

Changes in Emotional States Before and After Risk Taking in Scuba Diving

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The notion of risk-taking implies a cognitive process that determines the level of risk involved in a particular activity or task. This risk appraisal process gives rise to emotional responses, including anxious arousal and changes in mood, which may play a significant role in risk-related decision making. This study examines how emotional responses to the perceived risk of a scuba-diving injury contribute to divers' behavior, as well as the ways that risk taking or non-risk taking behavior, in turn, affects emotional states. The study sample consisted of 131 divers (risk takers and non-risk takers), who either had or had not been in a previous diving accident. Divers' emotional states were assessed immediately prior to diving, as well as immediately following a dive. Results indicated presence of subjective emotional experiences that are specific to whether a risk has been perceived and whether a risk has been taken. Important differences in emotion regulation were also found between divers who typically take risks and those who do not.

Keywords: risk-taking, emotional states, emotional arousal, self-regulation ■

Numerous factors contribute to the appraisal of risk and engagement in risk-taking behavior, including both individual and situation-specific variables. Emotional states associated with the perception of risk both before and after risk-taking behavior can influence the process of evaluating the risk, giving greater or lesser significance to individual and situation-specific variables. In addition, emotions may act as determinants of risk-taking behaviors (i.e., contributing to an individual's perception of risk), and at the same time, those who engage in risk-taking behaviors can undergo significant emotional changes, which can alter perception of risk after completion of the task. This study was designed to examine the way that these emotional states moderate both individual and situation-specific variables that contribute to risk perception and risk-taking behavior.

Cognitive and Psychopathological Approaches to Risk

Risk-taking occurs when the consequences of an activity are uncertain. This uncertainty may involve possibility of physical danger (e.g., parachute jumping), social evaluation (e.g., public speaking), or other consequences (e.g., making or missing a winning goal). Among the different facets of risk-taking behavior, two characteristics have previously been noted: (a) the presence of positive aspects (e.g., exploration) and negative aspects (e.g., destruction and accidents; Leigh, 1999) and (b) the risk of short- or long-term acute or chronic injury as a result of the behavior (Michel, Purper-Ouakil, & Mouren-Siméoni, 2002). Other elements help define risk-taking behaviors as well, including (a) the generality of the risk as opposed to its specificity (i.e., risk unique to a certain domain), (b) knowledge of the probability of harm (i.e., whether likelihood of injury or other harm is known or unknown), and (c) objective characteristics of the risk (i.e., empirically observed) as opposed to its subjective characteristics (i.e., individual perception). Finally, risk can be differentiated according to the individual's involvement in the activity (i.e., active versus passive risk taking).

When working with clinical populations, the objective appraisal of risk often proves less useful than understanding how risk functions in the individual's life. Indeed, risk-taking behavior is often best understood as a chosen life path that involves daring to face danger (Pedinielli, Rouan, Gimenez, & Bertagne, 2004) and testing one's ability to adapt (Adès, Lejoyeux, & Tassain, 1994). Thus, in its pathological dimension, risk taking implies "the deliberate and repeated involvement in situations that are dangerous for oneself and perhaps for others" (Adès et al., p. 1). It is "a behavior not required by working or living conditions, but which is actively sought in order to experience strong sensations, to gamble with danger and often death" (p. 1). Frequent repetition of risk-taking behavior and assumption of increasing degrees of risk are the signs of a potentially problematic psychological state, which differs in kind from the risk incurred in athletic competition and other forms of human performance.

Certain sports are classified by Adès and colleagues (1994) as involving risk-taking behaviors, such as parachute jumping, climbing, or extreme skiing (or "free-skiing"). In these activities, the participant often pursues increasing levels of risk. Yet these activities differ from pathological risk taking in that the participant attempts to reduce that risk by mastering the techniques and developing expertise in the sport. If, however, the participant purposely chooses risk-taking behavior beyond his or her skill or mastery level, these activities could be viewed as deviant forms of the recreational or occupational activity.

