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Section III – Sports Training

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Development of the Compulsive Exercising Scale for Extreme Sports Participants

by
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The purpose of this study was to develop a scale to measure extreme sports participants' levels of compulsive exercising. There are a number of compulsive exercising scales; however, none of them is targeted for extreme sports participants, whose emotional responses differ from those of non-extreme sports participants. Five hundred extreme sports participants were involved in this study, which included literature analysis, expert review, and exploratory and confirmatory factor analysis. Firstly, 95 items were selected from previous studies related to extreme sports and compulsive exercising. Secondly, nine experts scrutinized the content validity of the 95 items, and 82 items were found to be valid. Thirdly, the 82-item survey was initially administered to 253 participants for the purposes of exploratory factor analysis. Lastly, the 20-item survey that came out as a result of the 82 items being put through the exploratory factor analysis was distributed to the other 247 participants in the confirmatory factor analysis. In the final results, 16 items regarding the four factors of the "withdrawal symptom", "attachment", "struggle", and "obsession" were confirmed. The factors used to measure extreme sports participants' compulsiveness in this study reflect somewhat different dimensions from those developed in previous studies for non-extreme sports participants or exercisers. Only factors in the affective and behavioral dimensions are included in the present study's scale, while factors in the cognitive or the combined cognitive, affective, and behavioral dimensions were investigated in previous studies. This explains the need for the present study.

Key words: *compulsive exercising scale, extreme sports, factor analysis.*

Introduction

Too much is as bad as too little. This common sense piece of advice applies to life in general, and to the purposes of this study, in particular. Addiction to sports could be as bad as occasional, irregular, and passive engagement. It could be even worse if it is associated with serious or fatal injuries. This study was begun to develop a scale to measure extreme sports participants' levels of compulsive exercising. The results of this scale would enable them to acknowledge and deal with their level of compulsiveness. Addiction is defined as the inability to moderate compulsive behavior in response to an activity or a substance that is known to be harmful (Cottler, 1993; Orford, 2001; Rounsaville et al., 1993). The American Society of Addiction Medicine (2011) even defines it as "a primary, chronic disease of brain reward, motivation, memory, and related circuitry".

Addiction has been classified into two different types: behavioral and substance addiction, which has brought about disputes over their resemblance (Potenza, 2006). There, however, seem to be inherent similarities between the two types of addiction. Firstly, both share neurological substance responses (Hoeft et al., 2008; Knutson et al., 2007; van Holst et al., 2012;

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Wang et al., 2004). Secondly, similar pharmacological substances are secreted from both types of addicts (Heirene et al., 2016).

One may ask what frequency of or time spent engaged in certain behaviors indicate an addiction. Addiction, however, is associated with the capacity of an individual to control a particular behavior, rather than the frequency or duration of engagement in the behavior. In general, the premise that what one does is barely under one's control, regardless of its harmful results, is instilled in the state of addiction. As the result of addiction, one indulges in activities like gambling, drug abuse, or compulsive exercising in spite of deficits in one's financial account balance, or without consideration of how plausible it is that one would become exposed to any sort of disease or injury. Thus, it is certain that participation in exercise or sports will progress from the stage of enjoyment to the stage of an addiction or compulsion if it gets out of one's control (Glasser, 1976; Sachs, 1981).

In addition to an increased risk of fatal injury, compulsive exercise has been known to cause anemia, irregular menstruation, anxiety, anorexia nervosa and depression, and it even weakens the immune system (Brehm et al., 2002a). Nevertheless, one may insist that compulsive exercising is just putting a bit more emphasis on exercising, doing sports or more frequent or intensive participation in exercise or sports than others do. However, addiction to sports is definitely considered a negative behavior, since it increases the probability of financial hardships, physical injuries, or sometimes fatality due to the prioritizing of participation in exercise or sports, strictly scheduling it, and becoming distressed without it, as mentioned by Grave et al. (2008). It is, as described previously, well known that the positive affective results of exercise could lead to the unexpected negative consequences of compulsion or addiction. What about extreme sports, which are presumably accompanied by higher levels of emotional responses than compulsive exercising?

