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Running head: Risk perception and risk exposure in rock climbing

Risk perception as a function of risk exposure amongst rock climbers

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Abstract

Objectives: The first objective was to examine the extent to which climbers' climbing safety perceived competence (CSPC) and perceived own absolute (POAR) and comparative (PCR) risk of getting seriously injured whilst climbing is related to risk exposure. The second objective was to examine which variables influence POAR and PCR.

Method: 235 climbers ($M = 32$, $SD = 10.2$ years of age) completed the following questionnaires: a CSPC scale specifically developed to assess perceived ability to practice climbing safely; indirect measures of PCR, consisting in the subtraction of the participants' assessment of their own risks from their assessment of other climbing referents' risks; and the Life Orientation Test-Revised, measuring dispositional optimism (DO). Participants were approached in their practices sites from Mediterranean regions, and were divided into groups based on their climbing practice's risk exposure; that is, high-risk: traditional climbing (TRAD; $n = 42$); moderate risk: leading (LEAD; $n = 89$); and low risk: either top-roping (TOP; $n = 51$) or indoor bouldering (IND; $n = 53$).

Results: Analyses of variance showed that TRAD expressed higher CSPC and higher POAR than the other groups. PCR also differed amongst the groups. More specifically, TRAD expressed comparative pessimism and LEAD expressed comparative optimism, as their POAR was, respectively, higher and lower than their perceived average climber's risk. TOP and IND perceived their own risk in a similar way to that of the average climber. Regression analyses showed that DO did not influence POAR or PCR. Past injury episode was positively related to POAR and negatively related to the propensity to express comparative optimism, though only amongst TRAD and LEAD.

Conclusions: Climbers' risk perception accurately reflected their risk exposure. Climbers whose climbing modality involves higher risks acknowledged so when evaluating their own absolute and comparative risks of getting seriously injured whilst climbing.

Key-words: Safety perceived competence; Risk assessment; Risk involvement; Comparative

optimism; Comparative pessimism. Risk perception as a function of risk exposure amongst rock climbers

Sport injuries are a major concern in developed countries. For instance, every year in France, they account for nearly 20% (around 900,000) of all home and leisure injuries requiring hospital emergency care (Duval & Salomon, 1997; Ricard, Rijou, & Thélot, 2007). Psychological and psychosocial studies have focused on individual factors associated with susceptibility for injuries from participation in sport (Andersen & Williams 1998, 1999; Johnson, 2007). For instance, competitive trait anxiety (Lavallee & Flint, 1996; Petrie, 1993), low trait self-esteem (Kolt & Roberts, 1998), as well as internal locus of control (Kolt & Kirkby, 1996; Pargman & Lunt, 1989), low coping resources (Williams, Tonymon, & Wadsworth, 1986) and low social support (Hardy, Richman, & Rosenfeld, 1991), are linked to an increased sport injury risk. The frequency and the severity of accidents depend also on the level and the type of the sport practised (McGuine, 2006). Engaging in high-risk sports such as, for instance, skydiving, rock climbing or scuba-diving, typically involve a high probability of serious injury or death (Zuckerman, 1983). Despite the high prevalence of injuries and the potentially fatal nature of these activities, the popularity of high-risk sports has increased exponentially in Western societies (Jones, Asghar, & Llewellyn, in press). Thus, it seems important to identify factors underlying the different risk-related behavioural strategies that can be observed within a high-risk sample (e.g., Llewellyn & Sanchez, 2008; Llewellyn, Sanchez, Asghar, & Jones, 2008). Psychosocial factors such as the subjective perception of the potential for injury or death (Davis-Berman & Berman, 2002) have been widely investigated, and low levels of perceived vulnerability have been associated with a significant increase in risk of injury (Kontos, 2004). Numerous studies have also focused on perceived situational risk relative to one's perceived confidence to deal with that risk (Llewellyn et al., 2008; Robinson, 1992). Studies have shown that, despite their sport injury risk, high-risk sport participants such as mountaineers (Delle Fave, Bassi, & Massimini, 2003; Demirhan, 2005), rock-climbers (Llewellyn & Sanchez,

2008; Llewellyn et al., 2008), BASE-jumpers (first author, 2006), or skydivers (Laurendeau, 2006; Moen & Rundmo, 2005), trust themselves to negotiate risky situations and demonstrate feelings of self-efficacy (Bandura, 1997), believing in their abilities to cope with the risk. However, previous research has often failed to examine the ways and extent to which high-risk sport participants compare their own risks of getting injured, and the strategies they use to manage that risk, with that of their peers.

