523***	.613***	.277***	.434***	.500***	1.00	
FEAR	.273***	-.389***	-.267***	-.322***	-.224*	-.211*	-.210*	1.00

* $p < .03$

*** $p < .004$ (see note below)

DAS = Death Anxiety Scale

PSE = Physical Self-Efficacy Scale

SES = Self-Esteem Scale

SSS = Sensation Seeking Scale

WAS = World Assumptions Scale

WASI = World Assumptions (invulnerability)

LOT = Life Orientation Test

Fear = fear thermometer

Note: Bonferroni correction (experiment-wise error set at .10) for 28 comparisons would necessitate any specific comparison be $p < .004$ to be considered reliable.

Appendix B

Consent Form

I understand that I am voluntarily participating in a research project that is concerned with the impact of people's beliefs on military training. I understand that I will be asked to respond to several questionnaires dealing with my beliefs and opinions about myself, others, and various activities. I may choose to answer any questions or refrain from answering questions. I further understand that similar, follow-up questionnaires will be administered several days from now. These questionnaires should take about 15 minutes total to complete. Finally, I understand that portions of the rappelling training to be conducted on August 23, 1991 will be observed and videotaped by members of the research team, and that these tapes will be kept in a secure place. This videotaped information will be kept strictly confidential, and, once viewed by the principle investigators, all identity information will be removed to insure my anonymity. These tapes will be destroyed at the conclusion of the research project, not more than six months from now.

In agreeing to participate in this research, I understand that:

1. My participation in this research will in no way affect my standing in the Corps of Cadets. The ROTC staff and cadet cadre will not be given any information about individual cadets' responses. This research is not an ROTC function, and has no bearing on my performance or evaluation in ROTC.
2. There are no anticipated risks associated with my participation in this study.
3. I understand that portions of the rappelling training may be videotaped, and I give my permission to be videotaped by members of the research team.
4. I am free to withdraw my consent and discontinue participation at any time without any negative consequences.

5. This research has been approved by the Human Subjects Committee of the Psychology Department and by Virginia Tech's Internal Review Board. In addition, Major General Musser, Commandant of Cadets, Virginia Tech ROTC, has approved this research project. Questions should be addressed to the chairperson of the Human Subjects Committee or to the research director of this project (see below).

6. If I would like a copy of this form, I may have one.

7. If I am interested in the final analysis of the results, they will be available from the research director during the fall semester. However, because data will be confidential and will not be analyzed on an individual basis, I will not be able to obtain information directly pertinent to any responses I make. Only a summary of the final data (i.e., average responses) will be made available.

8. All information that I offer will be held in strict confidence.

THANK YOU!

Dr. Danny Axsom

Dr. Ernest Stout

Dr. Helen Crawford

Research Director

Associate Provost

Human Subjects Committee Chair

231-6495

231-9359

231-7916

I hereby agree to participate voluntarily in the research project described above and under the conditions described above.

Name (print): _____

SSN: _____

Signature: _____

Cadet Company: _____

Appendix C

Pre-Measure

BELIEF SCALE

We are interested in the beliefs people have about themselves and others. You will be asked to estimate how likely it is that you will experience the events listed below and how likely it is that another person will experience these same events. Record all answers by circling one number on each scale following the events below.

Self Rating

How likely is it that you will experience each of the following events sometime during your life? (Please circle one number on each scale.)

1. Having a heart attack

Not at all likely 1 2 3 4 5 6 7 Extremely likely

2. Developing a drug/alcohol addiction

Not at all likely 1 2 3 4 5 6 7 Extremely likely

3. Contracting a venereal disease

Not at all likely 1 2 3 4 5 6 7 Extremely likely

4. Getting a divorce

Not at all likely 1 2 3 4 5 6 7 Extremely likely

5. Attempting suicide

Not at all likely 1 2 3 4 5 6 7 Extremely likely

Later this week, all new cadets will go through military training in rappelling. "Rappelling" is using a rope to descend down a 20-40 foot tower. How likely is it that you will experience each of the following events during this rappelling training? (Please circle one number on each scale.)

6. Getting injured

Not at all likely 1 2 3 4 5 6 7 Extremely likely

7. Slipping and falling from the tower

Not at all likely 1 2 3 4 5 6 7 Extremely likely

8. Spraining an ankle or breaking a bone

Not at all likely 1 2 3 4 5 6 7 Extremely likely

9. Having your rope break mid-way down the tower

Not at all likely 1 2 3 4 5 6 7 Extremely likely

10. Getting a concussion

Not at all likely 1 2 3 4 5 6 7 Extremely likely

Have you ever rappelled before? Yes No (Circle one)

If yes, how many times?

