



PERGAMON

Personality and Individual Differences 25 (1998) 1063–1083

---

---

PERSONALITY AND  
INDIVIDUAL DIFFERENCES

---

---

# Sensation seeking among high- and low-risk sports participants

S. J. Jack\*, K. R. Ronan

*Department of Psychology, Massey University, New Zealand*

Received 10 September 1997

---

## Abstract

Investigated were the sensation seeking tendencies of a diverse sample of 166 athletes. The main aim of the study was to assess empirical support for Zuckerman's (1994) Impulsive-Sensation-Seeking (ImpSS) theory and to replicate and extend previous research findings in this area using high- and low-risk sport participants. The Sensation Seeking Scale-V (Zuckerman et al., 1978) and the Impulsiveness Scale of the Impulsiveness-Venturesome-Empathy Scale (Eysenck and Eysenck, 1978), were administered to both male and female athletes currently engaged in one of eight sport disciplines: Hang-gliding, mountaineering, sky-diving, automobile racing, swimming, marathon running, aerobics or golf. Results provided support for the main thrust of Zuckerman's ImpSS theory (a) that sensation seeking is integrated within a broader trait called Impulsive-Sensation Seeking; and (b) that total sensation seeking differentiated between high- and low-risk sport participants. On the other hand, these participants did not differ on the impulsiveness dimension. These and other findings are integrated with respect to Zuckerman's (1994) Impulsive-Sensation Seeking model. Limitations of the present study and suggestions for future research are also discussed. © 1998 Elsevier Science Ltd. All rights reserved.

---

## 1. Introduction

The personality trait known as 'Sensation Seeking' (SS), is defined as 'the seeking of varied, novel, complex and intense sensations and experiences and the willingness to take physical, social, legal and financial risks for the sake of such experiences' (Zuckerman, 1994). Zuckerman (1994) hypothesised that sensation seeking was integrated within a broad trait called Impulsive-Sensation Seeking (ImpSS). That is, the personality dimensions of impulsiveness and sensation seeking are thought to be interconnected.

---

\* Corresponding author: Dr Kevin R. Ronan, Department of Psychology, Massey University, Private Bag 11222, Palmerston North, New Zealand. E-mail: K.R.Ronan@massey.ac.nz

One implication of the sensation seeking construct is that the particular sport discipline one is more likely to participate in may be based on whether one is high or low on the sensation seeking trait. In addition, sensation seeking in the sporting context has often been looked at from a risk-taking perspective (Zuckerman, 1983).

Zuckerman (1983) classified sports according to the associated risks involved. At one end of the sport risk continuum are sports such as sky-diving, motor-car racing and hang gliding. What characterizes these sports is the acute danger associated with accidents (i.e. risk of fatal injury). At the other end of the classification are sports such as golf, swimming and marathon running where injuries can occur but the probability of fatalities is fairly remote. Between these two groups (Medium-Risk sports) are the contact sports, such as American football or rugby, wherein serious injuries are possible but the chances of death are remote.

In a summary of the early work, Zuckerman concluded, 'The broad trait of SS is related to participation in specific kinds of sports, namely those that provide unusual sensations and novel experiences such as those involved in sky-diving, hang-gliding, skiing and scuba diving' (1983, p.290). For example, sky divers (Hymbaugh and Garrett, 1974), auto racers and hang gliders (Straub, 1982) have all been shown to have higher SS scores compared to controls. Medium risk sports (e.g. body-contact sports) have also been associated with higher sensation seeking. More recent work has also replicated aspects of the hypothesized relationship between higher levels of sensation seeking and participation in risk sports (Cronin, 1991; Freixanet, 1991).

Lower-risk sports, such as running and gymnastics, were negatively related to sensation seeking. That is, these sports have been generally found to be more commonly pursued by persons low in sensation seeking (McCutcheon, 1980). Potgieter and Bisschoff (1990) concluded that the trait of sensation seeking serves as a possible underlying explanation for the motivation of many individuals to participate in high-risk vs low-risk sports. A comprehensive summary of research conducted in the area of sensation seeking and sport participation is given in Table 1. As may be seen, research has generally shown that athletes who are currently active in risky sports, typically score significantly higher than control groups on the Sensation Seeking, Scale (SSS) and the Thrill and Adventure Seeking (TAS) and Experience Seeking (ES) subscales.