Risk Taking in Scuba Diving

In scuba diving, risk is typically assessed in terms of the potential physical consequences of the behavior. Biomechanical, biochemical, and biophysical systems are all proximal causes of potential medical consequences associated with scuba-diving risks. Accidents or injuries involving biomechanical systems (e.g., knocking the mask off, barotraumatism, or pulmonary overinflation) rarely happen to experienced

divers. These systems are therefore unlikely to be linked to deliberate risk taking on the part of the diver. By contrast, accidents or injuries involving biochemical and biophysical systems are often the outcome of voluntary actions performed by experienced divers. Biochemical accidents are often the result of a rise in the partial pressure of the gases in the diver's breathing mixture (nitrogen, carbon, oxygen) as the diving depth increases. This rise in pressure can have pathogenic effects, and the deeper the dive, the greater the risk. Narcosis (i.e., cognitive disturbance), shortness of breath, and hyperoxia (i.e., oxygen intoxication) are three biochemical disturbances that can, in extreme cases, prove lethal. Biophysical accidents, on the other hand, occur when surfacing stages are not achieved in a sufficiently gradual manner. Surfacing stages allow various parts of the body to eliminate the nitrogen that accumulates under the effects of high pressure. Failure to use these stages appropriately can have lethal consequences. In addition, the means of estimating the safety level of an ascent in real time, so that decompression occurs with the fewest possible risks, are not always reliable. This is especially true when divers engage in several dives in succession with a high time-to-depth ratio.

Emotional Self-Regulation of Behaviors and Cognitive-Behavioral Processes

A better understanding of the relationship between emotion and cognition can help us understand how emotions partly determine risk-taking behavior. For purposes of this study, emotions are regarded as dynamic sequences of subjective states (Scherer, 1984). A review of different theories of emotion and emotional experience will help explain our use of this definition.

The concept of "primary emotions," as defined by Izard (1992), has often been used to operationalize the study of emotional experience. Izard described emotions as "basic" subjective states because of their "essential biological and social functions in evolution and adaptation" (p. 561). In this view, emotions underlie the strategies implemented by individuals to adapt to their physical and social environments. They can be described from neurophysiological, expressive, and subjective standpoints.

From a functional perspective, emotions are often thought to precede actions. As such, the perceptual-cognitive processes at play in the execution of a behavior could be influenced by emotions. In addition, the way that an individual experiences, interprets, and processes emotions may be influenced by his or her representations of the emotional state. For example, if anger is perceived as an unacceptable emotion, the individual may experience a variety of self-judgments upon sensing irritation at another person. These judgments could lead to an experience of other emotions, such as guilt or sadness. Emotions also influence cognitive processing, which in turn may modify the intensity or nature of the experienced emotion. For example, a person experiencing anxiety while giving a lecture may devote cognitive resources to perceiving or imagining audience reactions, and this activity could reduce resources needed for working memory tasks. Inability to recall information needed for the lecture could then lead to an even greater experience of anxiety, and heightened perception of the audience's reactions could further exacerbate this anxiety. As such, emotions constitute a cluster of responses with expressive,

physiological, and subjective manifestations. In this way, physiological arousal and mental representations of sensations are linked (Amado-Boccaro, Donnet, & Olié, 1993).

Of course, emotions perform various functions, and one of these is to guide actions (Frijda, Kuipers, & Schure, 1989). As a result, actions that follow emotions tend to be congruent with the triggering emotions (Levenson, Ekman, & Friesen, 1990). In addition to prompting an individual to act, emotions also orient the individual to specific motivations and goals (e.g., fear leads to avoidance of injury) and prepare the person for necessary upcoming action (Clore, 1994; Levenson, 1994).

Interestingly, efforts to study the relationship between emotion and cognitive activity have generated considerable disagreement. Some studies have shown that emotions can inhibit cognitive processing (Levenson, 1994) and, in doing so, lead to disorganized action (Frijda, 1994). According to Watson and Clark (1994), however, individuals have a dual cognitive-emotional system, consisting of phylogenetic responses (which are automatic and adaptive), and a more elaborate information gathering and assessment process. Through this latter process, emotions heighten the need to assemble information and direct the individual's attention while developing understanding of the environment. Along these lines, Clore (1994) has argued that individuals use their awareness of subjective emotional experiences to make functional judgments and decisions.