Other Rating

How likely is it that the average ROTC cadet of your sex at Virginia Tech will experience each of the following events sometime during his or her life? (Please circle one number on each scale.)

1. Having a heart attack

Not at all likely 1 2 3 4 5 6 7 Extremely likely

2. Developing a drug/alcohol addiction

Not at all likely 1 2 3 4 5 6 7 Extremely likely

3. Contracting a venereal disease

Not at all likely 1 2 3 4 5 6 7 Extremely likely

4. Getting a divorce

Not at all likely 1 2 3 4 5 6 7 Extremely likely

5. Attempting suicide

Not at all likely 1 2 3 4 5 6 7 Extremely likely

How likely is it that the average ROTC cadet of your sex at Virginia Tech will experience each of the following events during the rappelling training later this week?

(Please circle one number on each scale.)

6. Getting injured

Not at all likely 1 2 3 4 5 6 7 Extremely likely

7. Slipping and falling from the tower

Not at all likely 1 2 3 4 5 6 7 Extremely likely

8. Spraining an ankle or breaking a bone

Not at all likely 1 2 3 4 5 6 7 Extremely likely

9. Having their rope break mid-way down the tower

Not at all likely 1 2 3 4 5 6 7 Extremely likely

10. Getting a concussion

Not at all likely 1 2 3 4 5 6 7 Extremely likely

DAS

If a statement is true or mostly true as applied to you, circle "T" for true. If a statement is false or mostly false as applied to you, circle "F" for false.

- | | | | |
|---|---|-----|--------------------------------------------------------------|
| T | F | 1. | I am very much afraid to die. |
| T | F | 2. | The thought of death seldom enters my mind. |
| T | F | 3. | It doesn't make me nervous when people talk about death. |
| T | F | 4. | I dread to think about having to have an operation. |
| T | F | 5. | I am not at all afraid to die. |
| T | F | 6. | I am not particularly afraid of getting cancer. |
| T | F | 7. | The thought of death never bothers me. |
| T | F | 8. | I am often distressed by the way time flies so very rapidly. |
| T | F | 9. | I fear dying a painful death. |
| T | F | 10. | The subject of life after death troubles me greatly. |
| T | F | 11. | I am really scared of having a heart attack. |
| T | F | 12. | I often think about how short life really is. |
| T | F | 13. | I shudder when I hear people talking about a World War III. |
| T | F | 14. | The sight of a dead body is horrifying to me. |
| T | F | 15. | I feel that the future holds nothing for me to fear. |

WAS

The following are statements that people sometimes make about the world and about themselves. Please indicate how much you yourself agree or disagree with each statement.

Place one number to the left of the column for each item as follows:

1 = Strongly agree

2 = Agree

3 = Mildly agree

4 = Mildly disagree

5 = Disagree

6 = Strongly disagree

- ___ 1. Misfortune is least likely to strike worthy, decent people.
- ___ 2. People are naturally unfriendly and unkind.
- ___ 3. Bad events are distributed to people at random.
- ___ 4. Human nature is basically good.
- ___ 5. The good things that happen in this world far outnumber the bad.
- ___ 6. The course of our lives is largely determined by chance.
- ___ 7. Generally, people deserve what they get in this world.
- ___ 8. I often think I am no good at all.
- ___ 9. There is more good than evil in the world.
- ___ 10. I am basically a lucky person.
- ___ 11. People's misfortunes result from mistakes they have made.
- ___ 12. People don't really care what happens to the next person.
- ___ 13. I usually behave in ways that are likely to maximize good results for me.
- ___ 14. People will experience good fortune if they themselves are good.