The sensation seeking model hypothesizes that sensation seeking is embedded in a broader trait called ImpSS (Zuckerman, 1994). Like Zuckerman (1994), Eysenck and Eysenck (1978) believe that 'these two concepts—sensation seeking and impulsiveness—seem to overlap considerably' (p. 1248). However, findings regarding this hypothesis have been mixed. For example, Freixanet (1991) found that alpinists, mountaineering-related sportsmen and other sportsmen not engaged in mountaineering did not differ from controls on the impulsiveness dimension. Although no significant differences were found between these sport groups, Freixanet (1991) did find positive correlations between impulsiveness and the SS subscales and Total scale. Fowler et al. (1980) found that a group consisting of experienced mountaineers and those with an interest in mountaineering, were higher on monotony avoidance, impulsive extraversion and other impulsiveness scales than students not interested in mountaineering.

Other studies have not supported the ImpSS model. Kerr and Svebak (1989), using the risk classifications of Zuckerman (1983), compared those engaging in risky and non-risky sports across the following dimensions: impulsiveness, arousal avoidance, planning orientation and serious-mindedness. The only consistently significant difference between those engaging in risky vs safe sports was on the arousal avoidance scale. Those practicing safe sports were higher on arousal

Table 1  
Research relating sensation seeking to sports

	Author(s)	Experimental (sex, <i>N</i> )	Control (sex, <i>N</i> )	Differences
High-risk sports				
Parachuting	Hymbaugh and Garrett (1974)	Sky-divers (M and F = 21)	Non-sky-divers	Sky-divers higher on Gen.SSS (II)
Hang-gliding, Auto-racing	Straub (1982)	Hang-gliders (M = 33); Auto-racers (M = 22)	Bowlers (M = 25)	Gliders > bowlers Total TAS, ES (V), racers > bowlers on Total ES, Dis, BS
Misc; Parachute racers, Snow- mobilers, police and firemen	Kusyszyn et al. (1974)	'Risk-takers' (M = 85)	Civil servants and college students (M = 70)	Risk-takers higher on Gen. TAS (IV)
Scuba diving (novice)	Heyman and Ross (1980)	Novice divers (M = 29; F = 18)	Same-sex students	Divers higher on Total (v) Subscales not analysed
Scuba salvage diving	Bacon(1974)	Volunteer salvage divers	College students (matched)	Divers higher on Gen. TAS Dis, BS (IV)
Skiing	Connolly (1981)	Skiers (M = 27; F = 18)	Non-skiers from health-spa (matched)	Skiers higher on Total, TAS, Ski- instructors > skiers Total TAS, ES
Mountain climbing	Fowler et al. (1980)	Climbers (M = 11, F = 7) and students interested in climbing (9)	Dental students not interested in climbing (32)	Climbers and interested higher on Gen. TAS (IV)
	Cronin (1991)	Climbers (M and F = 21)	College students (M and F = 20)	Climbers > controls on Total, ES, TAS (V)
Alpinists moutaineer rings, high-risk sportsmen	Freixanet (1991)	Alpinists (M = 29) mountaineers (M = 72), sportsmen	Subjects not engaged in any risk activities (M and F = 54)	Alpinists, mountaineers, sportsmen > controls on TAS, ES, Total (V)
Hang-gliders	Wagner and Houlihan (1994)	Glider pilots (M and F = 170)	Golfers (M and F = 90)	Glider pilots < golfers on all four subscales and Total (V)
White-water	Campbell et al. (1993)	Canoe and Kayak paddlers (M = 34; F = 54)	Normative scale	Paddlers higher on TAS (V)

Table 1  
Continued

	Author(s)	Experimental (sex, <i>N</i> )	Control (sex, <i>N</i> )	Differences
Medium-risk sports				
Body-contact sports	Stirling (1977)	Body-contact sports (M = 14)	Non-contact sports (M = 11); Non-athletes (M = 11)	Contact > non-athletes on Gen, TAS Dis (IV)
Football	Cellini (1982)	Criminal offenders on probation or parole (M = 65)		Total, TAS ES (V) correlated with participation in football. Little correlation with non-contact sports
Rugby	Potgieter and Bisschoff (1990)	Rugby players (M = 35)	Marathon runners	Rugby players higher on Total and TAS (V)
Low-risk sports				
Running	McCutcheon (1980)	Runners (M = 42; F = 20)	Non-runners (matched)	Male runners lower on Dis, Female runners lower on Total, TAS
Gymnastics	Straub (1982)	Gymnasts (F = 28)	Bowlers (F = 31)	No differences on SSS (V) scales
Physical Education Majors	Wykoff (1982)	Physical Education (M = 52; F = 60)	SSS norm group	No difference on any SSS (V) scales

avoidance. Arousal avoidance is thought to have an inverse relationship with sensation seeking (i.e. low arousal avoidance is a feature of high sensation seeking). No differences were found on the other dimensions. Importantly, the lack of finding on the impulsiveness dimension did not provide support for the ImpSS construct.