Linking Emotion and Risk-Taking Decisions

Under the influence of emotions, individuals may choose between two types of cognitive processing strategies: (a) top-down or conceptually-driven processing or (b) bottom up or data-driven processing. Analyzing how emotion affects the use of these strategies may provide insight into the processes by which risk-taking behavior is initiated. In addition, it is useful to consider whether regulation efforts used in responding to emotion are directed at changing internal experience or the external environment. Gross (1999) has argued that changes to subjective experience could occur through efforts to increase positive emotion and reduce negative emotion, while changes to the external environment could involve approach or avoidance responses to stimuli that evoke emotional states (see also Gross, 2002; Richards & Gross, 2006).

According to Schwarz and Clore (1996), individuals who are in a positive emotional state are inclined to use top-down processing strategies: They rely heavily on their prior knowledge and pay little attention to information about their current activity. By contrast, individuals in a negative emotional state tend to use bottom-up processing strategies, focusing on processing information about the activity currently in progress. Theoretically, the use of top-down processing strategies might contribute to risk-taking behaviors because this form of processing places less emphasis on newly obtained information than on prior experience. Likewise, bottom-up processing should contribute to less risk taking, since currently available data are likely to be considered more carefully and given more weight than prior knowledge or beliefs. Data from risk-taking studies support this theory, though only to some extent. Isen (1997) and others (e.g., Nygren, Isen, Taylor, & Dulin, 1996) have indicated that individuals in positive mood states are generally risk

averse, preferring to conserve their good mood than risk losing it. Yet decision-making researchers have also found that positive mood does increase the tendency to take risks when the relative consequences of the risk are minimal. For example, individuals experiencing positive emotions are more likely to risk betting small sums, but less likely to bet large sums, than those in a negative emotional state (see Spies, Hesse, & Brandes, 1997).

Yet Lerner and Keltner (2000), who have studied the valence and nature of emotions such as fear and anger, suggest that the positive or negative valence of an emotion may be less important than the specific type of emotion (e.g., anger, sadness, joy) and the type of processing it evokes. In a study of perceived risk, these authors found that participants who were afraid tended to make pessimistic judgments of future events, while participants who were angry tended to make more optimistic judgments. Similarly, in a 2004 study, Fessler, Pillsworth, and Flamson found that two negative emotional states (anger and disgust) triggered different behaviors. Specifically, anger gave rise to risk taking, and disgust gave rise to risk avoidance, especially when the risk was physical.

According to Gasper and Clore (1998), however, these affect-related cues influence judgments only when they are believed to supply relevant information. That is, the impact of emotions on judgments is dictated by individuals' beliefs about the value of their affective experience (with respect to past experiences) rather than by the activation of representations that are congruent with their affect. In other words, an individual's belief that positive affect contributes to peak performance is more likely to influence actual performance than whether that individual activates top-down processing associated with a positive emotional state. Having insight into this process and how it affects one's performance would be conceptually close to emotional intelligence (i.e., the ability to process emotional information accurately and efficiently).

It is also important to note that the data linking emotional states and risk-taking are somewhat inconsistent. Some studies (Isen & Patrick, 1983; Zuckerman, 1978, 1988), for example, have found that emotional state and risk taking do not interact. Rather, these studies suggest that the perceived value of the risk-taking behavior (e.g., hope of reaping large benefits) may have more influence on individuals' behavior than emotion-related underestimation or overestimation of the situation.

Purpose of the Present Study

A principal goal of this study was to ascertain whether emotional states (e.g., happiness, anger, sensitivity, etc.) influence the execution of a risk-taking behavior. A secondary goal was to determine if engaging in risk taking altered emotional states and whether potential changes in emotion contribute to risk-related decision making. Specifically, we sought to determine whether risk takers exhibit emotional states before engaging in a risky activity and to analyze changes in participants' emotional experience after the activity is performed. The activity used for this investigation was scuba diving, which involves a variety of accident and injury risks. It was assumed, however, that given the level of experience and mastery of the risk-taking divers, they would consider the risks involved in their dives to be small. For this reason, it was assumed that risk taking would be associated with greater positive affect since, as noted above, individuals with positive affect are

more inclined to take risks than those with negative affect if the consequences of risk are small (Nygren et al., 1996; Spies et al., 1997).

