Who takes risks in high-risk sport? The role of alexithymia

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1   Abstract

2   People who have difficulty identifying and describing their emotions are more likely to seek

3   out the experience of emotions in the high-risk domain. This is because the high-risk domain

4   provides the experience of more easily identifiable emotions (e.g., fear). However, the

5   continued search for intense emotion may lead such individuals to take further risks within

6   this domain, which in turn would lead to a greater likelihood of experiencing accidents.

7   Across three studies, we provide the first evidence in support of this view. In Study 1 ($n =$

8   762) alexithymia was associated with greater risk taking and a greater propensity to

9   experience accidents and close calls. In Study 2 ($n = 332$) and Study 3 ($n = 356$) additional

10   bootstrapped mediation models confirmed these relationships. The predictive role of

11   alexithymia remained significant when controlling for sensation seeking (Study 1) and

12   anhedonia (Study 2 and Study 3). We discuss the practical implications of the present model

13   as they pertain to minimizing accidents and close calls in the high risk domain.

1   Who takes risks in high-risk sport? The role of alexithymia

2   Fear… and the state between survival and death are such strong
3   experiences that we want them again and again. We become addicted.
4   Strangely, we strive to come back safely and being back, we seek to
5   return, once more, to danger. *Reinhold Messner*
6   (Coffey, 2005, p. 7)
7
8   There is currently a lack of consensus regarding a suitable descriptive moniker for

9   sports that include skydiving, rock climbing, and white water kayaking. Indeed, such sports

10   have been labeled as *adventure, alternative, extreme, lifestyle* or *risk-taking* (e.g., Brymer,

11   2010; Castanier, Le Scanff, & Woodman, 2011; Kerr & Houge Mackenzie, 2012; West &

12   Allin, 2010). For the purpose of this research, we choose the term "high-risk sport" which is

13   defined as "all sports where you have to reckon with the possibility of serious injury or death

14   as an inherent part of the activity" (Breivik, 1999, p. 10). Of note is that such activities can be

15   performed in environments where the danger is viewed as relatively sanitized (e.g., Grade 1

16   kayaking) but the sport itself would still be considered high-risk, as the person who

17   progresses within that sport will progress toward greater danger (e.g., more dangerous rivers

18   such as Grade 3 and beyond).

19   Recent research demonstrates that one participatory goal for certain high-risk sport

20   participants, be it conscious or not, is to experience and to enhance a sense of emotion

21   regulation in everyday life (Barlow, Woodman, & Hardy, 2013; Woodman, Cazenave, & Le

22   Scanff, 2008). Emotion regulation is the term used to characterize the diverse processes

23   involved in initiating, maintaining, and modulating the intensity, type, or duration of

24   emotions (Gross & Thompson, 2007; Thompson, 1994). Emotion regulation refers to actions

25   that influence "which emotions we have, when we have them, and how we experience and

26   express them" (Gross, 2002, p. 282). A growing body of research has provided evidence that

27   participation in high-risk sport reflects a means of emotion self-regulation (Barlow et al.,

28   2013; Cazenave, Le Scanff, & Woodman, 2007; Levenson, 1990; Shapiro, Siegel, Scovill, &

1   Hays, 1998; Taylor & Hamilton, 1997; Woodman et al., 2008; Woodman, Hardy, Barlow, &

2   Le Scanff, 2010; Woodman, Huggins, Le Scanff, & Cazenave, 2009).

3   **Risk taking in high-risk sport.** Individual differences exist in how participants

4   approach, control, and modulate the risks that are inherent within the high-risk sport domain

5   (Barlow et al., 2013; Castanier, Le Scanff, & Woodman, 2010b; Taylor, Gould, Hardy, &

6   Woodman, 2006). For example, Woodman et al. (2013) demonstrated that high-risk sport

7   participants might engage in *precautionary behaviors* in order to minimize risk and/or might

8   maximize their exposure to risk via *deliberate risk taking* behaviors (see also Paquette,

9   Lacourse, & Bergeron, 2009). Emotion regulation, a foundation of the present study, appears

10 to be a fruitful framework from which to understand the motives for adopting differing risk

11 taking behaviors (Castanier, Le Scanff, & Woodman, 2010a).

12   **Alexithymia.** A specific emotion regulation difficulty that is of particular theoretical

13 interest in relation to risk taking behaviors is Alexithymia; a stable trait (Luminet, Rokbani,

14 Ogez, & Jadoulle, 2007) that is characterized by difficulties in differentiating one's feelings

15 and expressing them in words (Taylor, Bagby, & Parker, 1999). Alexithymic individuals can

16 appear to lack feelings altogether because of their inability to express their emotions and their

17 difficulty in understanding or realizing their own emotions. Furthermore, alexithymic

18 people's inability to interpret their own emotional signals can often have a profoundly

19 disruptive effect on their personal lives, with poor emotional communication frequently

20 hampering interpersonal relationships (Taylor et al., 1999). For individuals with emotion

21 regulation difficulties, there are broadly two different options: The first is that they might let

22 their emotion regulation difficulties take hold and thus adopt destructive behavior patterns or

23 reach a stage of clinical depression (Pierson, Le Houezec, Fossaert, Dubal, & Jouvent, 1999).

24 For example, high levels of alexithymia are associated with substance abuse and alcohol

25 dependency (e.g., Loas, Otmani, Lecercle, & Jouvent, 2000). The second option is for the

1   alexithymic individual to react by pursuing more adaptive behaviors as a compensatory

2   strategy (Pierson et al., 1999; Taylor & Hamilton, 1997). Indeed, high-risk sport has been

3   shown to be an attractive and effective compensatory strategy for the alexithymic individual

4   (Woodman et al., 2008).

5   The alexithymic individual's difficulty with the experience and interpretation of

6   emotion is such that the source, valence, and intensity of emotions evoked in everyday life

7   may be confusing and unclear (Cisler, Olatunji, Feldner, & Forsyth, 2010). In other words, in

8   everyday life, alexithymic people are unable to identify the specific origin of their emotion,

9   express it, or control it effectively (Woodman et al., 2010). A specific attraction of the high-

10   risk domain is that it enables such individuals to move from experiencing non-specific,

11   ambiguous and internal emotions (e.g., anxiety) to experiencing specific and intense emotions

12   (e.g., fear), which are attached to an objective danger (cf. Castanier et al., 2011; Fenichel,

13   1939; Sadock & Sadock, 2007). Such an emotional experience may be particularly attractive

14   to the alexithymic individual because emotions concerned with externalized relatively

15   objective threats are more readily identifiable and require explicit emotion regulation

16   (Gyurak, Gross, & Etkin, 2011; Koole & Rothermund, 2011). Thus, alexithymic people may

17   experience emotion in the high-risk domain in a way that is perceived as not readily available

18   to them in everyday life (Woodman et al., 2010). For example, Dean Potter[1], whose rock

19   climbing, BASE jumping, and high-lining accomplishments have become some of the most

20   celebrated of their kind in the extreme sports community, stated, "I just want emotions

21   rushing through me that normally aren't there in everyday life . . . the feeling totally

22   overwhelms me… I wish I could find that without risking my life but right now it's the only

23   way I know how to find it" (Potter & Soldinger, 2010).

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[1] We are not suggesting that Dean Potter is an alexithymic individual.

1   **Emotional acclimatization.** The emotional experience of the high-risk domain may

2   be so attractive to the alexithymic individual that the desire to repeat the experience becomes

3   somewhat addictive (cf. Franken, Zijlstra, & Muris, 2006). However, simply repeating the

4   same high-risk activity will, over time, reduce the engendered intensity of the emotional

5   experience of participating (Franken et al., 2006; Pierson et al., 1999) and consequently likely

6   diminish the emotion regulation benefit to the alexithymic individual. Specifically, the

7   emotion regulation benefit is a consequence of experiencing distinct, unambiguous, intense

8   emotion: the type that is perceived as not being readily available in everyday life. If the

9   engendered emotion (of the high-risk domain) becomes normative, and thus by definition

10   does not significantly differ from that experienced in everyday life, the (emotion regulation)

11   benefit will be lost (Solomon, 1980). Such an emotional-acclimatization cycle is similar to

12   that of the pharmacological-acclimatization experienced by the substance abuser. Namely,

13   when frequently administered, the hedonic value of drugs (e.g., cocaine) is decreased as the

14   user's reward set-point shifts in order to maintain physiological homeostasis (Ahmed &

15   Koob, 1998). Thus, to gain a renewed 'high' the drug user must increase the dose of the drug

16   and, as a consequence, increase the associated risk of the drug taking behavior (Franken et

17   al., 2006).