Owing to these mixed findings and the limitations of previous research (e.g. small sample sizes below 50 participants), further study in this area is warranted.

## 2. The present study

The present study had three primary goals: (a) to provide a specific test of Zuckerman's ImpSS theory with a relatively large sample of New Zealand athletes and to (b) to replicate and (c) extend

previous research which has examined the relationship between sensation seeking and participation in a variety of sporting activities. The aim was to assess the sensation seeking profiles of a group of participants engaged in high physical risk sport activities and to compare them with a group engaged in lower physical risk sport activities. Specific sports of interest included: (a) High-Risk Sports—sky-diving; mountaineering; hang-gliding; motor-car racing; and (b) Low-Risk Sports—marathon running; aerobics; swimming; golf.

### 2.1. *The hypotheses*

The following main hypotheses were the focus of the present study:

(1) Sensation seeking was hypothesized to be part of a broader trait, namely impulsive-sensation seeking (Zuckerman, et al., 1998, 1991). As discussed earlier, findings in this area have been mixed. Kerr and Svebak (1989) found no relation between sensation seeking and impulsiveness. On the other hand, Fowler et al. (1980) did find a positive relationship. Based on ImpSS theory, it was hypothesized that the personality dimensions of sensation seeking and impulsiveness would be significantly related—that is, significant differences would be found between high and low-sensation seekers on impulsiveness and that Sensation Seeking would correlate significantly with Impulsiveness. Thus, positive correlations were predicted between the Sensation Seeking subscales and Impulsiveness.

(2) Based on ImpSS theory and previous research findings, the present study hypothesized that individuals with a strong tendency to seek sensations would be attracted to high-risk sports, whereas individuals with weaker sensation seeking dispositions would tend to participate in low-risk sports. Thus, it was hypothesized that sensation seeking would differentiate high from low-risk sport participants.

(3) It was hypothesized that individuals who participate in high-risk sports would score higher not only on total sensation seeking, but also on the specific subscales of the SSS than those subjects who participate in the low-risk sports. It was further hypothesized that individuals who participate in the high-risk sports would score higher on impulsiveness than those subjects who participated in the low-risk sports.

## 3. Method

### 3.1. *Participants*

There were 272 sets of materials sent out to potential participants and of these, 166 were returned and used in analyses (a return rate of 61%). Thus, the sample was made up of 166 volunteering participants (male = 119; female = 47), ranging in age from 13–76 years, who were currently participating in one of eight sport categories: Automobile racing, sky-diving, hang-gliding, mountaineering, marathon running, swimming, golf, or aerobics.

Table 2 provides information with regard to the sample's demographic data. The mean age for the whole sample was 29.2 years ( $SD = 11.86$ ,  $r = 13-76$ ). The mean age for the high-risk sample was 31.0 years ( $SD = 9.16$ ,  $r = 16-61$ ) and for the low-risk sample 27.1 years ( $SD = 14.36$ ,  $r = 13-76$ ). In terms of gender the mean ages were 29.0 years ( $SD = 16$ ,  $r = 13-76$ ) for females and also

Table 2

Sample characteristics: Comparing high and low risk groups with the sample as a whole

	Whole sample ( <i>N</i> = 166)		High-risk ( <i>N</i> = 93)		Low-risk ( <i>N</i> = 73)	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
<b>Age</b>						
19 or less	40	24	9	10	31	42
20–29	54	33	34	37	20	27
30–39	45	27	35	38	10	14
40–49	18	11	13	14	5	7
50–59	4	2	1	1	3	4
60+	5	3	1	1	4	5
<b>Sex</b>						
Female	47	72	10	11	37	49
Male	119	28	83	89	36	51
<b>S.E.S.</b>						
Student	41	25	10	11	31	43
Administration	39	24	29	31	10	14
Professional	21	13	19	20	2	8
Clerical	21	13	13	14	8	11
Sales	20	12	17	18	3	4
Service	10	6	4	4	6	8
Other	9	12	0	0	9	12
Agricultural	2	1	1	1	1	1
Unemployed	2	1	0	0	2	3
Production	1	1	0	0	1	1
Transport	0	0	0	0	0	0
Labourers	0	0	0	0	0	0
<b>Marital status</b>						
Single	100	60	46	50	54	64
Married/DeFacto	56	34	39	42	17	23
Divorced/Separated	10	6	8	9	2	3
Widowed	0	0	0	0	0	0
<b>Ethnic</b>						
European	154	93	86	93	68	93
Maori	5	3	2	2	3	4
Polynesian	1	1	1	1	0	0
Asian	2	1	1	1	1	1
Other	3	2	3	3	0	0

S.E.S. = Socioeconomic Status. Percentages rounded to the nearest whole number.