The experiences of people participating in extreme sports seem to be akin to those of non-extreme sports participants, since extreme sports participants have been reported to share similar emotional experiences with gamblers or substance users whose neurological and pharmacological bodily substance secretions overlap with those of non-extreme sports participants (Buckley, 2012; Myrseth et al., 2012; Price and Bundesen, 2005; Willing, 2008). It seems certain that extreme sports people, non-extreme sports participants, gamblers, and substance users share similar feelings like excitement, nervousness, pleasure, helplessness, achievement, disappointment, etc.

The extreme sports participant population has been consistently growing during the last few decades (Brymer and Schweitzer, 2013). Unsurprisingly, most people assume that the fatality rate of extreme sports is much higher than that of non-extreme sports. The fatality rates for climbing, hang-gliding, and paragliding, as introduced by Shephard (2013), clearly show the danger of participating in extreme sports. He describes in his study that three climbers of Mt. Denali out of one thousand have fatal injuries. He also hazards a guess that only 3 out of 19 hang-gliding and paragliding injuries are officially reported. Therefore, it needs to be noted that there could be numerous serious or fatal accidents occurring in extreme sports circumstances. Moreover, the chances, due to the compulsiveness of the extreme activity, of suffering accidental injuries or chronic after effects are accordingly increased.

Why do people keep participating in extreme sports? It could be because of extreme sports participants' distinctive emotional experiences, which are associated with high levels of dopamine release (Herman et al., 2014; Spoelder et al., 2017; Stolf et al., 2017). In addition, the answer for why people do extreme sports despite the high chances of serious injuries and fatalities could be sought using neuroscientific approaches. The results of recent research show that participating in extreme sports and acute exercise is interrelated with increasing levels of Dopamine Receptor D2 (henceforth, DRD2) (Hu et al., 2015) and ◎-endorphin (Sinaei and Kargarfard, 2015), both of which are known as compulsive-related substances. In other words, extreme sports participants seem to experience more intensive senses of excitement, reward, motivation, immersion, achievement, etc. than those participating in non-extreme sports or moderate levels of exercise. This helps us infer that the quantitative difference between released DRD2 and ◎-endorphin probably marks the differences

in intensity between the senses of excitement, reward, motivation, immersion, achievement, etc. felt by extreme and non-extreme sports participants.

In addition to differences in the emotional intensity experienced by the non-addicted and addicted individuals, and between the extreme and non-extreme sports addicts, there seem to be somewhat different senses extreme sports participants experience compared to gambling, Internet, nicotine, and alcohol addicts, or even compulsive exercisers. Ewert and Hollenhorst (1989) describe how extreme sports participants take fatal risks and experience senses of danger, alertness, fear, thrill, etc. in addition to the senses of achievement, helplessness, excitement, nervousness, immersion, or self-realization that non-extreme sports participants are used to experiencing, which leads us to the inference that DRD2 and β-endorphin could intervene in the production of isomorphic senses like danger, alertness, fear, thrill, etc. that extreme sports participants are much more likely to experience than non-extreme sports participants.

There are intuitive cases that suggest what extreme sports participants feel could be more or less different from the feelings that addicted gamblers, substance users, or non-extreme compulsive sports participants or exercisers experience. For instance, what skydivers feel when jumping from an airplane or what snowboarders feel when sliding down on a sheer cliff could be different in affect and intensity from what gamblers feel when betting or what non-extreme sports participants like soccer players feel when they score a goal. Thus, what skydivers and snowboarders feel could be described as "thrill" rather than "excitement", which sounds less intense. Apart from the debate of whether "excitement" and "thrill" are identical in their emotional origins, the intensity of these two feelings seems quite different. Differences in the intensity of feelings between what extreme sports participants go through and what non-extreme sports people experience surely does not imply differences in the degree of addictiveness or the levels of susceptibility to addiction between the two. However, emotional differences in the kind or the intensity of the experience definitely influence what and how addictiveness or compulsiveness should be measured.