18   **Maintaining emotional intensity.** In order to maintain an ongoing emotion

19   regulation benefit of participation, the alexithymic individual will likely seek out a continued

20   sense of emotional intensity during participation as a means of experiencing the distinct

21   identifiable emotions associated with engagement (e.g., fear). One way that emotional

22   intensity can be influenced is via an individual's specific attitude to risk *within* the high-risk

23   domain. Indeed, attitudes to risk *within* the high-risk domain have been shown to vary

24   considerably (Woodman et al., 2013). Specifically, many high-risk sport participants engage

25   with the express desire to minimize and control the dangers inherent in the high-risk domain

1   by exhibiting *precautionary behaviors* (e.g., Pain & Pain, 2005). Indeed, *mastery* (e.g.,

2   Slanger & Rudestam, 1997), *flow* (e.g., Houge Mackenzie, Hodge, & Boyes, 2011) and a

3   sense of control over the dangers inherent in the high-risk domain (Barlow et al., 2013) may

4   be a central motive for certain high-risk sport participants' engagement with their activity.

5   Conversely, other participants "view risk as desirable rather than a thing to be minimized"

6   (Celsi, Rose, & Leigh, 1993, p. 16). Such individuals appear purposefully to increase their

7   exposure to danger by engaging deliberately in additional risk taking behaviors whilst

8   participating in high-risk sport (e.g., Llewellyn & Sanchez, 2008; Slanger & Rudestam, 1997;

9   Woodman et al., 2013). An example of such behavior is a mountaineer who purposefully

10   ascends a snow gully despite the existence of a less dangerous alternate route and in the

11   knowledge that the chosen snow gully has a known high probability of avalanche.

12   According to the present theoretical framework, high-risk sport participants with

13   alexithymic tendencies will engage in *deliberate risk taking behaviors* and minimize

14   *precautionary behaviors* with the aim of experiencing emotional intensity from their

15   participation. Indeed, *precautionary behaviors* would attenuate the *in situ* experience of

16   intense emotion (Campos, Frankel, & Camras, 2004) and would enable participants to

17   experience less fear during participation (Kerr & Houge Mackenzie, 2014). As the

18   alexithymic high-risk sport participant seeks an emotion regulation experience, he/she will

19   likely deploy only the perceived minimum requisite *precautionary behaviors* for participation

20   (cf. Barlow et al., 2013). Minimizing precautionary behaviors and increasing deliberate risk

21   taking behaviors serve to increase both the unpredictability and potential for physical harm

22   that is inherent within the activity (Merrick et al., 2004; Pickett et al., 2006; Turner, McClure,

23   & Pirozzo, 2004); the likelihood for accidents and close calls is thus increased (see Woodman

24   et al., 2013).

1   **Hypothesis.** Given the strong theoretical link between alexithymia and risk taking,

2   and the established relationship between risk taking and accidents/close calls, we hypothesize

3   that *alexithymia* will predict risk taking behaviors (both *deliberate risk taking*, positively –

4   and *precautionary behaviors*, negatively), which in turn will lead to a greater propensity to

5   experience accidents and close calls in the high-risk domain. Thus, the relationship between

6   alexithymia and accidents will be mediated by *risk taking behaviors* (see Figure 1).

7   **Study 1**

8   **Measuring accidents and close calls.** Woodman et al. (2013) argued that the

9   measurement of risk taking outcomes should not be limited to the measure of accidents.

10   Specifically, individuals who deliberately expose themselves to danger may repeatedly

11   experience life-threatening "close calls" yet largely avoid accidents and injury. Woodman et

12   al. (2013) defined close calls as, "incidents that come very close to resulting in a negative

13   outcome but that fail to materialize into a negative outcome" (p. 480). As such, close calls are

14   largely the same as an accident except for the outcome. For example, a sizeable rock that falls

15   from above a mountaineer and hits him/her would be considered an accident. Conversely, a

16   sizeable rock that falls from above a mountaineer and narrowly misses him/her would be

17   considered a close call. It can be argued that close calls (compared to accidents) are a

18   somewhat more refined measure of the potential outcome of risk taking behaviors, as they

19   account for other – more private – aspects of engagement. Specifically, the typical nature of a

20   close call in the high risk domain is such that the participant is aware of its occurrence in a

21   way that any informant or observer might not be. For example, even on a dangerous climb

22   where a fall could be terminal, a rock climber can come very close to falling off – due to

23   finger slipping off a crucial hold or being slightly off balance – without anyone (i.e.,

24   including his/her immediate climbing partner and especially an observer) being aware that an

25   accident almost occurred. However, there is currently no measure of accidents and close calls

1   in the sport literature and *observing* accidents, and especially close calls, in the high-risk

2   domain has practical limitations.

3   Consequently, to date, researchers have measured participants' accidents and close

4   calls via recall of, for example, the mean number of annual accidents resulting in acute

5   injuries (Woodman et al., 2013). However, such a measure is not without its limitations (van

6   Mechelen, Hlobil, & Kemper, 1992), especially since injury and accident recall is not always

7   very accurate, even over a 12-month period (Gabbe, Finch, Bennell, & Wajswelner, 2003).

8   As such, we sought to develop a self-report measure of accidents and close calls in the high-

9   risk sport domain. Although we acknowledge that self-report shares similar limitations to the

10   recall methodology (Paulhus & Vazire, 2007) it was deemed advantageous for this line of

11   research since it provides phenomenological data and can be administered conveniently to a

12   large sample. Thus, one of the first aims of the present study is to propose and develop a self-

13   report measure the Accidents and Close Calls in Sport Inventory (ACCSI).

14   **Sensation Seeking.** The main aim of Study 1 was to test the hypothesized mediation

15   model presented in Figure 1. Additionally, we sought to ensure that the mediation model

16   could not be discounted on the grounds of a sensation seeking explanation. This is because

17   one could argue that risk taking behaviors might be triggered by the express aim of attaining

18   "sensation rewards" during participation (Zuckerman, 2007, p. 13). That is, so called

19   sensation seekers may forgo certain precautionary behaviors, and engage in deliberate risk

20   taking behaviors, in an effort to maximize thrilling sensations while participating (see Barlow

21   et al., 2013). Given that sensation seeking has been shown to be a significant predictor of *risk*

22   *taking* and *injuries* (Kern et al., 2014), sensation seeking propensity provides a potential

23   source of confound in the present study. As such, it was deemed necessary to control for

24   variations in sensation seeking within the present mediation models.

25   **Method**

1   **Participants.** The original sample comprised 762 traditional rock climbers aged 18 or

2   above. Traditional climbing refers to outdoor roped climbing where the lead climber utilizes

3   self-placed protection in the rock to arrest any potential fall. A lack of high-risk sport

4   experience and skill is associated with a decreased awareness of uncontrollable dangers and a

5   decreased accuracy in differentiating risky behaviors (Celsi et al., 1993). Indeed,

6   inexperienced participants are more likely to engage in deliberate risk taking behaviors

7   (Ogilvie, 1974) leading to accidents and close calls (cf. Kontos, 2004). Thus, we excluded

8   participants who reported that they were a 'beginner' or who had fewer than three years'

9   traditional rock climbing experience ($n = 49$). Recruitment advertisements, placed on

10   international rock climbing forums (e.g., ukclimbing.co.uk, rockclimbing.com, 8a.nu), led

11   participants to a webpage providing details of the university's ethical approval, a

12   confidentiality agreement, and a notification that proceeding to the next page was an

13   expression of informed consent to participate. Once data screening procedures had been

14   applied to identify spurious data (e.g., block-answering) the final sample comprised 690

15   individuals (598 men, 92 women; $M_{age} = 32.05$, $SD = 11.85$). Demographic data revealed a

16   sample that was largely experienced ($M_{years' participation} = 11.06$, $SD = 7.66$), competent

17   ($M_{technical climbing ability} = HVS^2$), and participated frequently (frequency of participation: $\geq$

18   weekly, $n = 510$; $\geq$ twice monthly, $n = 106$; $\geq$ monthly, $n = 38$; $\geq$ every 2 months, $n = 21$; $\geq$

19   twice annually, $n = 11$; $\leq$ annually, $n = 4$).

20   **Measures.**

21   ***Toronto Alexithymia Scale (TAS-20).*** The TAS-20 (Bagby, Parker, & Taylor, 1994)

22   comprises 20 items that assess three aspects of the alexithymia construct: *Difficulty*

23   *identifying feelings* (e.g., I am often confused about what emotion I am feeling); *Difficulty*

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[2] The British adjectival grading system for climbing was used. HVS is an abbreviation for 'Hard Very Severe' and represents an advanced level of technical ability.

1   *describing feelings* (e.g., It is difficult for me to find the right words for my feelings);

2   *Externally oriented thoughts* (e.g., I prefer to analyze my problems rather than just describe

3   them). Items are rated on a five-point Likert scale ranging from 1 (*Strongly disagree*) to 5

4   (*Strongly agree*). The three subscales are combined to produce a *total alexithymia score* (high

5   scores equate to high alexithymia). Parker, Taylor & Bagby (2003) reported internal

6   reliability coefficients ranging from 0.73 to 0.84 for the total score and a sample norm mean

7   of 45.57 (*SD* = 11.35). All reliability scores from the present study are presented in Table 2.