Information was collected about the emotional states of two types of divers: (a) those who typically take risks and (b) those who do not typically take risks. Using measures of the divers' emotional states taken before and after risky or nonrisky dives, three hypotheses were tested:

1. Before diving, participants who engage in risk-taking dives will report stronger feelings of happiness, lower emotional arousal, and fewer negative emotions than participants who do not engage in risk-taking dives.
2. After diving, participants who engage in risk taking will report greater happiness, lower arousal levels, and fewer negative emotions than participants who do not engage in risk taking.
3. Execution of a risk-taking dive will trigger changes in a participant's emotional state. Specifically, after diving, risk-taking participants should report more positive emotions, less arousal, and fewer negative emotions than reported before diving.

Method

Participants

The participants consisted of 131 scuba divers using air as their breathing mixture, with a gender breakdown of 116 males and 15 females. This ratio is representative of the diving population, since scuba diving is much more common among men than women. The participants' mean age was 40.20 ($SD = 9.45$, range = 22–70).

All divers had reached a diving skill level that enabled them to dive safely without an instructor (level III FFESSM). A questionnaire about diving practices was used to classify participants into two risk groups: (a) risk takers and (b) non-risk takers (see Table 1). Sixty-one of the divers reported that they typically took diving risks and 70 reported that they did not. The risk takers said that they (a) dove to depths below 65 m and (b) did not follow safety rules (e.g., they completed several dives in succession with high time-to-depth ratios leading to nitrogen saturation). These practices were labeled "risky" because they could potentially result in biochemical or biophysical diving injuries. In addition, participants were recruited to

Table 1 Number of Participants in Each Group, Defined by the Experimental Factor "Risk Taking" and the Controlled Factor "Diving Accident" ($N = 131$)

Risk Takers		Non-Risk Takers	
70		61	
No accident	Accident	No accident	Accident
38	32	33	28

include a mix of divers who had previously experienced a diving accident and divers who had not experienced an accident. The risk-taking and non-risk-taking groups were then further divided into equivalent diving-accident and no-diving-accident groups, for a total of four groups: (a) risk-taking with accident, (b) risk-taking with no accident, (c) non-risk taking with accident, and d) non-risk taking with no accident. Exploring the potential effects of prior accidents on participants' diving behaviors, however, is beyond the scope of this article (see Bonnet & Pedinielli, 2001; Bonnet, Rouan, Romain, & Pedinielli, 2003■).

Measures

A 12-item, forced-choice questionnaire was devised to determine eligibility for the study and to classify the divers as risk-takers or non-risk-takers. The questionnaire assessed each participant's diving level, preferred diving depth, diving frequency, total number of dives performed, adherence to safety rules, and history of prior diving accidents.

The Differential Emotion Scale (DES; Izard, 1977), translated and validated for the French language (Ouss, Carton, Jouvent, & Widlöcher, 1990), was used to study the subjective components of emotion. In the French version of this measure, the instructions ask the participant to assess his or her current emotional state. The scale is comprised of a list of 30 adjectives (items) used to describe emotional states (e.g., sadness, happiness, anger, etc.). The adjectives pertain to nine factors: *sensitivity*, *happiness*, *anger*, *paranoia*, *surprise*, *attentiveness*, *discouragement*, *alertness*, and *disgust*. Participants answered each item on a scale ranging from 1 (*very little or not at all*) to 5 (*extremely*). A score for each factor was obtained by summing the scores on the corresponding items.

Procedure

Emotional-state data were gathered before and after dives. Participants in the no-accidents groups were recruited in the Marseille area of France. Participants in the accidents group were found by contacting hospitals with hyperbaric chambers in Marseille, Nice, Toulon, and Perpignan.