- ___ 15. Life is too full of uncertainties that are determined by chance.
- ___ 16. When I think about it, I consider myself very lucky.
- ___ 17. I almost always make an effort to prevent bad things from happening to me.
- ___ 18. I have a low opinion of myself.
- ___ 19. By and large, good people get what they deserve in this world.
- ___ 20. Through our actions we can prevent bad things from happening to us.
- ___ 21. Looking at my life, I realize that chance events have worked out well for me.
- ___ 22. If people took preventive actions, most misfortune could be avoided.
- ___ 23. I take the actions necessary to protect myself against misfortune.
- ___ 24. In general, life is mostly a gamble.
- ___ 25. The world is a good place.
- ___ 26. People are basically kind and helpful.
- ___ 27. I usually behave so as to bring about the greatest good for me.
- ___ 28. I am very satisfied with the kind of person I am.
- ___ 29. When bad things happen, it is typically because people have not taken the
necessary actions to protect themselves.
- ___ 30. If you look closely enough, you will see that the world is full of goodness.
- ___ 31. I have reason to be ashamed of my personal character.
- ___ 32. I am luckier than most people.

SES

This questionnaire is designed to measure how you see yourself. It is not a test, so there is no right or wrong answers. Please answer each item as carefully and accurately as you can by placing a number by each one as follows:

1 = Strongly agree

2 = Agree

3 = Disagree

4 = Strongly disagree

- ___ 1. I feel that I'm a person of worth, at least on an equal basis with others.
- ___ 2. I feel that I have a number of good qualities.
- ___ 3. All in all, I am inclined to feel that I am a failure.
- ___ 4. I am able to do things as well as most other people.
- ___ 5. I feel I don't have much to be proud of.
- ___ 6. I take a positive attitude toward myself.
- ___ 7. On the whole, I am satisfied with myself.
- ___ 8. I wish I could have more respect for myself.
- ___ 9. I certainly feel useless at times.
- ___ 10. At times I think I am no good at all.

PSE

Please place one number to the left of the column for each item as follows:

1 = Strongly agree

2 = Agree

3 = Somewhat agree

4 = Somewhat disagree

5 = Disagree

6 = Strongly disagree

- ___ 1. I have excellent reflexes.
- ___ 2. I am not agile and graceful.
- ___ 3. I am rarely embarrassed by my voice.
- ___ 4. My physique is rather strong.
- ___ 5. Sometimes I don't hold up well under stress.
- ___ 6. I can't run fast.
- ___ 7. I have physical defects that sometimes bother me.
- ___ 8. I don't feel in control when I take tests involving physical dexterity.
- ___ 9. I am never intimidated by the thought of a sexual encounter.
- ___ 10. People think negative things about me because of my posture.
- ___ 11. I am not hesitant about disagreeing with people bigger than I.
- ___ 12. I have poor muscle tone.
- ___ 13. I take little pride in my ability in sports.
- ___ 14. Athletic people usually do not receive more attention than I.
- ___ 15. I am sometimes envious of those better looking than myself.
- ___ 16. Sometimes my laugh embarrasses me.

- 17. I am not concerned with the impression my physique makes on others.
- 18. Sometimes I feel uncomfortable shaking hands because my hand is clammy.
- 19. My speed has helped me out of some tight spots.
- 20. I find that I am not accident prone.
- 21. I have a strong grip.
- 22. Because of my agility, I have been able to do things that many others could not do.

LOT

Please be as accurate and honest as you can, and try not to let your answers to one question influence your answers to other questions. There are no correct or incorrect answers.

Please indicate the extent to which you agree with each of the statements below by writing to the left of the item the appropriate number, according to the following key:

0 = Strongly agree

1 = Agree

2 = Neutral

3 = Disagree

4 = Strongly disagree

- ___ 1. In uncertain times, I usually expect the best.
- ___ 2. It's easy for me to relax.
- ___ 3. If something can go wrong for me, it will.
- ___ 4. I always look on the bright side of things.
- ___ 5. I'm always optimistic about my future.
- ___ 6. I enjoy my friends a lot.
- ___ 7. It's important for me to keep busy.
- ___ 8. I hardly ever expect things to go my way.
- ___ 9. Things never work out the way I want them to.
- ___ 10. I don't get upset too easily.
- ___ 11. I'm a believer in the idea that "every cloud has a silver lining".
- ___ 12. I rarely count on good things happening to me.