8   **The Risk Taking Inventory (RTI).** The RTI (Woodman et al., 2013) measures risk

9   taking behaviors in high-risk sport and comprises seven items across two orthogonal factors:

10   *deliberate risk taking* (e.g., I deliberately put myself in danger) and *precautionary behaviors*

11   (e.g., I take time to check for potential hazards), measured on a five-point Likert scale

12   ranging from 1 (*Never*) to 5 (*Always*). Woodman et al. (2013) reported composite reliability

13   scores from 0.64 to 0.78 for *deliberate risk taking* and 0.64 to 0.71 for *precautionary*

14   *behaviors*.

15   **Accidents and Close Calls in Sport Inventory (ACCSI).** The ACCSI was specifically

16   developed for the present study (see Table 1). The initial measure comprised two proposed

17   four-item factors: *accidents* (e.g. "My decisions in this activity lead to accidents") and *close*

18   *calls* (e.g. "I experience close calls when participating in my sport") in the high-risk sport

19   domain, measured using a seven-point Likert scale from 1 (*Never*) to 7 (*Always*).

20   **Brief Sensation Seeking Scale (BSSS).** The BSSS (Hoyle, Stephenson, Palmgreen,

21   Pugzles, & Donohew, 2002) is a brief version of Zuckerman's (1979) Sensation Seeking

22   Scale measuring four dimensions of sensation seeking on a five-point Likert scale ranging

23   from 1 (*Strongly disagree*) to 5 (*Strongly agree*). The four dimensions, each comprising two

24   items, are: *Experience Seeking* (e.g., I would like to explore strange places); *Boredom*

25   *Susceptibility* (e.g., I get restless when I spend too much time at home); *Disinhibition* (e.g., I

1   like wild parties); *Thrill and Adventure Seeking* (e.g., I like to do frightening things). These

2   four dimensions are combined to provide a *total sensation seeking score*. The internal

3   reliability coefficients range from 0.74 to 0.76 for the total score (Hoyle et al., 2002).

4   **Procedure.** Participants completed the survey online after recruitment adverts had led

5   them to a webpage providing details of the research, a confidentiality agreement, and a

6   notification that proceeding to the next webpage was an expression of informed consent to

7   participate. If participants chose to continue, they completed demographic data followed by

8   the TAS-20, RTI, ACCSI, and BSSS. The whole procedure took approximately 20 minutes.

9   **Results**

10   **Development of the Accidents and Close Calls in Sport Inventory.** The Accidents

11 and Close Calls in Sport Inventory (ACCSI) data were analyzed using confirmatory factor

12 analysis (CFA) partially in an exploratory fashion. Continuous variable CFA methods were

13 deemed appropriate since the ordered-categorical data comprised seven categories

14 (Rhemtulla, Brosseau-Liard, & Savalei, 2012). Prelis (Jöreskog & Sörbom, 2006) was used to

15 generate a covariance matrix and Lisrel 8.8 (Jöreskog & Sörbom, 2006) was used to test the

16 models. A model was considered a good fit to the data if the Comparative Fit Index (CFI,

17 Bentler, 1990) and the Non-Normed Fit Index (NNFI, Tucker & Lewis, 1973) were greater

18 than or equal to .95; the Root Mean Square Error of Approximation (RMSEA, Bentler, 1990)

19 was less than or equal to .06; the Standardized Root Mean Square Residual (SRMR, Bentler,

20 1990) was less than or equal to .08; and the Satorra–Bentler (S-B) χ^2/df ratio was less than

21 2.00.

22   Initially, the proposed two-factor eight-item model was examined in order to ensure

23 each item was a good indicator of the underlying latent variable (Jöreskog, 1993). The data fit

24 the model adequately (*S-B* χ^2 *(19)* = 150.94; CFI = .97; NNFI = .95; RMSEA = .12; SRMR =

25 .048; χ^2/df = 7.94). However, examination of standardized residuals, factor loadings, and

1   modification indices for Theta-delta revealed two items as problem residuals. Both items

2   were a poor indicator of the underlying factor and were removed (Jöreskog, 1993), which

3   reduced the number of items from four to three for both subscales. This removal significantly

4   improved the fit of the model to the data, and testing the two-factor six-item full-model

5   revealed a good fit (see Table 1) and acceptable alpha reliability levels (see Table 2). As the

6   factor–factor correlation was moderately high (.72), we conducted a Satorra and Bentler

7   (2001) scaled difference χ^2 test (S-B χ^2_{diff}) on the two-factor model and a respecified single-

8   factor model. This test supported the discriminant validity of *accidents* and *close calls* factors

9   (S-B $\chi^2_{\text{diff}}(1) = 94.26$, $p < .001$).

10   **Preliminary analysis.** It is well established that risk taking propensity is greater in

11   men compared to women (Byrnes, Miller, & Schafer, 1999). In the present study, no

12   significant difference between men and woman was evidenced for *precautionary behaviors*

13   ($t_{688} = 1.23$; $p = .11$). However, independent samples *t* test revealed that men scored

14   significantly higher than women on *deliberate risk taking* ($t_{688} = 4.43$; $p < .001$), *close calls*

15   ($t_{688} = 3.08$; $p < .01$), *sensation seeking* ($t_{688} = 3.80$; $p < .001$) and *alexithymia* ($t_{688} = 2.43$; $p <$

16   .01), and the *accidents* difference approached significance ($t_{688} = 1.56$; $p = .06$).

17   Consequently, all variables in this study, and the subsequent studies reported in this

18   manuscript, were standardized within sexes before further analysis.

19   **Mediation models.** All mediation analyses were conducted using an SPSS macro

20   designed and developed by Hayes (2013) using 5,000 bootstrap samples. A mediation effect

21   was deemed significant if the upper and lower 95% Confidence Interval limits of the size of

22   the indirect path did not include zero. In line with recommendations by Preacher and Kelley

23   (2011) two different effect sizes are reported: the unstandardized indirect effect (*ab*) and the

24   kappa-squared (κ^2) effect. The advantages of κ^2, detailed in Preacher and Kelley (2011), are

25   that it is standardized, insensitive to sample size, and on an interpretable metric (0 to 1).

1   As hypothesized, *alexithymia* significantly predicted *deliberate risk taking* (*a* path),

2   *accidents* (*c'* path), and *close calls* (*c'* path). Additionally, *deliberate risk taking* significantly

3   predicted *accidents* (*b* path) and *close calls* (*b* path; see Table 3). As hypothesized, *deliberate*

4   *risk taking* significantly mediated the relationship between *alexithymia* and both *accidents*

5   and *close calls*, generating small to medium κ^2 effect sizes. The models explained 10.6% and

6   27.9% of the variance in *accidents* and *close calls*, respectively. Although the κ^2 analyses

7   provided some evidence for mediation, *precautionary behaviors* largely did not significantly

8   mediate the relationship between *alexithymia* and either *accidents* or *close calls* (see Table 3).

9   **Sensation seeking.** *Sensation seeking* was negatively correlated with *precautionary*

10   *behaviors* and positively correlated with *deliberate risk taking*, *accidents*, *close calls*, and

11   *alexithymia* (see Table 2). However, when *sensation seeking* was entered into the mediation

12   model as a covariate, *deliberate risk taking* continued to significantly mediate the relationship

13   between *alexithymia* and both *accidents* (*b* = .020; CI = .004-.042) and *close calls* (*b* = .037;

14   CI = .005-.071).

15   **Age.** *Age* was significantly positively correlated with *precautionary behaviors* and

16   significantly negatively correlated with *deliberate risk taking*, *close calls*, *alexithymia*, and

17   *sensation seeking* (see Table 2). However, when age was entered into the mediation model as

18   a covariate, *deliberate risk taking* continued to mediate significantly the relationship between

19   *alexithymia* and both *accidents* (*b* = .036; CI = .014-.063) and *close calls* (*b* = .060; CI =

20   .023-.099).

21   **Discussion**

22   The primary aim of Study 1 was to test the hypothesis that alexithymia would be

23   associated with greater risk taking, which in turn would result in a greater propensity to

24   experience accidents and close calls. Study 1 provided strong evidence for the mediating role

25   of deliberate risk taking in the relationship between alexithymia and accidents and close calls.