First, the participants filled out the questionnaire about their usual diving practices. In doing so, they also consented to participate in the experiment. The next step was to collect the emotional-state data before and after a dive. For ethical reasons, the procedure for this step was different for the risk-taking divers than for non-risk-taking divers. For the non-risk takers, data collection took place at their diving clubs in the presence of the experimenter. They were given two copies of the DES (Izard, 1977; Ouss et al., 1990), one that they answered 30 minutes before the dive and another that they completed less than 60 minutes after the dive. For the risk takers, however, it was not possible (for reasons of ethical and legal responsibility) for the experimenters to be present during the dive. In fact, risky dives (e.g., those with descent depths greater than 65 m) are prohibited at diving clubs. Like the non-risk-taking divers, the risk-taking participants received two copies of the DES, one to be completed before and the other to be completed after a typical dive. Because the experimenters were not present, however, these divers were asked to submit their completed forms by mail.

Results

The subjective emotional states of the two groups of divers before and after the dive were compared separately for each factor on the DES (Izard, 1977; Ouss et al., 1990). Note, however, that results for the paranoia factor are not presented because this factor was insensitive to the experimental variables (group and time of measurement).

Comparison of Subjective Emotional States Before Diving

Table 2 summarizes the means and standard deviations of the risk-taking and non-risk-taking groups on the various emotion factors prior to diving. As predicted, risk takers received lower scores on sensitivity (a negative emotional state) than non-risk takers, $F(1129) = 9.45$, $MSE = 2.64$, $p = 0.003$. With regard to happiness (positive emotional state), however, there was no significant difference between the risk-taking and non-risk-taking groups ($p > 0.05$). For alertness (overall arousal state), the risk-taking participants obtained significantly higher scores than the non-risk-taking participants, $F(1129) = 6.21$, $MSE = 1.28$, $p = 0.01$.

Comparison of Subjective Emotional States After Diving

Table 3 summarizes the means and standard deviations of the risk-taking and non-risk-taking groups on the various emotion factors prior to diving. Unlike the before-diving results, there were no significant differences between the risk takers and the non-risk-takers ($p > 0.05$) in surprise, attentiveness, or alertness (i.e., arousal states). With regard to anger, discouragement, and disgust (negative emotional states), however, the two groups differed significantly. Risk-taking participants reported less anger after diving than non-risk-taking participants, $F(1129) = 4.57$, $MSE = 2.03$, $p = 0.034$. In addition, risk takers felt less discouraged after diving than non-risk takers, $F(1129) = 5.72$, $MSE = 1.82$, $p = 0.018$, as well as less disgusted than non-risk-takers, $F(1129) = 4.05$, $MSE = 1.88$, $p = 0.046$ (see Table 3). Moreover, with regard to happiness (positive emotional state), the risk-taking participants felt significantly happier than the non-risk-taking participants after diving, $F(1129) = 7.47$, $MSE = 6.59$, $p = 0.007$.

Effect of the Dive: Comparison of Emotional States Before and After Diving

Comparison of DES (Izard, 1977; Ouss et al., 1990) scores before and after diving (using repeated measures ANOVA) indicated significant within and between-group differences in the emotional states of the divers before and after diving. With regard to happiness (positive emotional state), there was a significant within-groups emotional-state change for risk-taking participants, who reported greater happiness after diving than before diving, $F(1129) = 3.78$, $MSE = 4.00$, $p = 0.05$. With regard to surprise, attentiveness, and alertness (emotional arousal), there were both within-group and between-group changes. Both the risk-taking divers and the non-risk-taking divers were more surprised after the dive (risk takers: $M = 5.36$, $SD = 2.49$; non-risk takers: $M = 4.70$, $SD = 2.03$) than before the dive (risk takers: $M = 3.98$, $SD = 1.77$; non-risk takers: $M = 3.84$, $SD = 1.44$), $F(1129) = 36.38$, $MSE = 2.23$, $p = 0.0001$. Both groups were also less attentive after the dive (risk takers:

Table 2 Mean Scores on the Differential Emotion Scale for Risk Taking and Non-Risk Taking Groups Before Diving