Occupational and health psychology literature (e.g., Chambers & Windschitl, 2004, Helweg-Larsen & Shepperd, 2001, Weinstein, 1980, 1987) has described people's tendency to report that they are less likely than others to experience negative events (such as having a heart attack, or being involved in a road accident) and more likely than others to experience positive events (such as winning the lottery). Such a tendency, known as unrealistic optimism (Weinstein, 1980) or comparative optimism (CO; Harris & Middleton, 1994; Shepperd, Carroll, Grace, & Meredith, 2002), has been widely observed for a variety of events in daily life such as driving (Matthews & Moran, 1986), crime (Perloff & Fetzer, 1986), and health (Weinstein, 1980). In the field of high-risk sport, ethnographic-based studies have suggested that high-risk sport participants tend to attribute casualties of accidents to those who "*do not possess the right stuff*" (Lyng, 1990, p. 859) and to the "*poor judgements*" peers make regarding safety (Laurendeau, 2006, p. 596). To the best of the authors' knowledge, there exist few empirically-based quantitative studies that have examined high-risk sportsmen's risk perception, from that social comparison perspective. Moreover, existing studies have reported contradictory results; high-risk sportsmen would assess their vulnerability of getting seriously injured either similarly (First author, 2008) or lower to that of their peers (Moen & Rundmo, 2005).

Since CO may be (a) related to the way people perceive safety recommendations (Chappé, Verhiac, & Meyer, 2007; Perloff & Fetzer, 1986) and adopt cautious behaviours (Klein, 1997; McKenna, Stanier, & Lewis, 1991), and (b) linked to an increase in accident risk (e.g., in the field

of road traffic; Sümer, Özkan, & Lajunen, 2006), it seems necessary to measure how risk sports practitioners perceive their risk exposure whilst practising their activity, in comparison to that of 'others'. Thus, in order to assess the link between absolute and comparative risk perception and risk exposure, we examined climbers' climbing safety perceived competence (CSPC; i.e., their confidence in their abilities to practice climbing safely), perceived own absolute risk (POAR; i.e., their self-risk assessment of getting seriously injured), and perceived comparative risks (PCR; i.e., the difference they perceive between their own risk and that of others) whilst practising their activity, and took into account their past injury episodes.

We focused on climbers because their sport may be practised in several ways, each of which involves a different degree of risk exposure. The modality 'soloing' climbing is the most extreme modality of practice where the climber ascends without a rope and is, therefore, completely unprotected in the event of a fall. The modality known as 'traditional' climbing is a high-risk modality of practice where the climber progresses up long rock faces for hundreds of feet, and have to place his/her own protections and mobile anchors rather than clipping pre-placed bolts for security using stoppers-nuts, straps and friends. Such protections may tear themselves away from the rock, particularly in case of a fall. Thus, traditional climbers are exposed to the risk of falls which can be 20 to 30 metres high before being stopped by the rope, and, in that respect, are simultaneously exposed to greater risk of serious injury or even death (Gerdes, Hafner, & Aldaq, 2006). Another modality of practice is 'leading' climbing, where the climber safeguards him/herself as progresses up the rock by clipping pre-placed bolts for security. Leading can be considered as a moderate-risk modality of practice, as climbers in this modality are exposed to the risk of falls that are, for the most part, of 2 to 8 metres high and can involve slight or moderate injuries such as spraining an ankle or breaking a leg (Fong, Hong, Chan, Young, & Chan, 2007; Hohlrieder, Lutz, Schubert, Eschertzhuber, & Mair, 2007). 'Top-roping' is a fourth modality of climbing, which can be considered as involving almost no risk of serious injury. Climbers progress with a prearranged

rope coming from above that holds the climber in case of falling. Finally, 'indoor bouldering' is a modality of practice consisting of progressing on low-rise climbing indoor areas (measuring 3 metres maximum), where the climber falls on mats. Indoor bouldering climbers may be exposed to the risks of micro-traumatic climbing-specific injuries such as flexor tendon pulley ruptures or tendonitis (Logan, Makwana, Mason, & Dias, 2004; Schoffl, Einwag, Strecker, Hennig, & Schoffl, 2007), but are at low risk of serious injury.