29.0 years ( $SD = 10$ ,  $r = 15$ – $61$ ) for males. The majority (57%) of the sample were aged between 13 and 29 years. Almost two-thirds (60%) of the participants were single. Most of the participants (93%) identified themselves as of European descent, with 3% identifying themselves as Maori. The remaining participants identified themselves as either Polynesian ( $N = 1$ ) or Asian ( $N = 2$ ); three identified themselves as 'Other'. One participant did not state his/her ethnicity. In regards to socioeconomic status, nearly half of the sample were either employed in the administrative and managerial fields (24%) or were students (25%). The remaining half of the sample were employed in the following areas: professional/technical (13%); clerical (13%); sales (12%); service (6%); agricultural (2%); production (0.6%—one participant); unemployed (1%) and other (5%).

Both for convenience and clarity of information, the demographic characteristics of each individual sport group are presented in Table 3.

### 3.2. Measures

#### 3.2.1. The sensation seeking scale (Form V)—(SS-V)

The Sensation Seeking Scale is used to measure individual sensation seeking tendencies. Form V of the SSS comprises 40 items, requiring forced-choice responses between two statements. The overall score for the 40 responses is regarded as a general sensation seeking score. The questionnaire also yields scores in four subsections. Ten items are contained within each of the four subscales:

(1) Thrill and Adventure Seeking (TAS): Items in this scale indicate a desire to engage in sports or other activities that provide unusual sensations of speed or defiance of gravity, such as parachuting, scuba diving, or skiing. The basic theme is summarized in the item 'I sometimes like to do things that are a little frightening'. Zuckerman (1979) has stated that the TAS subscale reflects the more socially acceptable type of sensation seeking behaviour.

(2) Experience Seeking (ES): Items in this scale represent the seeking of stimulation through the mind and the senses, through music, art, travel and psychedelic drugs. This scale also contains items which represent a desire to associate with unusual or unconventional persons (e.g. 'I have tried marijuana or would like to').

(3) Disinhibition (Dis): The items in this scale describe seeking sensation through social activities like parties, social drinking, gambling and sexual variety. An item describing this factor is; 'I like to have new and exciting experiences even if they are a little unconventional or illegal'.

(4) Boredom Susceptibility (BS): Items in this scale represent an intolerance for repetitive experience of any kind, including routine work and boring social interchange. An item expressing the attitude is; 'The worst social sin is to be a bore' (vs the forced-choice alternative: 'The worst social sin is to be rude').

In line with previous research (Rowland, 1986; Freixanet, 1991), a new variable was created. As most of the items from the Thrill and Adventure Seeking (TAS) subscale (9 out of 10) were concerned with sports and activities that the subjects were actually participating in, or had a desire to participate in, a new variable named 'Total Sensation Seeking minus Thrill and Adventure Seeking' (SSS-TAS) was created to control for the possibility of variance in Total Sensation Seeking scores being due solely to sports participation (vs more general activities). That is, SSS-TAS represents the sum of the remaining three subscales (possible range, 0–30). The reliability coefficient for internal consistency (Cronbach's  $\alpha$ ) for scores on the SSS-TAS scale was  $r = 0.96$ .

A positive correlation coefficient (0.94) was also found between SSS-TAS and Total Sensation Seeking ( $P < 0.001$ ).

The results of several studies have supported the SSS-V as a reliable and valid measure of sensation seeking (Farley and Farley, 1967; Zuckerman and Link, 1988; Zuckerman et al., 1978; Straub, 1982; Rossi and Cereatti, 1993). Internal consistency coefficients for the four subscales for an American sample ( $N = 97$ ) ranged from 0.67–0.84 (Zuckerman, 1979). Using the current sample, internal consistency coefficients for the four subscales of the SSS-V ranged from 0.56 of 0.68. Intercorrelations among the four subscales is moderate, ranging from 0.06 to 0.37 (Zuckerman,