1   Furthermore, the role of alexithymia could not be explained by sensation seeking. The role of

2   precautionary behaviors was somewhat less clear. Certainly, the findings from Study 1

3   warrant replication for two principal reasons: First, there was some incongruence between the

4   unstandardized effect and the kappa-squared (κ^2) effects for precautionary behaviors with

5   some analyses revealing a mediation effect and others revealing no such effect (see Table 3),

6   which requires clarification. Second, the results of Study 1 warrant extending to populations

7   beyond rock climbers to participants of other high-risk sports. This extension is for the

8   purposes of generalizability but also because the exclusive participation of rock climbers may

9   have contributed to the mixed precautionary behaviors findings. Indeed, there is an element

10   of precautionary behavior that is considered an integral part of rock climbing (e.g., checking

11   one's harness is correctly secured prior to climbing). Thus, the aim of Study 2 was to re-

12   examine the alexithymia and accidents/close calls relationship with a sample drawn from a

13   variety of high-risk sports. We hypothesized that risk taking (deliberate risk taking and

14   precautionary behaviors) would mediate this relationship.

15   We also sought to explore an alternative explanation for the role of alexithymia in risk

16   taking by including anhedonia as a covariate in the mediation model. Anhedonia is the loss of

17   self-reported pleasure and individuals high in anhedonia only feel pleasure in the most

18   intense of hedonic environments (Volkow, Fowler, & Wang, 2003). Participants of some

19   high-risk sports such as skydiving have been shown to demonstrate elevated anhedonia

20   (Pierson et al., 1999). For such individuals, the experience of chronic under-arousal in

21   everyday life may motivate them to seek sources of intense stimulation with a view to

22   increase their arousal to a hedonic point (Eysenck & Eysenck, 1978). Purposefully seeking

23   out intense hedonic sensations may be understood as a compensatory strategy for the

24   anhedonic individual's basal arousal deficit (Carton, Jouvent, Bungener, & Widlöcher, 1992).

25   In line with the sensation seeking argument presented in Study 1, anhedonic individuals may

1   forgo certain precautionary behaviors, and may engage in further purposeful risk taking

2   behaviors, in an effort to maximize hedonic sensations while participating (see Franken et al.,

3   2006). Since these risk taking behaviors would likely also lead to an increased incidence of

4   both accidents and close calls, anhedonia provides a potential source of confound in the

5   previous analyses. Although they are conceptually distinct, anhedonia and alexithymia have a

6   degree of commonality insomuch as they reflect a state of emotion dysregulation (Loas,

7   Fremaux, & Boyer, 1997). Given the strong theoretical link between anhedonia and

8   alexithymia and between anhedonia and risk-taking, we aimed to test whether the alexithymia

9   – risk-taking relationship would hold when controlling for anhedonia in the present mediation

10   model.

11   **Study 2**

12   **Method**

13   **Participants.** The sample comprised 332 new participants. Checking the email

14   addresses of all participants across all three studies revealed that participants across the three

15   studies participated in one study and in one study only. In the present study participants

16   engaged in a variety of high-risk sports (e.g., downhill mountain biking, rock climbing, sky

17   diving, white water kayaking) and were recruited via internet advertisements placed on

18   international sporting forums (e.g., dropzone.com, newschoolers.com). The inclusion criteria

19   (i.e., minimum of 18 years of age, a minimum of 3 years' participation in the individual's

20   main high-risk sport and not self-classified as a beginner) mirrored those of Study 1. Data

21   screening, as used in Study 1, removed five participants. The final sample comprised 327

22   individuals (292 men, 35 women; $M_{age} = 35.43$, $SD = 12.92$). Demographic data revealed that

23   participants were largely experienced ($M_{years'\ participation} = 15.74$, $SD = 11.22$), competent

24   (intermediate, $n = 49$; advanced, $n = 166$; expert, $n = 112$) and regularly engaged in their

1   chosen high-risk sport (frequency of participation: ≥ weekly, n = 183; ≥ twice monthly, n =

2   84; ≥ monthly, n = 39; ≥ every 2 months, n = 13; ≥ twice annually, n = 7; ≤ annually, n = 1).

3   **Measures.** We administered the RTI, TAS-20, and ACCSI, as in Study 1.

4   ***Snaith-Hamilton Anhedonia Pleasure Scale (SHAPS).*** The SHAPS (Snaith et al.,

5   1995) was produced to assess an individual's hedonic capacity using 14 items concerning a

6   variety of subjects: hobbies, family, appearance and food/drink (e.g., *"I would find pleasure*

7   *in my hobbies and past times"*). Responses were scored on a four-point Likert scale from 1

8   (*Strongly agree*) to 4 (*Strongly disagree*) with high scores representing high levels of

9   anhedonia. Nakonezny, Carmody, Morris, Kurian, and Trivedi (2010) reported an alpha

10   reliability coefficient of 0.91.

11   **Procedure.** The online presentation of the inventories mimicked that of Study 1, with

12   the additional inclusion of the SHAPS, and took approximately 25 minutes to complete.

13   **Results**

14   **ACCSI model fit.** An adequate fit for the two-factor, six-item ACCSI model was

15   confirmed (see Table 1). The factor–factor correlation was .87. Satorra–Bentler scaled

16   difference χ^2 test again supported the discriminant validity of the two factors (S-B $\chi^2_{diff}(1)$ =

17   10.90, $p < .001$).

18   **Mediation models.** As hypothesized, and confirming the findings from Study 1,

19   *deliberate risk taking* significantly mediated the relationship between *alexithymia* and both

20   *accidents* and *close calls* (see Table 3), generating small to medium κ^2 effect sizes. The

21   models explained 18.0% and 26.4% of the variance in accidents and close calls, respectively.

22   As expected, *alexithymia* significantly positively predicted *deliberate risk taking* (*a* path),

23   *accidents* (*c'* path), and *close calls* (*c'* path). Additionally, *deliberate risk taking* significantly

24   positively predicted *accidents* (*b* path) and *close calls* (*b* path; see Table 3)*.*

1   As hypothesized, and clarifying the ambiguous finding in Study 1, *precautionary*

2   *behaviors* significantly mediated the relationship between *alexithymia* and both *accidents* and

3   *close calls* although the generated κ^2 effect sizes were small. The models explained 8.9% and

4   8.8% of the variance in *accidents* and *close calls*, respectively. As expected, *alexithymia*

5   significantly negatively predicted *precautionary behaviors* (*a* path), and positively predicted

6   *accidents* (*c'* path), and *close calls* (*c'* path). Additionally, *precautionary behaviors*

7   significantly negatively predicted *accidents* (*b* path) and *close calls* (*b* path; see Table 3).

8   **Anhedonia.** Anhedonia significantly positively correlated with *alexithymia* and

9   significantly negatively correlated with *precautionary behaviors*. Anhedonia was not

10   significantly correlated with either *deliberate risk taking*, *accidents*, or *close calls* (see Table

11   2). When *anhedonia* was entered into the mediation model as a covariate, *deliberate risk*

12   *taking* continued to significantly mediate the relationship between *alexithymia* and both

13   *accidents* (*b* = .081, CI = .038-.140) and *close calls* (*b* = .103, CI = .049-.168). Additionally,

14   *precautionary behaviors* continued to significantly mediate the relationship between

15   *alexithymia* and both *accidents* (*b* = .025; CI = .002-.072) and *close calls* (*b* = .023; CI =

16   .003-.060).

17   **Discussion**

18   As hypothesized, both deliberate risk taking and precautionary behaviors emerged as

19   significant mediators in the relationship between alexithymia and accidents/close calls.

20   Clarifying the results from Study 1, this mediation effect was consistent across the

21   unstandardized and kappa-squared effects. Anhedonia did not significantly reduce the

22   mediating effect of either deliberate risk taking or precautionary behaviors in the relationship

23   between alexithymia and accidents/close calls. Given the degree of ambiguity of the results in

24   Study 1 and the clarity of the results in Study 2, the aim of Study 3 is to confirm the

25   alexithymia – risk taking – accidents/close calls model.

1   **Study 3**

2   **Method**

3   **Participants.** The sample comprised 356 new participants. As in Study 2, participants

4   engaged in a variety of high-risk sports (e.g., hang gliding, mountaineering, surfing) and were

5   recruited using internet adverts on major international sporting fora. Data screening, as used

6   in Study 1 and Study 2, removed 15 participants. The final sample comprised 341 individuals

7   (271 men, 70 women; $M_{age} = 37.10$, $SD = 14.20$; $M_{years' participation} = 12.70$, $SD = 11.90$).

8   Demographic data revealed that participants' experience, ability, and frequency of

9   participation in their chosen sport, closely resembled those revealed in Study 2.

10   **Measures and procedures.** The procedure was the same as in Study 2.

11   **Results**

12   **ACCSI model fit.** A good fit for the two-factor, six-item ACCSI model was further

13   confirmed (see Table 1). The factor–factor correlation was .85. Satorra–Bentler scaled

14   difference χ^2 test again supported the discriminant validity of the two factors (S-B $\chi^2_{diff}(1) =$

15   32.55, $p < .001$).