The first objective of the present study was to examine the ways and the extent to which climbers' CSPC, their POAR, and their PCR of getting seriously injured, were influenced by their climbing risk exposure (inherent to their climbing modality). Since traditional rock climbers (TRAD) are frequently involved in risk taking, it was hypothesised that their CSPC would be higher than that of leading (LEAD), top-roping (TOP), and indoor bouldering (IND) climbers (Hypothesis 1). However, as traditional climbing remains highly dangerous, it was hypothesised that TRAD would express higher POAR of getting seriously injured while practising (Hypothesis 2), and lower CO when comparing their perceived risk of getting injured to that of a non-specific climbing referent (i.e. the average same-age and same-sex outdoor climber; Hypothesis 3), than the rest of the other groups. Finally, it was hypothesised that all groups would perceive their risk of getting seriously injured as similar to that of a specific climbing referent, that is, the average same-age and same-sex climber whose favourite modality of climbing is 'the same as mine' (Hypothesis 4).

The second objective of the present study was to examine which variables influenced POAR and PCR of getting seriously injured whilst climbing. Thus, the role of past injury episodes, age, climbing experience, and CSPC were examined. In the field of sport participation (Deroche, Stephan, Brewer, & Le Scanff, 2007; Lyng, 1990; Williams-Avery & McKinnon, 1996), past accident experiences have been shown to have an effect on people's risk perception. Thus, it was hypothesised that past injury episodes while climbing would have positive effects on POAR and negative effects on CO when one would compare his/her risk of getting seriously injured to that of

the abovementioned non-specific climber (Hypothesis 5). In addition, the putative influence of dispositional optimism (DO), which is the tendency to believe that one will experience positive outcomes in life (Scheier & Carver, 1985), was considered. We hypothesised that both CSPC and DO would have negative effects on POAR, and positive effects on CO, amongst all the climbers (Hypothesis 6).

Method

Participants

We surveyed 235 male adults from four European-Mediterranean regions (Catalonia, Midi-Pyrénées, Languedoc-Roussillon and Provence Alpes Côte d'Azur). These regions are famous for their wide variety of outdoor practice sites (e.g., le Verdon, la Sierra de Guara, Montserrat, les Gorges de la Jonte, les Calanques) and their Mediterranean sunny climate, which is ideal for sporting outdoor activities such as rock climbing. Precisely, the sample of climbers was composed of 42 TRAD, 89 LEAD, 53 TOP, and 51 IND.

Material

The questionnaire-pack consisted of four sections. The first section gathered general information on variables such as climbers' age and climbing experience (number of years of practice), who were also asked to report their favourite climbing modality; that is, the modality of climbing they practised the most (either traditional climbing, outdoor or indoor climbing). Participants who reported practising mostly outdoor climbing were asked to state whether they were mostly leading or top-rope climbers. Those who reported practising mostly indoor climbing were asked to state whether they were mostly route climbers or bouldering climbers. All indoor participants reported practising mostly bouldering, which is not surprising given that most of the indoor areas in the Mediterranean regions are boulders. Climbers were also required to provide the

number of years of rock climbing experience as well as the higher route-difficulty level successfully climbed, at least 5 times in the last 12 months. The International Mountaineering and Climbing Federation (Union Internationale des Associations d'Alpinisme, UIAA) numerical scale, which ranges from 1 (lowest level) to 12 (highest level), was utilised. Finally, the number of injury episodes was obtained from each participant. In order to minimise the problems raised by different subjective interpretations of what constitutes an “accident” (Gabbe, Finch, Bennell, & Wajswelner, 2003), we asked the participants to mention the number of injury episodes having necessitated medical attention whilst practising their favourite climbing modality. While previous sports injury studies (e.g., Bennell et al., 1998; Gabbe et al., 2003; Gerrard, Waller, & Bird, 1994; Jones et al., in press) have focused on a 12 months injury history, we aimed to measure injury episodes over the past 3 years. Although injuries amongst rock climbers are common, the mean number of years between the given injury and the participation in the study (questionnaire completion) vary amongst past research (e.g., 19 years in Logan et al., 2004). In addition, the results of our pilot study suggested that few injury episodes might have occurred over the past 12 months, making difficult to analyse putative statistical relationships between injury episodes and any other given variable. Thus, we decided to measure injury episodes over the past 3 years.