SSS VI

Below you will find a list of many different kinds of activities. We are only interested in your feelings, not in how others might regard these activities. Please indicate whether you would like to engage in each activity in the future, regardless of whether or not you have engaged in the activity in the past, using one of the following responses:

A = I have no desire to do this

B = I have thought of doing this, but probably will not do it

C = I have thought of doing this and will do it if I have the chance

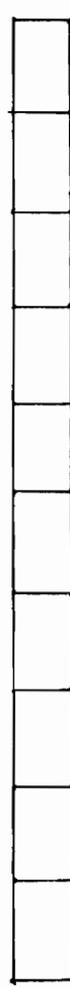
- ___ 1. Climbing steep mountains.
- ___ 2. Running in a marathon.
- ___ 3. Walking a tightrope.
- ___ 4. Swimming the English Channel.
- ___ 5. Parachute jumping.
- ___ 6. Flying an airplane.
- ___ 7. Scuba diving.
- ___ 8. Horseback riding at a gallop.
- ___ 9. Sailing long distances.
- ___ 10. Swimming alone far out from shore.
- ___ 11. Climbing Mount Everest.
- ___ 12. Skiing down high mountain slopes.
- ___ 13. Exploring caves.
- ___ 14. Hunting lions or tigers.
- ___ 15. Racing cars.
- ___ 16. Backpacking in Europe.

- ___ 17. Traveling to Antarctica.
- ___ 18. Taking a trip to the moon.
- ___ 19. Snorkeling over a reef.
- ___ 20. Backpacking in the wilderness (USA)
- ___ 21. Traveling up the Amazon.
- ___ 22. Surviving alone on an island for a week.

FEAR THERMOMETER

We expect that you will be afraid on some of your jumps. Please place a slash across the "thermometer" at the point which best describes how you feel right now, at this moment.

Extreme Fear



No Fear

Appendix D

Post-Measure

FOLLOW-UP QUESTIONNAIRE

Name: _____

Social Security Number: _____

Cadet Company: _____

Did you participate in the rappelling training earlier this week? _____ (Yes or No)

If "Yes":

How many times did you rappell off the 20 foot tower? _____ (Give #)

How many times did you rappell off the 40 foot tower? _____ (Give #)

SAFETY RATING

We are interested in how safely you think you performed each of your rappells. Please remember that safety is not necessarily the same thing as quality. Quality refers to the overall finesse or expertise with which you accomplished your rappells (eg, poor, average, or excellent). What we're interested in is whether or not you were in any danger during your rappells.

For each jump you made, please select one number from the scale below that best reflects how safe you think that jump was, ranging from extremely unsafe to extremely safe.

Write N/A for "not applicable" in the spaces next to jumps not taken. The number of jumps rated below should match the total number of jumps reported above.

How safe do you think your behavior was in accomplishing each of your rappells?

(Place a rating, 1-7, next to each jump made; write N/A next to jumps not made.)

Extremely unsafe 1 2 3 4 5 6 7 Extremely safe

Jump 1: _____

Jump 2: _____

Jump 3: _____

Jump 4: _____

Jump 5: _____

Jump 6: _____

BELIEF SCALE

We are interested in the beliefs people have about themselves and others. You will be asked to estimate how likely it is that **you** will experience the events listed below and how likely it is that **another person** will experience these same events. Record all answers by circling **one** number on each scale following the events below.

Other Rating

How likely is it that **the average ROTC cadet of your sex at Virginia Tech** will experience each of the following events sometime during his or her life? (Please circle one number on each scale.)

1. Having a heart attack

Not at all likely 1 2 3 4 5 6 7 Extremely likely

2. Developing a drug/alcohol addiction

Not at all likely 1 2 3 4 5 6 7 Extremely likely

3. Contracting a venereal disease

Not at all likely 1 2 3 4 5 6 7 Extremely likely

4. Getting a divorce

Not at all likely 1 2 3 4 5 6 7 Extremely likely

5. Attempting suicide

Not at all likely 1 2 3 4 5 6 7 Extremely likely

How likely is it that the average ROTC cadet of your sex at Virginia Tech will experience each of the following events while rappelling at some time in the future? (Please circle one number on each scale.)

6. Getting injured

Not at all likely 1 2 3 4 5 6 7 Extremely likely

7. Slipping and falling from the tower

Not at all likely 1 2 3 4 5 6 7 Extremely likely

8. Spraining an ankle or breaking a bone

Not at all likely 1 2 3 4 5 6 7 Extremely likely

9. Having their rope break mid-way down the tower

Not at all likely 1 2 3 4 5 6 7 Extremely likely

10. Getting a concussion

Not at all likely 1 2 3 4 5 6 7 Extremely likely

Self Rating

How likely is it that you will experience each of the following events sometime during your life? (Please circle one number on each scale.)