16   **Mediation models.** *Deliberate risk taking* significantly mediated the relationship

17   between *alexithymia* and both *accidents* and *close calls* (see Table 3), generating medium κ^2

18   effect sizes. The models explained 32.4% and 45.0% of the variance in accidents and close

19   calls, respectively. As expected, *alexithymia* significantly positively predicted *deliberate risk*

20   *taking* (*a* path), *accidents* (*c'* path), and *close calls* (*c'* path). Additionally, *deliberate risk*

21   *taking* significantly positively predicted *accidents* (*b* path) and *close calls* (*b* path; see Table

22   3).

23   Confirming the finding in Study 2, and in line with the hypothesis, *precautionary*

24   *behaviors* significantly mediated the relationship between *alexithymia* and both *accidents* and

25   *close calls*, generating small κ^2 effect sizes. The models explained 16.5% and 20.3% of the

1   variance in *accidents* and *close calls*, respectively. As expected, *alexithymia* significantly

2   negatively predicted *precautionary behaviors* (*a* path), and positively predicted *accidents* (*c'*

3   path), and *close calls* (*c'* path). Additionally, *precautionary behaviors* significantly

4   negatively predicted *accidents* (*b* path) and *close calls* (*b* path; see Table 3)*.*

5   **Anhedonia.** As in Study 2, *anhedonia* was significantly negatively correlated with

6   *precautionary behaviors* and significantly positively correlated with *alexithymia*. Again, no

7   significant correlation was revealed for either *deliberate risk taking* or *close calls* although, in

8   the present study, *anhedonia* was significantly correlated with *accidents* (see Table 2).

9   Confirming the Study 2 finding, when *anhedonia* was entered into the mediation model as a

10   covariate, *deliberate risk taking* continued to mediate significantly the relationship between

11   *alexithymia* and both *accidents* ($b = .159$, CI = .010-.231) and *close calls* ($b = .189$, CI =

12   .124-.293). Additionally, *precautionary behaviors* continued to mediate significantly the

13   relationship between *alexithymia* and both *accidents* ($b = .080$; CI = .036-.153) and *close*

14   *calls* ($b = .084$; CI = .041-.144).

15   **Discussion**

16   As in Study 2 both deliberate risk taking and precautionary behaviors emerged as

17   significant mediators of the relationship between alexithymia and accidents/close calls.

18   Additionally, the models could not be explained by anhedonia.

19   **General Discussion**

20   The aim of the present studies was to test the relationship between alexithymia, risk

21   taking, and accidents and close calls. Results consistently revealed that both deliberate risk

22   taking and precautionary behaviors mediated the alexithymia – accidents/close calls

23   relationship. Furthermore, we developed a two-factor measure of accidents and close calls in

24   sport, which consistently fit the data well and evidenced preliminary concurrent validity.

1   Unlike merely observing correlations between variables, the present mediation

2   analyses enable tentative causal inferences to be made (Preacher & Hayes, 2008).

3   Specifically, one could argue that the present results provide support for alexithymia causally

4   influencing risk taking behaviors, which in turn lead to the incidence of accidents and close

5   calls. The direction of this sequential pathway is made all the more likely by the nature of the

6   independent variable because alexithymia is widely considered a stable personality trait (e.g.,

7   Bagby et al., 1994; Luminet et al., 2007). However, more research is required before this

8   theoretically derived sequential position can be validated, as even stable personality traits are

9   not set in stone (Roberts, Walton, & Viechtbauer, 2006). Although a definitive conclusion

10   regarding causation would be premature, the alternative explanations are theoretically more

11   tenuous. Specifically, it is difficult to contend theoretically that risk taking, or indeed the

12   experience of accidents within a high-risk domain, would lead to elevated alexithymia.

13   Furthermore, it would be equally contentious to argue theoretically that the experience of

14   accidents in the high-risk domain might result in an increase in risk taking behaviors. Rather,

15   one would more easily argue for the opposite effect, as the experience of an accident would

16   likely decrease, not increase, the propensity to take risks (regardless of alexithymia). Despite

17   the strength of the theoretical position regarding the sequence of the mediation model, there

18   remains a need for further research to confirm (or otherwise) that position.

19   As discussed previously, it could be argued that it is either sensation seeking or

20   anhedonia that lead to greater risk taking behaviors in the high-risk domain. Indeed, both

21   sensation seeking (Study 1) and anhedonia (Study 2 and Study 3) are associated with

22   decreased precautionary behaviors, and sensation seeking is associated with increased

23   deliberate risk taking. However, the present analyses suggest that such an argument would be

24   ill-founded, as it was indeed alexithymia that consistently emerged a significant predictor of

25   risk taking behaviors when controlling for both sensation seeking and anhedonia. That being

1   said, future research would do well to explore additional variables that may significantly

2   contribute to the present mediation model (e.g., escape from self-awareness; Castanier et al.,

3   2011; Taylor & Hamilton, 1997).

4   Across the three studies, both the deliberate risk taking and precautionary behavior

5   mediation models demonstrated small to medium effect sizes with both accidents and close

6   calls. We prefer to avoid an inflexible interpretation of effect size based solely on arbitrary

7   benchmarks (cf. Preacher & Kelley, 2011) and rather prefer to emphasize that the relatively

8   modest effect sizes may have substantive practical importance. Specifically, in the context of

9   dangerous environments, people will die if they enter the high-risk sport domain and

10   completely fail to display any precautionary behaviors whilst simultaneously maximizing

11   deliberate risk taking behaviors. In other words, it can be argued here that small effect sizes

12   could have very meaningful real-life connotations.

13   The clear relationship between alexithymia and accidents/close calls has considerable

14   practical implications with regard to accident and injury prevention, which is a growing area

15   of research given the escalation of litigation costs associated with injuries (Hébert-Losier &

16   Holmberg, 2013). Indeed, the use of alexithymia as a construct to predict risk taking

17   behaviors could be useful in the identification of potentially dangerous participants -

18   dangerous to themselves, to other participants, or both. It is indeed likely that most instructors

19   and group leaders would welcome any such information when preparing participants for their

20   activity. However, further research is required to establish if the alexithymia – risk-taking

21   relationship might be extended beyond the population of experienced, competent, and adult

22   high-risk sport participants studied in the present study. As the high-risk sport participants'

23   group-mean levels of alexithymia were comparable to those of Parker et al.'s (2003) sample

24   norms, it would be worth testing whether the present model could be extended to other risk-

1 taking domains within sport and exercise (e.g., drug taking, overtraining) or indeed to risk

2 taking environments beyond sport (e.g., industrial and financial risks, crime).

3   The present theoretical framework suggests that the alexithymic individual actively

4 seeks out intense emotion, such as fear, via the high-risk domain. Of course, individuals may

5 actively initiate, experience, and subsequently control intense emotion such as fear (Fenichel,

6 1939; Woodman et al., 2010) such that fear is not actively experienced to any great degree

7 during the activity. Indeed, research suggests that certain high-risk sport participants perceive

8 they can control their fear in the high-risk domain (Barlow et al., 2013; Celsi et al., 1993);

9 even experiencing a perceived temporary "freedom from fear" (Lester, 2004, p. 91). This is

10 evidenced by Laberge[3] (1993), a specialist solo[4] rock climber, who said, "While climbing

11 solo, you experience moments of intense stress and you manage to dominate them" (p. 33).

12   Previous research (e.g., Barlow et al., 2013; Woodman et al., 2010) has proposed that

13 participation in high-risk sport may offer an adaptive form of compensation for individuals

14 with emotional difficulties. That is, such participation might be deemed emotionally adaptive

15 compared to relatively destructive behavioral patterns such as substance abuse (Pierson et al.,

16 1999). However, the present findings suggest that such a dichotomous adaptive-maladaptive

17 categorization may be somewhat simplistic. Indeed, the data consistently revealed that

18 alexithymia leads to a greater vulnerability to *maladaptive* outcomes – accidents – in what

19 has previously been considered an *adaptive* activity. Any adaptive outcome may be

20 experienced in the form of an emotion regulation benefit transferred from the high-risk

21 domain back into everyday life (Barlow et al., 2013). Specifically, the perceived ability to

22 deal effectively with the intense emotions in the high-risk domain (e.g., fear) may provide the

23 alexithymic individual with an enhanced, albeit temporary, sense of emotion regulation in

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[3] We are not suggesting that Laberge is an alexithymic individual.
[4] Rock climbing without the protection of a rope.

1   everyday life following the activity (Barlow et al., 2013; Woodman et al., 2009). Any such

2   benefits are of course likely enjoyed only to the extent that the person survives any

3   misdemeanors in the high-risk domain. In the specific context of the high-risk domain,

4   particularly for those with emotional difficulties, Nietzsche (1889/1998) was very probably

5   quite correct: "whatever does not kill me makes me stronger" (p. 58).