In the second section, CSPC was gathered through three items specifically developed to assess perceived ability to practice climbing safely, since no climbing-related specific scale is available in the literature for measuring such a perceived ability, to the best of the authors' knowledge. Based on the results of a qualitative study utilising semi-structured interviews (first author, 2002), we identified the major components of climbers' perceived competence in the domain under consideration – the ability to practice climbing safely (i.e., the knowledge about climbing, the know-how in practicing safely, and the general abilities for controlling risk). The following three items were pilot-tested with 27 rock-climbers approached at an outdoor rock climbing site (Claret, in the Languedoc-Roussillon, France): “I think that my knowledge about

outdoor rock climbing activity is very high”; “I think that my know-how in practicing outdoor rock climbing safely is very high”; and “I think I possess all the required abilities for controlling risks inherent to outdoor rock climbing”. In both the pilot research and the current study, the cumulative variance explained by the three items was 63.4% and 61.2%, and the internal consistency (*Cronbach’s alpha*) was .73 and .75, respectively. Answers were given on a scale ranging from 1 (‘I strongly disagree’) to 7 (‘I strongly agree’).

In the third section, PCR of getting seriously injured whilst being involved in one’s favourite climbing modality was obtained. There are two ways of obtaining PCR: directly or indirectly. The indirect method to obtain PCR is considered more stable and sensible than the direct method; in the latter, participants are explicitly asked how their risk compares to that of others and answer on a scale ranging, for instance, from ‘much less likely’ to ‘much more likely’ (Klein & Helweg-Larsen, 2002; Otten & van der Plicht, 1992). In the present study, similar to past research (e.g., Radcliffe & Klein, 2002; Rutter, Quine, & Albery, 1998), PCR was obtained indirectly. Firstly, participants evaluated their POAR by responding to the following question: “In your opinion, what is the probability of you getting seriously injured whilst being involved in your favourite climbing modality (provided at the beginning of the questionnaire)?”. The answer was given using a 7-point likert scale ranging from 1 (‘very low probability’) to 7 (‘very high probability’). Secondly, participants assessed the probability of getting seriously injured of both a non-specific (Q1) and a specific (Q2) climbing referent, by answering the following: Q1) “In your opinion, what is the probability of the average same-age and same-sex outdoor rock-climber of getting seriously injured whilst climbing?”; and Q2) “In your opinion, what is the probability of the average same-age and same-sex climber, who practices the same modality of climbing as your favourite, of getting seriously injured whilst climbing?”. The estimates of the participants’ own risk of getting seriously injured were then subtracted from the estimates of both non-specific and specific climbing referents’ risks. This use of a single item, subtracted to another one, has been validated in surveys

investigating PCR (e.g., Rutter et al., 1998). Positive scores (ranging from +1 to +6) indicate CO whilst negative scores (ranging from -1 to -6) indicate comparative pessimism (CP). Scores close to zero would indicate that participants rated their own risk of getting seriously injured whilst climbing as being similar to that of the aforementioned given climbing referent.

In the fourth and final section, DO was measured with the Life Orientation Test-Revised (LOT-R; Scheier, Carver, & Bridges, 1994), comprising three positive items (measuring optimism), three negative (measuring pessimism), and four filler items. Since alpha reliabilities of the Spanish (Perczek, Carver, Price, & Pozo-Kaderman, 2000) and the French (Sultan & Bureau, 1999) versions of the LOT-R were comparable to those of the English versions (*Cronbach's alpha* = .69, .70, .68, respectively), we used these above-mentioned translated versions of the LOT-R (see Vallerand, 1989, for further details about the methodology for transcultural validation of psychological questionnaires). The *Cronbach's alpha* coefficient (.71) of the LOT-R yielded in the present sample is comparable to that reported in Sultan and Bureau (1999). Answers were given on a scale from 1 'I disagree' to 5 'I totally agree'.