1. Having a heart attack

Not at all likely 1 2 3 4 5 6 7 Extremely likely

2. Developing a drug/alcohol addiction

Not at all likely 1 2 3 4 5 6 7 Extremely likely

3. Contracting a venereal disease

Not at all likely 1 2 3 4 5 6 7 Extremely likely

4. Getting a divorce

Not at all likely 1 2 3 4 5 6 7 Extremely likely

5. Attempting suicide

Not at all likely 1 2 3 4 5 6 7 Extremely likely

How likely is it that you will experience each of the following events while rappelling at some time in the future? (Please circle one number on each scale.)

6. Getting injured

Not at all likely 1 2 3 4 5 6 7 Extremely likely

7. Slipping and falling from the tower

Not at all likely 1 2 3 4 5 6 7 Extremely likely

8. Spraining an ankle or breaking a bone

Not at all likely 1 2 3 4 5 6 7 Extremely likely

9. Having your rope break mid-way down the tower

Not at all likely 1 2 3 4 5 6 7 Extremely likely

10. Getting a concussion

Not at all likely 1 2 3 4 5 6 7 Extremely likely

Appendix E

Debriefing

This study investigates a phenomenon called "unique invulnerability", which refers to our commonly held belief that other people will be the victims of misfortune more so than ourselves. This perception is reflected in the common saying: "It won't happen to me". A great deal of research shows that we have a general tendency to think that negative events are less likely to happen to ourselves than to others.

This begs an interesting question. If we think negative events are less likely to happen to us than to others, does this affect our behavior, causing us to behave less safely or more riskily than we might if we accurately assessed the likelihood of risk? For instance, if we think that it is very unlikely that we will be involved in a car accident, will this decrease our usage of seatbelts? Obviously, failing to wear a seatbelt would increase our actual vulnerability if we ever do get in an accident. You can see that engaging in risky behaviors can impact negatively on our health and well-being. For example, smoking, driving while intoxicated, and failing to practice safe sex can have drastic health consequences. This can be especially important in military environments where many of the jobs contain elements of risk (e.g. Air Force fighter pilot, Army airborne ranger, Navy SEAL). Thus, understanding the psychological mechanisms of risky behavior has important implications for health and safety outcomes for both military and civilian populations.

To work towards answering this question, we had you rate the probability that negative events (e.g., having a heart attack, getting a divorce, getting injured while rappelling, slipping and falling from the rappelling tower) would happen to you and to another person. The difference between the rating you made for yourself and the rating you made for the average ROTC cadet will show us whether you believe you are relatively invulnerable to experiencing those events. If you rated yourself as less likely than the

average cadet, you exhibit a belief of unique invulnerability. Then we observed your behavior rappelling. We will compare your invulnerability score with the "safety" of your rappelling jumps. We expect that cadets who rated themselves as highly invulnerable to negative events ("it really won't happen to me") will behave less safely while rappelling than cadets who rated themselves as less invulnerable ("it might happen to me"). Your participation in this study will help us better understand the relationship between our feelings of unique invulnerability and our behavior.

We want to reassure you again that all data will be kept strictly confidential, and that all personal information will be destroyed as soon as we have coded it. As your time is in high demand this week, we will not be able to discuss the study with you in more detail now. However, if you would like to find out more about the study and the results we obtained, please feel free to contact one of the principle investigators listed below.

Thank you again for your participation!

Capt. Kristen M. Vance

Principle Investigator

552-3316

Dr. Danny K. Axsom

Research Director

231-6495

Appendix F

Behavioral Measures

Accomplishment of jump

- Number of bounds down the tower
 - 20 foot tower: less than 2 = "risky", more than 3 = "conservative"
 - 40 foot tower: less than 3 = "risky", more than 4 = "conservative"

- Instructor's subjective rating of jump quality/safety:
 - 1="excellent"
 - 2="average"
 - 3="poor"

Decision to Go Off 40 Foot Tower

- Jumped off 40 foot: yes or no

Decision to Participate

- Accomplished at least one jump: yes or no

- Number of jumps off each tower

Vita

KRISTEN MORTON VANCE, CAPTAIN, USAF

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EDUCATION:

M.S., Applied-Experimental Psychology, Virginia Polytechnic Institute
and State University (VPI & SU), December 1991

Graduate courses, Human Factors Engineering, Wright State University,
1988-1990, 19 hours

Graduate courses, Experimental Psychology-Human Factors, University of
Dayton, 1988, 6 hours

B.S. (with honors), Behavioral Sciences-Human Factors, United States Air
Force Academy (USAFA), May 1987

MILITARY COMMISSION:

Regular, 27 May 1987, United States Air Force Academy

ASSIGNMENTS:

Jan 1992-Present Department of Behavioral Sciences and Leadership, United States
Air Force Academy (USAFA), CO

Faculty Member

Teaching psychology courses to undergraduate students at USAFA.