6   It could be argued that a limitation of the present studies is the self-report nature of

7   the ACCSI. That is, participants' responses may have suffered from biases, such as a self-

8   deception bias or an impression management bias (Gravetter & Forzano, 2012). Previous

9   research suggests that such inherent weaknesses of self-report methods may be somewhat

10   attenuated in the present sample. Specifically, high-risk sport participants do not significantly

11   differ from controls regarding impression management (Barlow et al., 2013) and their self-

12   report responses, pertaining to their own risk taking behaviors, significantly correlate with the

13   same self-report measures from an informant (Woodman et al., 2013). Furthermore, that the

14   ACCSI consistently showed good model-fit across three studies considerably mitigates this

15   limitation. We argue that a primary advantage of employing a self-report inventory is that

16   each individual – even an individual with emotional regulation difficulties – is in a unique

17   position of self-knowledge and self-awareness (Gravetter & Forzano, 2012). An alternative

18   method would have been to ask participants to recall their accidents and close calls in a

19   retrospective design. However, such methods are also reliant on self-report and are not

20   always very accurate even over a 12-month period (Gabbe et al., 2003). Thus, recording

21   accidents and close calls in a prospective design, with the use of diary data for example,

22   would somewhat mitigate this limitation and is therefore an important direction for future

23   research.

24   In summary, the present set of studies demonstrates that alexithymia leads to a

25   propensity to adopt greater risk taking behaviors, which in turn increases the likelihood of an

1   accident or a close call in the high-risk domain. The alexithymic individual may deem the

2   risk of physical harm as an acceptable – or indeed necessary – evil to derive the emotion

3   regulation benefit that is craved in the high-risk domain, and we urge researchers to consider

4   more fully and widely the emotion regulation motives that might be associated with risk

5   taking in sport and exercise environments more globally.

1   References

2   Ahmed, S. H., & Koob, G. F. (1998). Transition from moderate to excessive drug intake:

3   Change in hedonic set point. *Science*, *282*, 298–300.

4   Bagby, R. M., Parker, J. D., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia

5   Scale-I. Item selection and cross-validation of the factor structure. *Journal of*

6   *Psychosomatic Research*, *38*, 23–32.

7   Barlow, M., Woodman, T., & Hardy, L. (2013). Great expectations: Different high-risk

8   activities satisfy different motives. *Journal of Personality & Social Psychology*, *105*,

9   458–475. doi:10.1037/a0033542

10   Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*,

11   *107*, 238–246.

12   Breivik, G. (1999). *Empirical studies of risk sport*. Oslo: Norges idrettshøgskole, Institutt for

13   samfunnsfag.

14   Brymer, E. (2010). Risk taking in extreme sports: A phenomenological perspective. *Annals of*

15   *Leisure Research*, *13*, 218–239.

16   Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A

17   meta-analysis. *Psychological Bulletin*, *125*, 367–383. doi:10.1037//0033-2909.125.3.367

18   Campos, J. J., Frankel, C. B., & Camras, L. (2004). On the nature of emotion regulation.

19   *Child Development*, *75*, 377–394. doi:10.1111/j.1467-8624.2004.00681.x

20   Carton, S., Jouvent, R., Bungener, C., & Widlöcher, D. (1992). Sensation seeking and

21   depressive mood. *Personality and Individual Differences*, *13*, 843–849.

22   doi:10.1016/0191-8869(92)90059-X

23   Castanier, C., Le Scanff, C., & Woodman, T. (2010a). Beyond sensation seeking: Affect

24   regulation as a framework for predicting risk-taking behaviors in high-risk sport.

25   *Journal of Sport & Exercise Psychology*, *32*, 731–738.

Castanier, C., Le Scanff, C., & Woodman, T. (2010b). Who takes risks in high-risk sports? A typological personality approach. *Research Quarterly for Exercise and Sport*, *81*, 478–484.

Castanier, C., Le Scanff, C., & Woodman, T. (2011). Mountaineering as affect regulation: The moderating role of self-regulation strategies. *Anxiety, Stress, and Coping*, *24*, 75–89. doi:10.1080/10615801003774210

Cazenave, N., Le Scanff, C., & Woodman, T. (2007). Psychological profiles and emotional regulation characteristics of women engaged in risk-taking sports. *Anxiety, Stress & Coping*, *20*, 421–435. doi:10.1080/10615800701330176

Celsi, R. L., Rose, R. L., & Leigh, T. W. (1993). An exploration of high-risk leisure consumption through skydiving. *Journal of Consumer Research*, *20*, 1–23.

Cisler, J. M., Olatunji, B. O., Feldner, M. T., & Forsyth, J. P. (2010). Emotion regulation and the anxiety disorders: An integrative review. *Journal of Psychopathology and Behavioral Assessment*, *32*, 68–82. doi:10.1007/s10862-009-9161-1

Coffey, M. (2005). *Where the mountain casts its shadow: The dark side of extreme adventure*. New York, NY: St. Martin's Griffin.

Eysenck, S. B., & Eysenck, H. J. (1978). Impulsiveness and venturesomeness: Their position in a dimensional system of personality description. *Psychological Reports*, *43*(3 Pt 2), 1247–1255.

Fenichel, O. (1939). The counter-phobic attitude. *The International Journal of Psychoanalysis*, *20*, 263–274.

Franken, I. H. A., Zijlstra, C., & Muris, P. (2006). Are nonpharmacological induced rewards related to anhedonia? A study among skydivers. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, *30*, 297–300. doi:10.1016/j.pnpbp.2005.10.011

Gabbe, B. J., Finch, C. F., Bennell, K. L., & Wajswelner, H. (2003). How valid is a self reported 12 month sports injury history? *British Journal of Sports Medicine*, *37*, 545–547.

Gravetter, F. J., & Forzano, L. B. (2012). *Research methods for the behavioral sciences* (4th ed.). Belmont, CA: Cengage Learning.

Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology*, *39*(3), 281–91. doi:10.1017.S0048577201393198

Gross, J. J., & Thompson, R. A. (2007). Emotion regulation: Conceptual foundations. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 3–24). New York, NY: Guilford Press.

Gyurak, A., Gross, J. J., & Etkin, A. (2011). Explicit and implicit emotion regulation: A dual-process framework. *Cognition & Emotion*, *25*, 400–412. doi:10.1080/02699931.2010.544160

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press.

Hébert-Losier, K., & Holmberg, H. C. (2013). What are the exercise-based injury prevention recommendations for recreational alpine skiing and snowboarding? A systematic review. *Sports Medicine*, *43*, 355–366. doi:10.1007/s40279-013-0032-2

Houge Mackenzie, S., Hodge, K., & Boyes, M. (2011). Expanding the flow model in adventure activities: A reversal theory perspective. *Journal of Leisure Research*, *43*, 519–544.

Hoyle, R. H., Stephenson, M. T., Palmgreen, P., Pugzles, E., & Donohew, R. L. (2002). Reliability and validity of a brief measure of sensation seeking, *32*, 401–414.

Jöreskog, K. G. (1993). Testing structural equation models. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 294–316). Newbury Park, CA: Sage.

1 Jöreskog, K. G., & Sörbom, D. (2006). LISREL 8.8 for Windows [Computer software].

2   Skokie, IL: Scientific Software International, Inc.

3 Kern, L., Geneau, A., Laforest, S., Dumas, A., Tremblay, B., Goulet, C., … Barnett, T. A.

4   (2014). Risk perception and risk-taking among skateboarders. *Safety Science*, *62*, 370–

5   375. doi:10.1016/j.ssci.2013.08.009

6 Kerr, J. H., & Houge Mackenzie, S. (2012). Multiple motives for participating in adventure

7   sports. *Psychology of Sport and Exercise*, *13*, 649–657.

8   doi:10.1016/j.psychsport.2012.04.002

9 Kerr, J. H., & Houge Mackenzie, S. (2014). Confidence frames and the mastery of new

10   challenges in the motivation of an expert skydiver. *The Sport Psychologist*, *28*, 221–232.

11   doi:10.1123/tsp.2013-0069

12 Kontos, A. P. (2004). Perceived risk, risk taking, estimation of ability and injury among

13   adolescent sport participants. *Journal of Pediatric Psychology*, *29*, 447–455.

14   doi:10.1093/jpepsy/jsh048

15 Koole, S. L., & Rothermund, K. (2011). "I feel better but I don't know why": The

16   psychology of implicit emotion regulation. *Cognition & Emotion*, *25*, 389–399.

17   doi:10.1080/02699931.2010.550505

18 Laberge, S. (1993). Rock climbing: A high-risk sport? (L'escalade, un sport à risque?).

19   *Frontières, 3*, 31-33. Cited in Le Breton, D. (2000). Playing symbolically with death in

20   extreme sports. *Body & Society*, *6*, 1–11.