Procedure

After obtaining approval from the ethics committees of both Autonomous University of Barcelona (Spain) and University of the Mediterranean (France), participants were contacted in their outdoor practice sites from the aforementioned regions, during a 6-month period. In the 3-month winter period, we essentially conducted the survey in French sites (Claret and Les Calanques), where the majority of the participants were LEAD, TOP, and IND (although IND were present in the aforementioned outdoor sites, they reported practicing mostly at indoor places). Then, in the 3-month springtime, to complete sample with TRAD, we predominantly conducted the survey in the Spanish (Montserrat and la Sierra de Guara) and French (Le Verdon and Les Gorges de la Jonte) sites of traditional rock climbing. The climbers who were present on these sites were approached and invited to take part in a study investigating climbing, risk exposure and risk

perception, and were assured that their answers would be treated anonymously.

Amongst the 289 climbers approached, 18.7% (n = 54) refused to participate, putting forward as reasons for no participation 'lack of time' or 'lack of motivation'; the rest (81.3%, n = 235) gave their informed consent and agreed to participate. Participants answered the questionnaire-pack in the presence of an investigator, who collected them after completion. The completion of the questionnaires took approximately 15 minutes.

Statistical Analyses

For analyses purposes, participants' self-reported higher UIAA route-difficulty level was divided into three categories: under 5+, which generally characterises the novice level; from 5+ to 6+, which characterises the confirmed level; and over 7, characterising the expert level and perceived as a kind of threshold amongst the climbers (Asçi, Demirhan, & Dinç, 2007), which requires excellent skills, strength, and time commitment to maintain (Cox & Fulsaas, 2003).

One-sample *t*-tests were carried out to measure whether participants expressed significant CO, CP, or perceived their own risk as being similar to that of the non-specific and specific climbing referents (i.e., whether their PCR scores were higher, lower, or close to zero). Analyses of variance (ANOVA) were carried out to test the overall effect of climbing risk involvement on the following variables: CSPC, POAR, PCR, and DO. For all the ANOVA scores, the variable 'climbing experience' was entered as covariate. The η^2 values were used to control for the effect size of both climbing risk involvement and experience. All ANOVA were supplemented by pairwise comparisons with Tukey's correction to determine differences between groups.

Finally, regression analyses were carried out for each separate group of climbers to test the effects of age, experience, CSPC, DO and injury episodes on two dependent variables: POAR of getting seriously injured whilst practising one's favourite climbing modality, and CO regarding the risk of getting seriously injured when compared to the non-specific climbing referent.

Results

Participants characteristics

Table 1 provides the distribution of the sample, the respondents' average age and sporting characteristics, including injury episodes. No significant age differences were found between the groups ($F_{(3, 235)} = 2.8, p = .065$); however, there were differences regarding experience ($F_{(3, 235)} = 10.1, p < .001$), level of practice ($Chi^2_{(6, 235)} = 24.5, p < .001$), and injury episode over the last 3 years ($Chi^2_{(5, 235)} = 19.4, p < .01$) (See Table 1).

Insert Table 1 about here

Climbing safety perceived competence (CSPC), perceived own absolute risk (POAR) of getting seriously injured whilst climbing, and dispositional optimism (DO), as a function of climbing risk involvement

Climbing experience had no effect on CSPC ($F_{(1, 235)} = 1.9, p = .09, \eta^2 = .004$). Climbing risk involvement influenced CSPC ($F_{(3, 235)} = 6.2, p < .01, \eta^2 = .10$). TRAD reported more CSPC than did LEAD ($p < .05$), TOP ($p < 0.01$) and IND ($p < .01$), whilst TOP reported less CSPC than did LEAD ($p < .05$) and IND ($p < .05$). Climbing experience had an effect on POAR of getting seriously injured ($F_{(1, 235)} = 3.8, p < 0.05, \eta^2 = .05$). Climbing risk involvement also influenced POAR ($F_{(3, 235)} = 5.9, p < .01, \eta^2 = .11$), as TRAD reported more APR than did LEAD ($p < .01$), TOP ($p < .01$) and IND ($p < .01$). No significant differences were found between climbers on DO.