The scale that was previously invented to measure the compulsiveness of non-extreme sports or exercise needs to be developed further, or at least modified, if the intensity or kind of feelings extreme sports participants experience differ from those of non-extreme sports participants. This explains the purpose and the context of this study: the need to develop a scale to measure only extreme sports participants' compulsions or addictions. The purpose of extreme sports participants' acknowledgment of how compulsive they are is surely not to encourage them to quit or avoid adventures, but rather to help them become more cautious and better prepared with safety plans to enable them to keep enjoying the activity.

Compulsive exercise scales

The prevention of possible injuries has been a top priority in diverse sports circumstances. Wearable gadgets, protection equipment, secure facilities, safety plans, management systems, etc., have been adopted in sports settings to prevent accidents and injuries. These could, however, be useless without participants' understanding, attitude, motivation, and commitment, all of which underlie their behaviors (Deci and Ryan, 1994; Downs and Hausenblas, 2005; Stewart et al., 1991; Wang and Biddle, 2001). The very first step toward safe behavior and participation is to get to know the participants themselves: their levels of fitness, techniques, experience, mental readiness, compulsiveness, and so on.

Compulsive exercise (Goodwin et al., 2011; Taranis et al., 2011) has had diverse names such as exercise dependence (Downs et al., 2004; Hausenblas and Downs, 2002b; Ogden et al., 1997), commitment to exercise (Davis et al., 1993), exercise salience (Kline et al., 1994; Morrow and Harvey, 1990), obligatory exercise (Pasman and Thompson, 1988), exercise addiction (Kaur and Agarwal, 2009) and exercise orientation (Yates et al., 1999). Each scale uses slightly different factors in survey questionnaires to determine participants' addictiveness, compulsiveness, or dependence, although each was developed with a similar purpose; that is, to measure the level of participants' general uncontrollability in doing a particular exercise or sport.

In general, the factors and the survey items included in all the aforementioned exercise

compulsiveness, addictiveness, or dependence scales could be classified into physical, social, behavioral, emotional, and cognitive ones. The factors and survey items included in each scale were as follows: the physical ones were associated with "fatigue", "pain", "injury", "weight control" or "hormonal changes" (Kaur and Agarwal, 2009). The social ones were related to "reduction in other activities", "interference with social, domestic or occupational commitments" or "interpersonal sensitivity" (Ogden et al., 1997; Yates et al., 1999). The behavioral ones were more likely to be interrelated with "tolerance", "time", "lack of control", "intention effect" or "length of exercise time per day or week" (Hausenblas and Downs, 2002b). "Tolerance" indicates participants' need and commitment to increase their exercise duration or intensity if doing the activity for a short period of time. On the other hand, "time" means that a great deal of time is allotted to exercise such as "exercise on vacation" or "exercise on the weekend". "Intention effect" implies that exercising takes more time than is intended.

Goodwin et al. (2011) include "avoidance" as a behavioral factor, which means that whether one avoids what he/she has to do is one of the factors determining his/her compulsiveness. Feeling depression, anxiety, hostility, or helplessness could be classified as emotional factors. Feelings of preoccupation, withdrawal, obligation, discomfort, lack of enjoyment, or guilt are also classified as emotional factors (Hausenblas and Downs, 2002b; Taranis et al., 2011). There are only a few factors or survey items related to the cognitive aspects. Such factors or survey items include asking participants about their anticipation of what could happen in their workplace, home, or within themselves if they do not exercise. Participants' knowledge of the results of exercise addiction is another cognitive factor.

With regard to extreme sports participants' addictiveness, Heirene et al. (2016) investigated how to discern the withdrawal states of rock climbers. The results of their research show that "degrees of anhedonia", "craving" and "negative effect" could be useful measures for predicting participants' addictiveness to rock climbing. These three factors, however, are not to be used to understand the participants' general compulsiveness in regard to extreme sports. Rather, they are meant to show what influences the state of rock climbers' "withdrawal" experience, which is just one of the factors used to determine the degree of exercise compulsiveness evidenced by extreme and non-extreme sports participants.