Aug 1990-Present Air Force Institute of Technology, Civilian Institution Program,
VPI & SU, Blacksburg, VA

Graduate Student (Experimental Psychology)

Completed a Master of Science degree in Applied-Experimental Psychology at VPI & SU.

Jul 1987-Aug 1990 H. G. Armstrong Aerospace Medical Research Laboratory
(AAMRL), Human Engineering Division,
Wright-Patterson AFB, OH

Engineering Research Psychologist

Managed a multidisciplinary research and development (R&D) effort to accelerate the transition of human engineering technologies for use in crew system design (Design Effectiveness Technology); directed diversified laboratory resources, including six government and contractor scientists and over \$600,000 combined annual project resources; led a research team supporting the development of advanced cockpit displays and computer-supported design technologies; conducted experiments, analyzed and published results; coordinated findings with the Tri-services and NASA; provided overall technical direction for R&D contracts.

AWARDS/HONORS:

National Defense Service Medal, 1991

Air Force Commendation Medal, 1990

Distinguished Graduate, USAFA, 1987

Outstanding Student in Human Factors, USAFA, 1986-1987

PROFESSIONAL ORGANIZATIONS:

Air Force Association

Association of Graduates, USAFA

"Designing for the User" Committee, DOD Human Factors Engineering
Technical Group
Human Factors Society

RESEARCH INTERESTS:

Most recent interest is in evaluating the effects of illusions of invulnerability, specifically unrealistic optimism, on the assumption of risk while performing inherently risky behaviors (eg, flying an airplane, parachuting, rappelling).

Rapid Communication Display Technology (RAPCOM) is a visual display approach, developed at AAMRL, that optimizes information transfer. Previous research efforts demonstrated the advantages and viability of RAPCOM as compared with conventional display technology. Present interest is in developing a coding strategy to compensate for the loss of spatial coding cues associated with implementing RAPCOM in a crew station environment.

Another research interest is in empirically evaluating the application of hypermedia technology to a variety of Air Force problem areas: specifically, the feasibility of implementing hypermedia formats in operational, real-time crew station environments. One objective of this research is to demonstrate the impact a software change to hypermedia can make on overall system performance for the same hardware configuration.

PUBLICATIONS:

Boff, K., Polzella, D., & Morton, K. (1990). Crew system ergonomics information analysis center: a gateway for technology transfer. Proceedings of the Technology Transfer Society 15th Annual Meeting (International Symposium and Exhibit). Dayton, OH.

- Marshak, W., Fix, E., Purvis, B., & Morton, K. (1990). Human factors assessment of the KC-135 fuel savings advisory/cockpit avionics system (Work Unit 71841045). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory (AAMRL/HED).
- Morton, K., & Swierenga, S. (1990). Developing effective coding schemes for an advanced visual display technology. Proceedings of the Twelfth Biennial Psychology in the Department of Defense Symposium (pp. 328-332). Colorado: USAFA/DFBL.
- Swierenga, S., Boff, K., & Morton, K. (October, 1990). An engineering perspective on the usefulness and usability of human engineering information in system design. Paper presented at the meeting of the Human Factors Society 34th Annual Meeting, Orlando, FL.
- Swierenga, S., Morton, K., & Boff, K. (1990). Issues concerning the use of human engineering information: the system designers' perspective. Proceedings of the IEEE 1990 National Aerospace and Electronics Conference (pp. 881-885). New York: IEEE Publishing Services.
- Vance, K. M. (1991). Illusions of unique invulnerability: Impact of beliefs on behavior. Unpublished master's thesis, Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Zirkler, D., & Morton, K. (1990). Using engineering models to compare paper and hypermedia-based displays of flight information. Proceedings of the IEEE 1990 National Aerospace and Electronics Conference (pp. 770-774). New York: IEEE Publishing Services.
- Zirkler, D., & Morton, K. (1990). The "paperless" cockpit: an application of hypermedia. Proceedings of the Fifth Mid-Central Ergonomics/Human Factors Conference. Dayton, OH.