Insert Table 2 about here

Perceived comparative risk (PCR) of getting seriously injured as a function of climbing risk involvement

All the groups perceived their own absolute risk as similar to that of the specific climbing referent ($t < 1.5, p = ns$). When comparing their own risk to that of the non-specific climbing referent, only LEAD expressed CO, scoring 1.0 on a scale that ran from -6 to +6 ($t = 5.9, p < .001$). TRAD expressed CP, scoring -1.3 ($t = 6.5, p < .001$), whilst TOP and IND perceived their own absolute risk as similar to that of the non-specific climbing referent, scoring 0.1 and 0.2, respectively ($t < 1.2, p = ns$).

Climbing experience had no effect on PCR when the respondents compared their own risk to that of the specific climbing referent ($F_{(1, 235)} = 2.0, p = .12, \eta^2 < .001$), but had an effect on PCR when respondents compared their own risk to that of the non-specific climbing referent ($F_{(1, 235)} = 3.4, p < 0.05, \eta^2 = .04$). Climbing risk involvement had also an effect on PCR relative to the risk of the non-specific climbing referent ($F_{(3,235)} = 6.1, p < .001, \eta^2 = .11$). Tukey's *post-hoc* tests showed that TRAD's propensity to express CO was lower than that of LEAD ($p < .001$), TOP ($p < .01$) and IND ($p < .01$), whilst LEAD had a higher propensity to express CO than had TOP ($p < .01$) and IND ($p < .01$).

Insert Table 3 about here

Factors associated with perceived own absolute risk (POAR) and perceived comparative risk (PCR) of getting seriously injured whilst practising one's favourite climbing modality

Regression analyses showed that factors related to POAR of getting seriously injured were group-specific (see Table 4). Amongst TRAD and LEAD, age contributed to increase POAR ($\beta = .19, p < .05; \beta = -.23, p < .01$, respectively), as well as climbing experience ($\beta = .17, p < .05; \beta = .20, p < .05$, respectively) and injury episodes ($\beta = .30, p < .01; \beta = .33, p < .05$, respectively). Amongst TOP, POAR tended to decrease as climbing experience increased ($\beta = -0.21, p < 0.01$), whilst amongst IND, POAR increased as the years of climbing experience increased ($\beta = .18, p <$

.05). CSPC was negatively related to POAR amongst TOP and LEAD ($\beta = -.29, p < .01$ and $\beta = -.18, p < .05$, respectively), but not amongst TRAD and IND. Finally, DO did not have any effect on POAR in any of the groups (see Table 4).

Insert Table 4 about here

Other regression analyses were performed to determine factors related to CO regarding risk of getting seriously injured when compared to their non-specific climbing referent. CSPC was the only variable having a positive influence on CO (see Table 4), and was observed in LEAD ($\beta = .30, p < 0.01$) and TOP ($\beta = .23, p < .01$). Injury episodes had a negative effect on CO in TRAD ($\beta = -.30, p < .01$) and LEAD ($\beta = -.22, p < .01$). Age had a negative effect on CO in TRAD ($\beta = -.21, p < .05$), as well as climbing experience in TRAD ($\beta = -.25, p < .01$), LEAD ($\beta = -.18, p < .05$), and IND ($\beta = -.19, p < .05$). Finally, DO did not have any effect on CO (see Table 4).

Discussion

The first objective of the present study was to examine the extent to which climbers' climbing safety perceived competence (CSPC) and perceived own absolute (POAR) and comparative (PCR) risk of getting seriously injured whilst climbing was related to climbers' risk exposure (inherently to their climbing modality). The second objective was to examine which variables influenced POAR and PCR of getting seriously injured whilst climbing.