In general, most previous studies aimed at measuring the level of compulsiveness or addictiveness of exercise include multi-faceted dimensions to measure participants' addictiveness, dependence or compulsiveness. However, almost all of these studies were developed for regular exercise participants, not for sports or extreme sports participants. It seems that diverse scales with a variety of participant groups need to be developed, given that a scale based on a specific group of people in particular circumstances and at a certain time could be invalid or unreliable with another group of people in a different condition. Therefore, it seems that efforts to understand what measures could determine the degree of extreme sports participants' compulsiveness need to be maintained; firstly because extreme sports participants' compulsiveness could be linked to serious or fatal injuries, secondly, because the factors or survey items developed to investigate compulsiveness or addictiveness for non-extreme sports or exercise participants could be somewhat different from those developed for extreme sports participants, and finally, because there have been few studies developed to exclusively measure extreme sports participants' overall compulsiveness.

Methods

Procedures and Participants

There were three different groups of participants in this study aimed at developing the compulsive exercising scale for extreme sports participants. In the first phase of the study, nine experts were interviewed with the aim of searching for the factors affecting participants' compulsive exercising in extreme sports. Their demographic profiles are presented in Table 1. Extreme sports participants engaged in rock climbing, skin and scuba diving, paragliding, and leisure aviation were purposely asked to volunteer for the study. In the second phase, the exploratory factor analysis, 89 female and 164

male extreme sports participants were recruited on a volunteer basis. A similar number of different individuals, 95 females and 152 males, volunteered for the last phase of the confirmatory factor analysis. They had previously engaged in rock climbing, paragliding, mountain biking, leisure aviation, and scuba diving. The participant demographic information is provided in Tables 2 and 3.

Measures

Expert Review

Nine experts reviewed 95 items from the compulsive exercising scales previously developed by Davis et al. (1993), Downs et al. (2004), Goodwin et al. (2011), Hausenblas and Downs (2002b), Heirene et al. (2016), Insel and Roth (1993), Kang (2009), Kaur and Agarwal (2009), Kim and Yoo (2009), Kline et al. (1994), Morrow and Harvey (1990), Ogden et al. (1997), Pasman and Thompson (1988), Pierce (1994), Pierce and Morris (1998), Shin (2004), and Yates et al. (1999) for the content validity of the survey items. All these scales were used to measure the level of addiction for non-extreme sport participants. The experts were told the purpose of the study in advance. Then, it was emphasized that this study's proposed scale was especially for extreme sports participants, and they were asked to remove any item they considered to be irrelevant to extreme sports participants. The study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board of the Sookmyung Women's University approved the study (SMWU-1501-HR-073-01). All participants were informed about the study details, and they all provided informed consent.

Exploratory Factor Analysis

The 82-item survey obtained through expert review was administered to 253 participants to remove the redundant items and uncover the necessary factors, determined via factor loading values and goodness of model fit indexes.

Confirmatory Factor Analysis

Another group of 247 participants volunteered to confirm the explored factors. Participants joining the exploratory factor analysis were asked not to involve themselves in this process since their participation could impair the external validity of the study (Thomas and Nelson, 1996) and decrease the generalizability of the developed scale (DeVellis, 2012; Kline, 2011).

Statistical Analyses

Expert Review

In the expert review stage, each item in the initially developed 95-item survey was evaluated by the nine experts using a 4-point Likert scale. The scale used to measure the appropriateness of each survey item consisted of "Completely Inappropriate" (1 point), "Inappropriate" (2 points), "Appropriate" (3 points), and "Completely Appropriate" (4 points). Any item earning less than an average of 3 points based on the consensus of the experts was removed according to the recommendation of DeVellis (2012).

Exploratory Factor Analysis

In the exploratory factor analysis stage, the 82-item survey determined by the nine experts was distributed to 253 participants for the exploratory factor analysis. Factors were determined through maximum likelihood estimation. Oblique rotation was conducted to redefine the factors to allow for correlations and also distinctions in the meanings of the factors (Thomas and Nelson, 1996). The interpretability of the item was also included in the determination process. Interpretability is necessary for seeing whether the model has readily interpretable and theoretically sensible result patterns by examining the subset of the models (Comrey, 1978; Hakstian et al., 1982). Amos ver. 20.0 (IBM Corp., Armonk, NY, USA) was utilized in both the exploratory and confirmatory factor analyses. Maximum likelihood estimation and oblique rotation were applied to infer feasible factors. The values of the Root Mean Square Error of Approximation (henceforth, RMSEA), as well as the interpretability of the item and factor loadings (>0.4), were implemented to determine the model fit instead of just applying the standard of "Eigenvalue >1.0", since under or overproduction of factors could occur if only Eigenvalues are taken into account (Zwick and Velicer, 1986).