21 Lester, J. (2004). Spirit, identity, and self in mountaineering. *Journal of Humanistic

22   Psychology*, *44*, 86–100. doi:10.1177/0022167803257111

23 Levenson, M. R. (1990). Risk taking and personality. *Journal of Personality & Social

24   Psychology*, *58*, 1073–1080.

Llewellyn, D. J., & Sanchez, X. (2008). Individual differences and risk taking in rock climbing. *Psychology of Sport and Exercise*, *9*, 413–426. doi:10.1016/j.psychsport.2007.07.003

Loas, G., Fremaux, D., & Boyer, P. (1997). Anhedonia and alexithymia: distinct or overlapping constructs. *Perceptual and Motor Skills*, *84*, 415–425.

Loas, G., Otmani, O., Lecercle, C., & Jouvent, R. (2000). Relationships between the emotional and cognitive components of alexithymia and dependency in alcoholics. *Psychiatry Research*, *96*, 63–74.

Luminet, O., Rokbani, L., Ogez, D., & Jadoulle, V. (2007). An evaluation of the absolute and relative stability of alexithymia in women with breast cancer. *Journal of Psychosomatic Research*, *62*, 641–648. doi:10.1016/j.jpsychores.2007.01.003

Merrick, J., Kandel, I., Birnbaum, L., Hyam, E., Press, J., & Morad, M. (2004). Adolescent injury risk behavior. *International Journal of Adolescent Medicine and Health*, *16*, 207–213.

Nakonezny, P. A., Carmody, T. J., Morris, D. W., Kurian, B. T., & Trivedi, M. H. (2010). Psychometric evaluation of the Snaith-Hamilton pleasure scale in adult outpatients with major depressive disorder. *International Clinical Psychopharmacology*, *25*, 328–333. doi:10.1097/YIC.0b013e32833eb5ee

Nietzsche, F. (1998). Twilight of the idols. In D. Large (Ed.), *Friedrich Nietzsche: Twilight of the idols. A new translation*. Oxford, UK: Oxford University Press. (Original work published 1889).

Ogilvie, B. C. (1974). The sweet psychic jolt of danger. *Psychology Today*, *October*, 88–94.

Pain, M. T. G., & Pain, M. A. (2005). Essay: Risk taking in sport. *Lancet*, *366*(Suppl.), S33–S34. doi:10.1016/S0140-6736(05)67838-5

Paquette, L., Lacourse, E., & Bergeron, J. (2009). Construction d'une échelle de prise de risques et validation auprès d'adolescents pratiquant un sport alpin de glisse [Construction and validation of a risk-taking scale for adolescent practitioners of Alpine ski sports]. *Canadian Journal of Behavioral Sciences*, *41*, 133–142.

Parker, J. D. A., Taylor, G. J., & Bagby, R. M. (2003). The 20-item Toronto Alexithymia Scale-III. Reliability and factorial validity in a community population. *Journal of Psychosomatic Research*, *55*, 269–275.

Paulhus, D. L., & Vazire, S. (2007). The self-report method. In R. W. Robins, R. C. Fraley, & R. F. Krueger (Eds.), *Handbook of research methods in personality psychology* (pp. 224–239). London, UK: The Guilford Press.

Pickett, W., Dostaler, S., Craig, W., Janssen, I., Simpson, K., Shelley, S. D., & Boyce, W. F. (2006). Associations between risk behavior and injury and the protective roles of social environments: An analysis of 7235 Canadian school children. *Injury Prevention*, *12*, 87–92. doi:10.1136/ip.2005.011106

Pierson, A., Le Houezec, J., Fossaert, A., Dubal, S., & Jouvent, R. (1999). Frontal reactivity and sensation seeking an ERP study in skydivers. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, *23*, 447–463.

Potter, D. (Interviewee), & Soldinger, M. (Director). (2010). Daredevils: The sky walker walker [Television broadcast]. In J. Wilkins (Executive Producer). London, UK: Firecracker films for Channel 4.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*, 879–891.

Preacher, K. J., & Kelley, K. (2011). Effect size measures for mediation models: Quantitative

strategies for communicating indirect effects. *Psychological Methods*, *16*, 93–115.

doi:10.1037/a0022658

Rhemtulla, M., Brosseau-Liard, P. É., & Savalei, V. (2012). When can categorical variables

be treated as continuous? A comparison of robust continuous and categorical SEM

estimation methods under suboptimal conditions. *Psychological Methods*, *17*, 354–373.

doi:10.1037/a0029315

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in

personality traits across the life course: A meta-analysis of longitudinal studies.

Psychological Bulletin, *132*, 1–25. doi:10.1037/0033-2909.132.1.1

Sadock, B. J., & Sadock, V. A. (2007). *Kaplan & Sadock's synopsis of psychiatry:*

Behavioral Sciences/Clinical Psychiatry (10th ed.). Philadelphia, PA: Lippincott

Williams & Wilkins.

Shapiro, R., Siegel, A. W., Scovill, L. C., & Hays, J. (1998). Risk-taking patterns of female

adolescents: What they do and why. *Journal of Adolescence*, *21*, 143–159.

doi:10.1006/jado.1997.0138

Slanger, E., & Rudestam, K. E. (1997). Motivation and disinhibition in high risk sports:

Sensation seeking and self-efficacy. *Journal of Research in Personality*, *31*, 355–374.

doi:10.1006/jrpe.1997.2193

Snaith, R. P., Hamilton, M., Morley, S., Humayan, A., Hargreaves, D., & Trigwell, P. (1995).

A scale for the assessment of hedonic tone the Snaith-Hamilton Pleasure Scale. *The*

British Journal of Psychiatry, *167*, 99–103. doi:10.1192/bjp.167.1.99

Solomon, R. L. (1980). The opponent process theory of acquired motivation: The costs of

pleasure and the benefits of pain. *American Psychologist*, *35*, 691–712.

Taylor, G. J., Bagby, R. M., & Parker, J. D. A. (1999). *Disorders of affect regulation: Alexithymia in medical and psychiatric illness*. Cambridge, UK: Cambridge University Press.

Taylor, M. K., Gould, D. R., Hardy, L., & Woodman, T. (2006). Factors influencing physical risk taking in rock climbing. *Journal of Human Performance in Extreme Environments*, *9*, 15–26. doi:10.7771/2327-2937.1044

Taylor, R. L., & Hamilton, J. C. (1997). Preliminary evidence for the role of self-regulatory processes in sensation seeking. *Anxiety, Stress & Coping*, *10*, 351–375. doi:10.1080/10615809708249309

Thompson, R. A. (1994). Emotion regulation: A theme in search of a definition. In N. A. Fox (Ed.), *The development of emotion regulation: Biological and behavioral considerations* (pp. 25–52). Chicago: University of Chicago Press.

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika*, *38*(1), 1–10. doi:10.1007/BF02291170

Turner, C., McClure, R., & Pirozzo, S. (2004). Injury and risk-taking behavior-a systematic review. *Accident; Analysis and Prevention*, *36*(1), 93–101.

Van Mechelen, W., Hlobil, H., & Kemper, H. C. (1992). Incidence, severity, aetiology and prevention of sports injuries: A review of concepts. *Sports Medicine*, *14*, 82–99.

Volkow, N. D., Fowler, J. S., & Wang, G.-J. (2003). The addicted human brain: Insights from imaging studies. *The Journal of Clinical Investigation*, *111*, 1444–1451. doi:10.1172/JCI18533

West, A., & Allin, L. (2010). Chancing your arm: The meaning of risk in rock climbing. *Sport in Society*, *13*, 1234–1248. doi:10.1080/17430431003780245

1 Woodman, T., Barlow, M., Bandura, C., Hill, M., Kupciw, D., & Macgregor, A. (2013). Not

2   all risks are equal: The risk taking inventory for high-risk sports. *Journal of Sport &*

3   *Exercise Psychology*, *35*, 479–492.

4 Woodman, T., Cazenave, N., & Le Scanff, C. (2008). Skydiving as emotion regulation: The

5   rise and fall of anxiety is moderated by alexithymia. *Journal of Sport & Exercise*

6   *Psychology*, *30*, 424–433.

7 Woodman, T., Hardy, L., Barlow, M., & Le Scanff, C. (2010). Motives for participation in

8   prolonged engagement high-risk sports: An agentic emotion regulation perspective.

9   *Psychology of Sport and Exercise*, *11*, 345–352.

10 Woodman, T., Huggins, M., Le Scanff, C., & Cazenave, N. (2009). Alexithymia determines

11   the anxiety experienced in skydiving. *Journal of Affective Disorders*, *116*, 134–138.

12   doi:10.1016/j.jad.2008.11.022

13 Zuckerman, M. (1979). *Sensation seeking: Beyond the optimal level of arousal*. Cambridge,

14   UK: Cambridge University Press.

15 Zuckerman, M. (2007). *Sensation seeking and risky behavior*. Washington, DC: American

16   Psychological Association.

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Table 1.