We observed that traditional rock-climbers (TRAD), who were involved in one of the most dangerous modalities of practice requiring the most effort to manage risks, reported a higher CSPC than the other groups (i.e., leading (LEAD), top-roping (TOP), and indoor bouldering (IND) climbers). These results supported H1, and the findings of Llewellyn and Sanchez (2008) and Slinger and Rudestam (1997). The former found that climbers high in self-efficacy were more likely to take greater risks when climbing whilst the latter reported that risk sports practitioners had higher scores in physical self-efficacy compared to participants involved in low-risk sports. We can

speculate that TRAD have a higher CSPC because they are used to managing risks and have learnt safety-related techniques. In their regard, their perceived competence is likely to be realistic-based, since exposure to a dangerous modality of climbing would lead to the development of must-have health and safety skills.

Although TRAD had the highest score of CSPC, the climbers in that group expressed higher POAR of getting seriously injured in comparison to the participants in the other groups, who were involved in less dangerous climbing modalities; this supported H2. While Kontos (2004) suggested a link between self-efficacy and a lower propensity to fear failure, in our study this seemed not to be the case as TRAD expressed high CSPC and high POAR of getting seriously injured. This suggests that being self-confident in one's own ability to take safety precautions may not be contradictory with perceiving one's own vulnerability to injury, probably because of the presence of uncontrollable risks characterising high-risk sports. To some extent, TRAD's POAR can be considered as realistic as climbers in that group are exposed, to a great extent, to the risks inherent to uncontrollable events such as the fall of rocks or damaged security bolts that are likely to tear away from the rock during a fall. Similar to previous studies (McKenna, Warbuton, & Winwood, 1993; Shapiro, Siegel, Scovill, & Hays 1998; Siegel et al., 1994), our findings suggest that risk exposure is not systematically linked to bias in risk perception, above all when respondents feel they have little personal control over risks (Harris, 1996; Langer, 1975; McKenna, 1993).

When comparing their own absolute risk of getting seriously injured to that of the non-specific climbing referent (i.e., the average same-age and same-sex outdoor climber), TRAD expressed lower CO than the other groups; this supported H3. More specifically, LEAD expressed CO, TRAD expressed CP, whilst TOP and IND perceived their own absolute risk as similar to that of the non-specific climbing referent. Participants' PCR were quite different when the referent was specific (i.e., the average same-age and same-sex climber practising the same climbing modality as the respondent's favourite). Participants perceived their own absolute risk as similar to that of the

specific climbing referent, which supported H4. This finding is similar to that of previous research, which has indicated that when the referent was specific, participants tended to perceive their own absolute risk as being similar to, rather than lower than, that of the referent (Causse et al., 2005; Chambers & Windschitl, 2004; Harris & Middleton, 1994). We may speculate that LEAD expressed less CO when comparing to the specific climbing referent than when comparing to the non-specific one because the climbers in that group changed their risk estimates for their referent rather than their POAR. Indeed, the perceived risk of a more specific referent would be easier to compute than would be the perceived risk of a less specific referent group (Chambers & Windschitl, 2004; Helweg-Larsen & Shepperd, 2001). However, this explanation cannot be applied to the TRAD's PCR in the present study. When comparing their POAR of getting seriously injured to that of their non-specific referent, TRAD expressed CP, probably because they compared themselves with the average climber who did not practice traditional climbing (very few climbers are involved in this risk modality of practice in a regular way in the European-Mediterranean regions investigated here). Such explanation would support the idea of the realistic nature of TRAD's POAR and PCR, observed in the present study.

Results from regression analyses confirmed that amongst TRAD, CSPC did not contribute to reduce POAR of getting seriously injured, nor did to increase CO regarding such a risk. As expected, past injury episode was positively related to POAR and negatively to CO, thus supporting H5; however, this was only found amongst TRAD and LEAD. Past research (e.g., Lyng, 1990) has already shown that amongst risk sport practitioners the experience of negative outcomes contributed both to threaten their illusion of control and to increase their perceived vulnerability. This link between experience and risk perception had been also demonstrated in other areas of daily life (e.g., Harris, 2007; McKenna & Albery, 2001; Rutter et al., 1998; Weinstein, 1987). We note that past injury episode was not related to POAR and CO amongst TOP and IND, probably because very few TOP (n = 7) and IND (n = 7) had suffered injury whilst practising.