Therefore, the appropriateness of the factor number was determined with these three values (Fabrigar et al., 1999). RMSEA scores show the extent to which the model fits the population covariance matrix (Browne and Cudeck, 1993). The model is considered a close fit if its value is less than 0.05, a fair fit if its value ranges from 0.05

to 0.08, and a poor fit if its score is greater than 1.0 (Browne and Cudeck, 1993; Browne and Mels, 1990).

Confirmatory Factor Analysis

In the last stage of the confirmatory factor analysis with 247 participants, maximum likelihood estimation was applied to remove the factors that did not acquire the unidimensional assumption. The scores of the Tucker-Lewis Index (henceforth, TLI), the Comparative Fit Index (henceforth, CFI), and the RMSEA were used to determine the model fit. The model was regarded as a good fit if the scores of the TLI and CFI were greater than 0.90 (Bentler, 1990; McDonald and Marsh, 1990; Tucker and Lewis, 1973) and if the RMSEA score was lower than 0.08.

Results

Expert Review

Previous studies indicate that the following are common characteristics of addiction: "dependence", "tolerance", "withdrawal symptoms", "obsession", "loss of control", and "denial" (Davis et al., 1993; Downs et al., 2004; Goodwin et al., 2011; Hausenblas and Downs, 2002b; Heirene et al., 2016; Insel and Roth, 1993; Kang, 2009; Kaur and Agarwal, 2009; Kim and Yoo, 2009; Kline et al., 1994; Morrow and Harvey, 1990; Ogden et al., 1997; Pasman and Thompson, 1988; Pierce, 1994; Pierce and Morris, 1998; Shin, 2004; Yates et al., 1999). From the literature review, 95 items were screened, and 82 of these were selected by the nine experts during the review stage. Each item was scored by the experts on a 4-point Likert scale for the purpose of content validity.

Exploratory Factor Analysis

With regard to determining the model fit with RMSEA, factors included in previous studies were investigated. Three to five factors were described in Heirene et al. (2016), Insel and Roth (1993), Kang (2009), Kim and Yoo (2009), Pierce (1994), Pierce and Morris (1998), and Shin (2004). Thus, the appropriateness of the factor number was calculated to the extent of ± 2.0, which ended with a one- to seven-factor model (DeVellis, 2012; Fabrigar et al., 1999). Factor 1 was revealed to be inappropriate and was removed in the process of determining the model fit with RMSEA (>0.08), while the other six factors were accepted since the RMSEA scores for the other six factors were lower than 0.08, as shown in Table 4.

Afterwards, the interpretability of the items and the scores of the factor loading were included to determine goodness of fit, as indicated by Devellis (2012) and Fabrigar et al. (1999). Factors having a factor loading value less than 0.4 and 62 uninterpretable items were removed. Consequently, a 4-factor survey was revealed with the values of $\chi^2 = 208.563$ ($p < 0.001$), df = 116, and RMSEA = 0.056 (Table 5). Items a14, a15, a16, a17, and a70 correlated with factor 1 (Withdrawal Symptom); a27, a30, a53, a55, a59, a75, and a78 correlated with factor 2 (Attachment); a1, a2, a4, and a5 correlated with factor 3 (Struggle); and a12, a19, and a47 correlated with factor 4 (Obsession) (See Table 5 in the Appendices). The naming of each group of items was based on the described symptoms for each item and definitions described in previous studies.