Item-factor loadings and full-model fit indices for the Accidents and Close Calls in Sport Inventory (ACCSI) in Study 1, Study 2 and Study 3.

Accidents and Close Calls in Sport Inventory	Study 1	Study 2	Study 3
Close Calls			
(1) I experience close calls when participating in my sport	.80	.81	.88
(3) I find myself in situations that lead to near misses	.85	.85	.91
(5) During participation in my sport I narrowly avoid accidents	.77	.72	.81
Accidents			
(2) I am involved in accidents when participating in my sport	.84	.82	.90
(4) My decisions in this activity lead to accidents	.70	.77	.72
(6) I sustain injuries as a result of accidents	.68	.71	.72
Two-factor full-model fit indices			
S-B χ^2 *(13)*	18.18	38.99	21.14
CFI	.99	.98	.99
NNFI	.99	.98	.99
RMSEA	.04	.12	.09
SRMR	.03	.04	.03
χ^2/df	2.27	4.87	2.64

Note: The wording for the item stem was "Please respond concerning your common experiences in high-risk sport". Item numbers (in parentheses) represent the item-order that was presented to the participants. *S-B* = Satorra-Bentler; CFI = Comparative Fit Index; NNFI = Non-Normed Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Residual.

Table 2.

Correlations between alexithymia, deliberate risk taking, precautionary behaviors, accidents, close calls, sensation seeking, and anhedonia in Study 1, Study 2, and Study 3.

		Deliberate risk taking	Precautionary behaviors	Alexithymia	Accidents	Close calls	Sensation seeking	Anhedonia	Age
1	Deliberate risk taking	.65	-.12***	.15***	.31***	.52***	.45***	-	-.21***
		.72	-.12**	.22***	.40***	.49***	-	.02	-.20***
		.80	-.34***	.31***	.54***	.64***	-	.06	-.19***
2	Precautionary behaviors		.72	-.23***	-.02	-.10**	-.20***	-	.16***
			.81	-.16***	-.22***	-.20***	-	-.18***	.13*
			.79	-.33***	-.33***	-.34***	-	-.14***	.14**
3	Alexithymia			.81	.15***	.19***	.15***	-	-.14***
				.85	.24***	.26***	-	.25***	-.19***
				.84	.33***	.38***	-	.30***	-.18***
4	Accidents				.79	.59***	.23***	-	-.06
					.81	.73***	-	.01	-.16**
					.86	.79***	-	.18**	-.10**
5	Close calls					.85	.31***	-	-.14***
						.83	-	.03	-.11*
						.90	-	.06	-.16**
6	Sensation seeking						.76	-	-.39***
							-	-	-
							-	-	-
7	Anhedonia							-	-
								.88	-.05
								.91	-.07
8	Age								-
									-
									-
	Mean (SD)	7.29 (2.22)	15.88 (2.64)	47.35 (10.15)	6.06 (2.22)	11.00 (3.64)	29.04 (5.28)	-	32.05 (11.85)
		6.93 (2.58)	17.24 (2.92)	48.18 (10.76)	6.93 (2.70)	10.20 (3.96)	-	23.80 (5.46)	35.43 (12.92)
		7.23 (3.03)	16.92 (2.88)	44.76 (11.18)	6.93 (2.91)	11.48 (4.28)	-	22.40 (6.16)	37.10 (14.20)

Note: A maximum of three values are presented in each cell of the table: Top = Study 1; Middle = Study 2; Bottom = Study 3. Where no value is present, indicated by a dash, this relationship was not measured in the particular study. Deliberate risk taking and precautionary behaviors = factor scores on Woodman et al.'s (2013) Risk Taking Inventory; Alexithymia = total score on Bagby et al.'s (1994) Toronto Alexithymia Scale 20; Accidents and Close calls = factor total scores on the new Accidents and Close Calls Inventory; Sensation seeking = total score on Hoyle et al.'s (2002) Brief Sensation Seeking Scale; Anhedonia = total score on Snaith et al.'s (1995) Snaith-Hamilton Anhedonia Pleasure Scale. Coefficient alphas are on the diagonal.

*p < .05, **p < .01, ***p < .001

Table 3.

The relationship between Alexithymia and accidents and close calls as mediated by risk taking behaviors in Study 1, Study 2 and Study 3.

	M	Y	Indirect effect			Kappa squared			a path		b path		c' path	
			b	LLCI	ULCI	κ^2	LLCI	ULCI	b	t	b	t	b	t
Study 1	DRT	Accidents	.04	.021	.071	.04	.020	.070	.15	3.86***	.29	8.04***	.10	2.83**
	DRT	Close calls	.07	.035	.115	.08	.038	.120	.15	3.86***	.50	15.29***	.11	3.45***
	PB	Accidents	-.00	-.022	.016	.00	.000	.009	-.23	-6.13***	.01	.31	.15	3.84***
	PB	Close calls	.01	-.005	.035	.01	.001	.035	-.23	-6.13***	-.06	-1.51	.17	4.49***
Study 2	DRT	Accidents	.08	.036	.134	.08	.037	.129	.21	3.96***	.36	7.02***	.16	3.08**
	DRT	Close calls	.10	.046	.160	.10	.048	.162	.21	3.96***	.46	9.49***	.15	2.98**
	PB	Accidents	.03	.004	.083	.03	.005	.080	-.16	-2.98**	-.18	-3.43***	.21	3.83***
	PB	Close calls	.03	.006	.069	.03	.006	.068	-.16	-2.98**	-.17	-3.14**	.22	4.03***
Study 3	DRT	Accidents	.15	.093	.220	.16	.100	.219	.31	6.07***	.49	10.37***	.18	3.75***
	DRT	Close calls	.18	.114	.259	.20	.125	.267	.31	6.07***	.58	13.72***	.19	4.59***
	PB	Accidents	.08	.037	.157	.08	.040	.151	-.33	-6.49***	-.25	-4.79***	.25	4.66***
	PB	Close calls	.09	.043	.152	.09	.046	.148	-.33	-6.49***	-.26	-5.07***	.29	5.65***

Note: M = Mediator; Y = Outcome variable; b = Unstandardized beta coefficient; LLCI = Lower limit confidence interval; ULCI = Upper limit confidence interval; κ^2 = Kappa squared; a path = predictor variable to mediator variable; b path = mediator variable to outcome variable; c' path = direct effect; DRT = Deliberate risk taking on Woodman et al.'s (2013) Risk Taking Inventory; PB = Precautionary behaviors on Woodman et al.'s (2013) Risk Taking Inventory; Accidents and Close calls = factor total scores on the new Accidents and Close Calls Inventory.
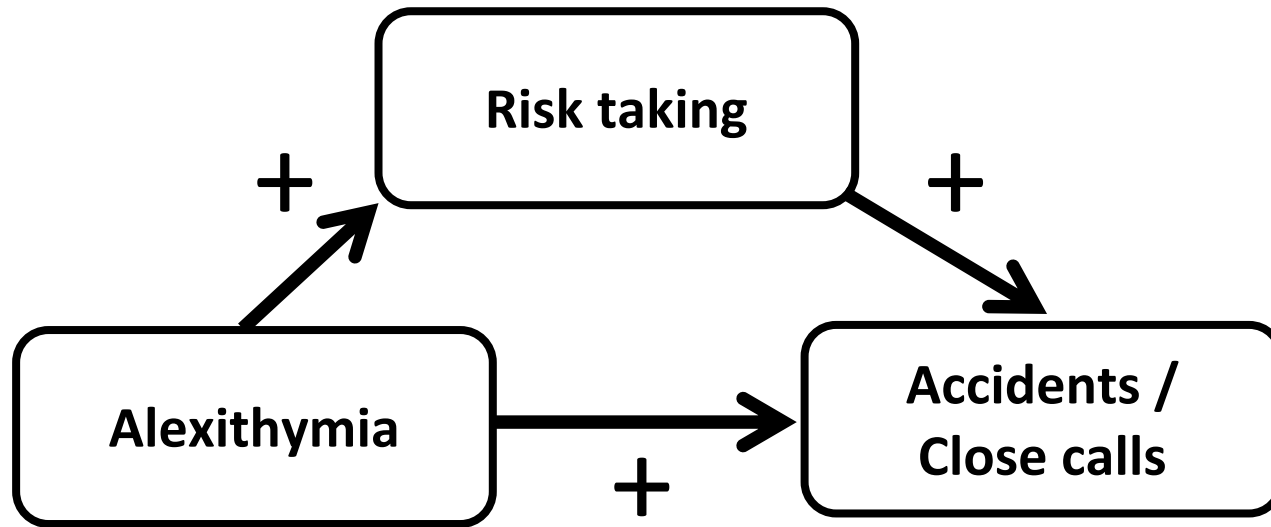*p < .05
**p < .01
***p < .001

Figure 1. The mediating role of risk taking in the alexithymia – accidents/close calls relationship.