CSPC had a negative effect on POAR amongst LEAD and TOP, and a positive effect on CO amongst LEAD, TOP, and IND. During climbing, LEAD, TOP and IND are hardly exposed to uncontrollable events in comparison to TRAD. This may explain why the lower their perceived own and comparative risk of getting seriously injured was, the more competent they would feel with regards to climbing safety. Interestingly, amongst TRAD, LEAD and IND, the more experienced the climber the higher his/her POAR and PCR risk of getting seriously injured was. It is possible that experience is a covariant of other variables we did not account for in the present study, such as knowing peers who, as a consequence of having made a mistake, would have threatened climbing security. Such variables could have influenced respondents' POAR and PCR. On the contrary, results showed that the more experienced the TOP, the lower their POAR was. Since the majority of TOP in our study reported a low climbing experience, and since novice climbers are likely to have high feelings of vulnerability during climbing (first author, 2002), one would expect TOP's POAR to be likely to decrease as climbing experience increases.

Finally, in contrast to what it was expected (H6), we did not observe any differences between the participants on dispositional optimism (DO), nor a relationship between DO and perceived own and comparative risk of getting seriously injured. This suggests that risk perception examined within a specific context may have no link with optimism measured as a general personality trait. This result is consistent with that of studies reporting a small or non-existent relationship between global optimism, risk perception and optimism about specific events (e.g., Davidson & Prkachin, 1997; Fontaine, 1994; Radcliffe & Klein, 2002). More generally, this result goes hand in hand with studies raising questions about the sensitivity of using general psychometric measures for a specific activity or for a selection of a very specific group of sportsmen, and the problems of generalisation that may follow. For instance, Slinger and Rudestam (1997)'s high-risk sports study indicated, as Bandura (1977) maintained, that precepts of self-efficacy are to great extent situational-specific, and do not necessarily generalise beyond activities that are similar to the original. Moreover, general

self-efficacy measures do not allow distinguishing between extreme- and high-risk sportsmen, while situational-specificity of self-efficacy do so. This seems to be also the case for the Sensation Seeking Scale (Zuckerman, Kolin, Price, & Zoob, 1964), which could not differentiate extreme- and high-risk sportsmen engaged in rock climbing (Slanger & Rudestam, 1997), or high-risk sportsmen such as alpinists and sportsmen engaged in lower risk sports such as swimmers (Goma-i-Freixanet, 1991). General psychometric measures have the advantage of allowing comparison between what can be observed amongst a specific and a broader sample, and thus allow possible generalisation of findings. However, in comparison with domain- or population-specific psychometric measures, we suggest that they are less appropriate for relevant analyses of risk assessment and risk taking phenomenon in the field of high-risk sport.

The findings of the present study should be treated with a degree of caution given the following limitations. Firstly, we did not gather qualitative information on respondents' past injury episodes, which could influence POAR and PCR. Thus, further research should explore such qualitative information in order to understand further the relationship between risk perception and risk exposure. Secondly, the present study surveyed male climbers only; therefore, future studies should explore the experiences of female participants in order to examine potential gender differences in risk perception and risk exposure. Finally, future research should also seek to examine the relation between risk exposure and risk perception among high-level, experienced participants, since these have hitherto been a largely neglected group of study.

Conclusion

In this study we set out to explore what has to date been a largely under-researched area in the study of social comparison and risk behaviours, namely, the relationship between CO and risk-taking in the field of high-risk sport. The findings from the present study suggest that risk perception is related to actual risk exposure inherent to the climbing modality practised, which provides support for the relatively realistic nature of risk perception. Participants seemed to assume their risk

standing, since they acknowledged their own absolute risk, as well as their comparative risk of getting seriously injured if practising a high-risk modality of rock-climbing, even if they had a high climbing safety perceived competence. Thus, contrary to the belief that CO would be linked to risky behaviours (e.g., Delhomme, 2001; Klein, 1997; McKenna et al., 1991), the present study showed no evidence of defensive denial amongst risk sport practitioners about their likelihood of getting seriously injured, since those whose behaviour put them at risk were conscious of their risk exposure relative to that of their peers. Therefore, research is needed to further examine the role that social comparison in general, and CO in particular, play in the risk-taking decision-making process in humans.

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