Confirmatory Factor Analysis

In the 2nd confirmatory factor analysis survey with 247 participants, the values of $\chi^2 = 328.728$ ($p < 0.001$) and df = 164 demonstrated an acceptable level of goodness of model fit. However, item a16 was removed according to the modification indices due to its multidimensionality. In addition, items a5, a70, and a78 were removed due to the low scores (<0.4) of squared multiple correlations (henceforth, SMC) (DeVellis, 2012). Finally, a model was determined with $\chi^2 = 167.775$ ($p < 0.001$), df = 98, TLI = 0.952, CFI = 0.961, and RMSEA = 0.054. The values of the standardized coefficient (>0.6), SMC (>0.4) and the Cronbach's α (>0.7) supported the goodness of model fit (Table 6).

In addition, the discriminant validity was found to be appropriate (<0.8) based on the values of the correlation coefficient among the latent variables (Table 7). The highest score of the correlation coefficient was 0.523 between the "Withdrawal Symptom" and "Attachment", while the lowest was 0.109 between "Attachment" and "Struggle". The finalized survey is described in Table 8.

Table 1

Demographic profiles of the participants in the expert review

		Status	Experience	Field of Vocation
Phase 1 (Expert Review)	Expert 1	Instructor	20 years	Leisure aviation
	Expert 2	Professor in Sport Pedagogy	11 years	University
	Expert 3	Doctorate in Sport Pedagogy	15 years	Skin and Scuba Diving
	Expert 4	Professor in Sport Sociology	10 years	University
	Expert 5	Doctorate in Sport Sociology	10 years	Rock Climbing
	Expert 6	Professor in Sport Psychology	15 years	Rock Climbing
	Expert 7	Doctorate in Leisure Science	10 years	Paragliding
	Expert 8	Professor in Sport Physiology	15 years	Skin and Scuba Diving
	Expert 9	Elite-level Instructor	19 years	Rock Climbing

Table 2

Demographic profiles of the participants in the exploratory factor analysis

	Classifications	Frequency	Ratio (%)
Gender	Female	89	64.8
	Male	164	35.2
Age	Mean = 29.854, Standard deviation = 10.582		
Income	~ 2,000,000 (KW)	50	19.8
· KW: Korean Won	2,000,000 ~ 3,000,000 (KW)	29	11.5
· $1= KW 1,100	3,000,000 ~ 4,000,000 (KW)	36	14.2
	4,000,000 ~ 5,000,000 (KW)	28	11.1
	5,000,000 ~ (KW)	35	13.8
	N/A	75	29.6
Activity	Rock Climbing	61	24.1
	Skin Scuba	106	41.9
	Paragliding	41	16.2
	Mountain Biking	24	9.5
	Leisure Aviation	21	8.3
Period of Participation (Month)	Mean = 41.083, Standard deviation = 47.539		

Table 3

Demographic profiles of the participants in the confirmatory factor analysis

	Classifications	Frequency	Ratio (%)
Gender	Female	95	61.5
	Male	152	38.5
Age	Mean = 29.190, Standard deviation = 10.742		
Income	~ 2,000,000 (KW)	61	24.7
· KW: Korean Won	2,000,000 ~ 3,000,000 (KW)	30	12.1
· $1= KW 1,100	3,000,000 ~ 4,000,000 (KW)	27	10.9
	4,000,000 ~ 5,000,000 (KW)	16	6.5
	5,000,000 ~ (KW)	36	14.6
	N/A	77	31.2
Activity	Rock Climbing	71	28.7
	Skin Scuba	89	36.0
	Paragliding	47	19.0
	Mountain Biking	23	9.3
	Leisure Aviation	17	6.9
Period of Participation (Month)	Mean = 38.988, Standard deviation = 49.618		

Table 4

Root Mean Square Error of Approximation scores for Model Fit

Factor Number	χ^2	df	Root Mean Square Error of Approximation
Factor 1	Estimation error		
Factor 2	6702.74	3158	0.067
Factor 3	6170.68	3078	0.063
Factor 4	5668.586	2999	0.059
Factor 5	5197.57	2921	0.056
Factor 6	4945.54	2844	0.054
Factor 7	4699.937	2768	0.053