Factors		Arousal			Negative		
Groups	Happiness	Surprise	Alertness	Attentiveness	Sensitivity	Anger	Disgust
Risk takers	11.20	3.98	3.30	8.72	7.85	3.27	3.22
Non-risk takers	10.64	3.84	2.80	8.40	8.73	3.20	3.18
Significance level	ns	ns	0.01	ns	0.003	ns	ns

Table 3 Mean Scores on the Differential Emotion Scale for Risk Taking and Non-Risk Taking Groups After Diving

Factors		Arousal			Negative		
Groups	Happiness	Surprise	Alertness	Attentiveness	Sensitivity	Anger	Disgust
Risk takers	11.90	5.36	2.70	6.62	7.57	3.07	3.15
Non-risk takers	10.67	4.70	2.34	5.99	7.60	3.60	3.71
Significance level	0.007	ns (.10)	ns	ns (.10)	ns	0.034	0.018
							0.046

$M = 6.62, SD = 2.33$; non-risk takers: $M = 5.99, SD = 1.98$) than before the dive (risk takers: $M = 8.72, SD = 1.58$; non-risk takers: $M = 8.40, SD = 2.22$), $F(1129) = 118.86, MSE = 2.79, p < 0.0001$, and less alert after the dive (risk takers: $M = 2.70, SD = 1.25$; non-risk takers: $M = 2.34, SD = 1.14$) than before the dive (risk takers: $M = 3.30, SD = 1.13$; non-risk takers: $M = 2.80, SD = 1.13$), $F(1129) = 17.33, MSE = 1.03, p < 0.001$.

In addition, there were four significant interaction effects between group and time-measured in regard to negative emotional states. The first (see Figure 1) indicated that the mean sensitivity scores before diving ($M = 7.85, SD = 1.30$) and after diving ($M = 7.57, SD = 1.27$) did not differ significantly for risk-taking participants, yet the mean was higher before the dive ($M = 8.72, SD = 1.86$) than after the dive ($M = 7.60, SD = 1.29$) for non-risk-taking participants, $F(1129) = 10.46, MSE = 1.12, p = 0.001$.

A second interaction (see Figure 2) showed that risk-takers' mean anger scores before diving ($M = 3.28, SD = 0.9$) and after diving ($M = 3.07, SD = 0.31$) did not differ significantly, while non-risk takers reported higher levels of anger after diving ($M = 3.60, SD = 1.93$) than before diving ($M = 3.20, SD = 0.69$), $F(1129) = 5.78, MSE = 1.05, p = 0.018$.

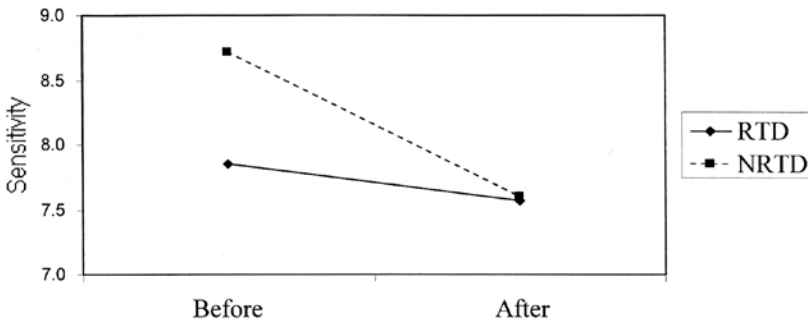


Figure 1 — Interaction between mean sensitivity scores of risk-taking and non-risk-taking groups before and after diving.

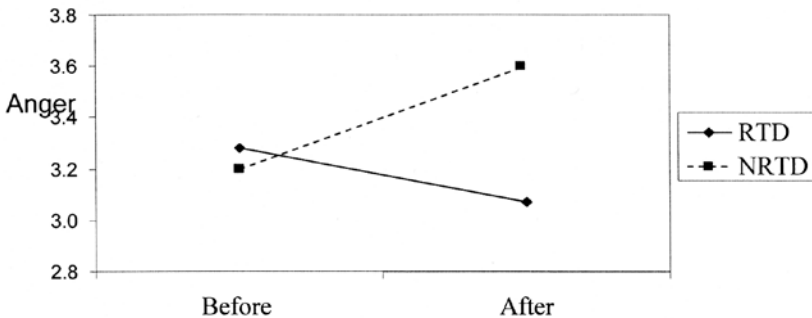


Figure 2 — Interaction between mean anger scores of risk-taking and non-risk-taking groups before and after diving.