Table 5

Factor Loading Matrix

Item	Factor 1 (Withdrawal symptom)	Factor 2 (Attachment)	Factor 3 (Struggle)	Factor 4 (Obsession)
a16	0.92	0.01	0.02	0.13
a15	0.77	0.07	0.01	-0.09
a14	0.75	-0.01	0.09	-0.11
a17	0.74	-0.03	-0.02	-0.12
a70	0.62	0.05	-0.04	0.00
a65	-0.06	0.85	-0.07	0.08
a55	0.08	0.77	0.06	0.04
a53	0.00	0.77	0.02	-0.01
a30	0.00	0.75	-0.03	-0.03
a59	-0.07	0.74	-0.03	-0.03
a75	0.08	0.74	0.04	0.03
a27	0.05	0.67	-0.04	-0.09
a78	0.01	0.64	0.07	-0.06
a1	0.05	-0.05	0.78	-0.02
a4	0.08	-0.10	0.73	-0.05
a2	0.11	0.05	0.69	0.06
a5	-0.13	0.06	0.50	-0.01
a12	-0.04	0.02	0.04	-0.84
a19	0.02	0.03	0.03	-0.81
a47	0.08	0.01	-0.05	-0.68

$\chi^2 = 208.563$, $df = 116$, Root Mean Square Error of Approximation = 0.056

Table 6

Scores of coefficients, *t*-value, squared multiple correlation, and reliability

Latent variables	Item	Non-standardized coefficients	Standardized coefficients	*t*	Squared Multiple Correlation	Reliability
Withdrawal symptom	a17	0.740	0.686	10.448***	0.518	0.81
	a14	0.855	0.735	11.099***	0.757	
	a15	1.000	0.871	ULI Constraints	0.695	
Attachment	a59	1.000	0.751	ULI Constraints	0.729	0.90
	a30	1.036	0.755	11.846***	0.448	
	a53	1.095	0.778	12.240***	0.451	
	a55	1.145	0.808	12.755***	0.518	
	a65	0.946	0.723	11.303***	0.460	
	a75	0.956	0.678	10.544***	0.523	
	a27	1.087	0.720	11.245***	0.653	
Struggle	a2	0.767	0.672	8.580***	0.605	0.77
	a4	0.828	0.669	8.565***	0.570	
	a1	1.000	0.854	ULI Constraints	0.564	
Obsession	a47	1.000	0.834	ULI Constraints	0.760	0.85
	a19	1.078	0.870	13.506***	0.541	
	a12	0.853	0.720	11.774***	0.471	

$\chi^2 = 167.775$, $df = 98$, $TLI = 0.952$, $CFI = 0.961$, $RMSEA = 0.054$

ULI, constraints indicate Unit Loading Identification Constraints;
TLI, Tucker-Lewis Index; CFI, Comparative Fit Index,
RMSEA, Root Mean Square Error of Approximation

***$p < .001$

Table 7

Inter-factor correlation scores in the confirmatory factor analysis

Latent variables	Route	Latent variables	Correlation coefficient
Withdrawal symptom	↔	Attachment	0.523
Withdrawal symptom	↔	Struggle	0.246
Withdrawal symptom	↔	Obsession	0.376
Attachment	↔	Struggle	0.109
Attachment	↔	Obsession	0.358
Struggle	↔	Obsession	0.215

Table 8

Compulsive Exercising Scale for Extreme Sports Participants

Factors	Item No.	Description	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Attachment	1	I feel immersing in the activity.	1	2	3	4	5
	2	The activity is an important part of my life.	1	2	3	4	5
	3	I used to losing track of time while doing the activity.	1	2	3	4	5
	4	The activity is one of the favorite things that I can do.	1	2	3	4	5
	5	I can express myself as much as I can while doing the activity.	1	2	3	4	5
	6	I feel more satisfied in doing the activity that in doing others.	1	2	3	4	5
	7	The activity is the most important leisure to me.	1	2	3	4	5
Withdrawal Symptom	8	I feel pity and angry to myself if not doing the activity for a few days.	1	2	3	4	5
	9	I feel devitalized if not doing the activity for a few days.	1	2	3	4	5
	10	I feel losing stamina or appetite if not doing the activity for a few days.	1	2	3	4	5
Struggle	11	I have struggled with family members because of doing the activity.	1	2	3	4	5
	12	I have struggled with my girl- or boyfriend or other friends because of doing the activity.	1	2	3	4	5
	13	I have worried about spending much time in doing the activity.	1	2	3	4	5
Obsession	14	I don't stop doing the activity because of an injury while performing it.	1	2	3	4	5
	15	I keep participating in the activity despite an injury.	1	2	3	4	5
	16	I keep doing the activity despite a pain.	1	2	3	4	5