A third interaction (see Figure 3) showed that the risk-takers' discouragement scores before ($M = 3.23$, $SD = 0.53$) and after ($M = 3.15$, $SD = 0.44$) the dive were not significantly different, whereas the non-risk takers had lower scores before the dive ($M = 3.19$, $SD = 0.52$) than after the dive ($M = 3.71$, $SD = 1.80$), $F(1129) = 6.69$, $MSE = 0.90$, $p = 0.01$.

The fourth interaction (see Figure 4) indicated that risk-taking divers reported more disgust before diving ($M = 4.41$, $SD = 0.93$) than after diving ($M = 4.07$, $SD = 0.89$), whereas the non-risk-taking divers reported less disgust before diving ($M = 4.41$, $SD = 1.07$) and more disgust after diving ($M = 4.55$, $SD = 1.68$), $F(1129) = 3.69$, $MSE = 1.20$, $p = 0.05$.

The principal changes in the divers' subjective emotional states before and after diving are summarized in Table 4.

Discussion

Results of this study revealed that the emotional experiences of risk taking and non-risk taking divers differed in important ways. Consistent with the first and second hypotheses, risk takers reported higher levels of positive emotion (happi-

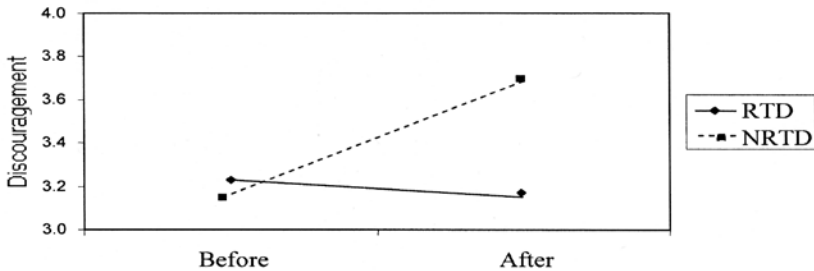


Figure 3 — Interaction between mean discouragement scores of risk-taking and non-risk-taking groups before and after diving.

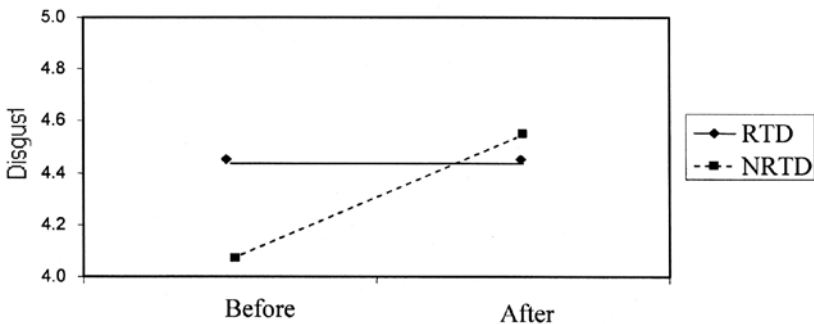


Figure 4 — Interaction between mean discouragement scores of risk-taking and non-risk-taking groups before and after the dive.

ness) and fewer negative emotional states (anger, discouragement, disgust) than non-risk takers, both before and after a dive. In a finding inconsistent with those hypotheses, however, the study also revealed that risk takers reported significantly greater arousal (alertness) prior to diving than did non-risk takers and equivalent arousal to non-risk takers after diving. We had expected that the arousal level of risk takers would be lower than that of non-risk takers both before and after diving.