Discussion

This study intended to develop a compulsive exercising scale for extreme sports participants, since the development of their understanding of the degree of their compulsiveness underlies their intentional, attitudinal, and behavioral changes aimed at not sustaining any injuries due to compulsiveness. Meticulously understanding the right factors for measuring compulsiveness in extreme sports is the very first step in preventing injuries or accidents that could be serious or even fatal.

There have been diverse previous studies aimed at developing a compulsive exercising scale, as described earlier in this study. What is different here compared to previous studies is as follows. Firstly, this study specifically targets extreme sports participants instead of non-extreme sports or exercise participants, assuming that the extreme sports participants' emotional experiences could be somewhat different from those of non-extreme sports or exercise participants. In addition to non-extreme sports or exercise participants' affective experiences such as fun, enjoyment, excitement, achievement, previous studies have shown that extreme sports participants can experience different emotional responses such as fear, sense of danger, alertness, ecstasy, and/or thrill.

Secondly, this study confirms that the participants in this study adopted only the emotional and the behavioral factors in determining their compulsiveness to extreme sports, while previous studies aimed at developing a compulsive exercising scale included the cognitive dimension as the main determinant, or they at least combined the cognitive, affective, and behavioral factors. This implies that the scale used to measure the compulsiveness of extreme sports participants needs to be developed separately from that used for exercisers or non-extreme sports participants.

It is certain that participants having any sort of addiction could share similar symptoms. Likewise, the factors resulting from this study seem very similar to the factors demonstrated in other research aimed at developing a compulsive exercising scale (DeVellis, 2012; Heirene et al., 2016; Hausenblas and Downs, 2002b; Sachs, 1981; Sachs and Pargman, 1984). Moreover, the literal or implied meanings of the factors described both in those studies and in this one aim, at least, at similar emotions, although it has been acknowledged in previous research that the extreme sports participants' emotional experiences could be somewhat different from what non-extreme sports participants or compulsive exercisers feel. The factors "Withdrawal Symptom", "Attachment", "Struggle" and "Obsession" resulting from this study are similar, in terms of their literal and implied meanings, to those of the previously developed scales in other studies.

What is noteworthy, however, is that the factors developed in this study comprise only two emotional and two behavioral dimensions, instead of including either the cognitive one or the cognitive, affective, and behavioral ones together. Seven survey items for the factor of "Attachment" and three for the "Withdrawal Symptom", as described in Table 8, are associated with what the participants feel. Three survey items for "Obsession" and three for "Struggle" ask what they do or have done, in relation to their participation in extreme sports. This enables the inference that participants' levels of compulsiveness in extreme sports could be influenced more by what they feel than by what they think. Accordingly, it is likely that how and what they do in relation to the compulsiveness to extreme sports could be affected more by their emotional responses than by their cognitive reasoning. In summary, it seems necessary to develop a scale only to measure extreme sports participants' compulsiveness; firstly since their emotional experiences during participation are implicitly somewhat different from those of non-extreme sports or exercise participants, and secondly, since their level of compulsiveness into extreme sports needs to be measured with a scale solely developed for them.

Conclusion

This study reveals that extreme sports participants experience somewhat different feelings, like fear, alertness, thrill, and/or danger during participation in addition to their feelings of satisfaction, achievement, excitement, etc., which are the same as those experienced by non-extreme sports participants or exercisers. Accordingly, the fact that the factors in the scale developed in this study reflect only the emotional and the behavioral dimensions rather than

focusing on the cognitive dimension or any combination of the cognitive, affective, and behavioral dimensions together, explains the need to develop a scale to measure compulsiveness only for extreme sports participants.

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