Results did show, however, that risk-taking and non-risk-taking divers differed more from each other after diving than before diving. Before diving, non-risk takers reported feeling less anger, discouragement, and disgust than they did after diving, while risk-taking participants, in contrast, reported higher levels of negative emotions before diving than after diving. It is possible, therefore, that risk taking involves the joint presence of negative emotional states and high levels of arousal. Such a combination could potentially disrupt the individual's capacity to regulate emotion and behavior effectively, leading to impulsive responses such as greater risk taking. In this case, consideration of the possible consequences of the behavior may no longer be rational and could lead to potentially destructive choices (Leith & Baumeister, 1996).

Also, consistent with the second hypothesis, risk takers reported more happiness (i.e., positive emotions) and less negative emotion after diving than did the non-risk takers. One reason for this pattern may be that risk takers experience negative reinforcement after diving because they have successfully alleviated an aversive prediving state, which involves both high negative emotion and high arousal. For both groups, diving seemed to provide an opportunity for a positive emotional experience, but for risk-taking participants it also offered a decrease in negative emotions. Yet, it did not lead to a state of relaxation (decreased arousal) in either risk takers or non-risk takers.

It is possible that the anticipation of both increased positive emotion and decreased negative emotion that risk takers reported after diving could also contribute to those participants' willingness to engage in risk-taking behaviors (see Boyer, 2006). Indeed, there may be a reciprocal determinism between the emotions and decision-making processes (see Bechara, Damasio, Tranel, & Damasio, 2005; Schwarz, 2000) of the risk-taking divers. On one hand, the decision to engage in a diving risk could heighten the risk taker's negative emotions (e.g., anger, discouragement, disgust) and arousal, while on the other hand, the prospect of alleviating that emotional state could also contribute to the individual's decision to engage in risk. Such a phenomenon would be consistent with other studies showing that the search for positive affect may influence risk-taking behaviors nearly as much as the desire to avoid negative outcomes (Cooper, Wood, Orcutt, & Albino, 2003).

Another finding concerns the significant within-group changes in the emotions experienced. The dive had the greatest impact on the non-risk-taking divers, as they exhibited six emotional state changes, versus only five for the risk-taking divers. The non-risk takers were more surprised, less alert, less attentive, less sensitive, angrier, and more discouraged after the dive than before the dive; their negative emotions and arousal states underwent the greatest changes. The risk takers were happier, more surprised, less alert, less attentive, and less disgusted after the dive than before the dive; their positive emotions and arousal states changed more than their negative emotional states. In keeping with the third hypothesis, risk takers reported feeling happier after diving than before diving, with lower arousal and

negative emotion states after diving. In fact, for emotional arousal, the same types of changes occurred in both groups after the dive (more surprise, less alertness, and less attentiveness). The important differences between the groups pertained to happiness and negative emotional states. Risk takers reported increased positive emotion after diving, whereas non-risk-taking divers reported higher levels of negative emotional states.

Performing a dive does appear to have an emotional effect on divers, and it is therefore possible that diving provides a way for participants to regulate their emotional states. Risky diving, in particular, may afford a means of obtaining pleasure and promoting entry into a “hedonistic loop” (Bonnet, 2003). When the participant fails to regulate his or her emotions, it may influence the decision-making process by supporting risk-taking behaviors (Byrnes, 1998, 2003). This supports the idea that ineffective efforts to regulate emotion may lead to a decision to engage in more risky behavior as a means of achieving a more desirable emotional state. For individuals already in a positive mood, the goal of initiating such behavior may be maintenance of the existing state of well-being (Bonnet et al., 2003).

The results of the current study are in line with models of emotion that see affect as supplying relevant information for use in personal decision-making. Specific emotional states would have a higher adaptive value than generalized ones (such as emotional dispositions), in part because specific, differentiated emotional experiences are easier to analyze (Schwarz, 1996). Thus, the discrete emotions triggered by risk-taking behaviors may serve to attain or maintain a state of well-being, which could later satisfy a self-serving function.

In summary, the current study demonstrated that emotional states play an important and active role in individual behavioral choices while also suggesting that risk-taking behavior performs important emotion-regulation functions. These results highlight the need for additional in vivo studies of emotional regulation processes, particularly with regard to risk-taking behavior as a form of emotion regulation.

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