Table 3  
Sample characteristics for individual sport groups

	Hang-gliders ( $N = 25$ )	Mountaineers ( $N = 22$ )	Sky-divers ( $N = 11$ )	Automobile racers ( $N = 32$ )
Age	$M = 31$ years $SD = 7.34$ $r = 17-47$	$M = 29$ years $SD = 8.26$ $r = 17-47$	$M = 31$ years $SD = 11.24$ $r = 17-48$	$M = 32$ years $SD = 10.72$ $r = 16-61$
Sex				
Male	24 (96%)	18 (82%)	8 (73%)	30 (94%)
Female	1 (4%)	4 (18%)	3 (27%)	2 (6%)
S.E.S.				
Professional	6	5	2	2
Administrative	6	8	27	14
Clerical	5	2	9	4
Sales	5	1	18	9
Service	0	0	0	0
Agricultural	0	3	0	1
Production	1	0	0	0
Transport	0	0	0	0
Labourers	0	0	0	0
Student	0	0	0	0
Unemployed	2	3	8	2
Other	0	0	0	0
Marital				
Single	9	14	6	15
Married/Defacto	15	7	1	15
Divorced/Separated	1	1	4	2
Ethnicity				
European	21	21	9	32
Maori	1	0	1	0
Polynesian	0	0	1	0
Asian	1	0	0	0
Other	2	1	0	0



Table 3  
*Continued*

	Golfers ( <i>N</i> = 22)	Swimmers ( <i>N</i> = 11)	Marathon runners ( <i>N</i> = 6)	Aerobics ( <i>N</i> = 34)
Age	<i>M</i> = 17 years <i>SD</i> = 3.12 <i>r</i> = 13–28	<i>M</i> = 40 years <i>SD</i> = 8.65 <i>r</i> = 29–53	<i>M</i> = 34 years <i>SD</i> = 8.78 <i>r</i> = 22–47	<i>M</i> = 28 years <i>SD</i> = 16.66 <i>r</i> = 14–76
Sex				
Male	12 (55%)	5 (46%)	2 (33%)	17 (50%)
Female	10 (46%)	6 (55%)	4 (67%)	17 (50%)
S.E.S.				
Professional	0	0	0	2
Administrative	0	3	5	2
Clerical	0	5	1	2
Sale	0	1	0	7
Service	0	0	0	6
Agricultural	0	0	0	1
Production	0	0	0	1
Transport	0	0	0	0
Labourers	0	0	0	0
Student	22	1	0	9
Unemployed	0	1	0	3
Other	0	0	0	1
Marital Status				
Single	22	2	4	26
Married/Defacto	0	7	2	8
Divorced/Separated	0	2	0	0
Ethnicity				
European	21	10	5	32
Maori	0	1	1	1
Polynesian	0	0	0	0
Asian	1	0	0	0
Other	0	0	0	0

*M* = mean; *SD* = Standard Deviation; *r* = Range; S.E.S = Socioeconomic Status. Percentages rounded to the nearest whole number.

1979). Again using the current sample, positive and significant intercorrelations among the four subscales were found, ranging from 0.21 ( $P < 0.01$ ) to 0.76 ( $P < 0.001$ ). Test–retest reliability for the four subscales and the total SS score, over a 3 week period, ranged from 0.61 to 0.93 (Zuckerman, 1979).

To test the concurrent validity of the SSS, are several tests available which have attempted to measure the same or similar constructs as the SSS have been correlated. The correlation between the General Scale and the Change Seeker Index (Garlington and Shimona, 1964) in five studies

ranged from 0.56–0.70, all significant  $P < 0.0001$  (Looft and Baranowski, 1971). The correlation of the General Scale with the need for change index of the Jackson Personality Research Form (Jackson, 1967) in two studies ranged from 0.39–0.60, all significant  $P < 0.01$  (Pearson, 1970; Zuckerman, 1974). Other studies have supported convergent validity (Farley and Farley, 1967; Zuckerman and Link, 1968).

In the sport field, the SSS started to be utilized about 15 years ago, particularly to understand better the interindividual differences within the sensation seeking tendencies in high- and low-risk sport participants. At present, the SSS has proved to be the most reliable and valid psychological instrument to assess the personality trait of sensation seeking among athletes (Straub, 1982; Rossi and Cereatti, 1993).

### 3.2.2. *Impulsiveness-venturesomeness-empathy scale-(IVE): impulsiveness scale*

The IVE is a 63 item questionnaire which measures three primary personality traits; impulsiveness, venturesomeness and empathy (Eysenck and Eysenck, 1978). The impulsiveness subscale consists of 24 questions, the venturesomeness subscale consists of 18 questions and the empathy subscale consists of 21 questions. As noted previously, only the impulsiveness subscale was included in the present study for analysis. The reliability coefficient for internal consistency (Cronbach's  $\alpha$ ) using the current sample was  $r = 0.83$ . This compares favorably with previous reliability estimates (e.g.  $r = 0.85$ ; Eysenck and Eysenck, 1978).

### *The complete research questionnaire battery*

(1) The demographic subsection inquired about age, gender, occupation, ethnicity, marital status and number of children; and participant's past and present sporting involvement; (2) the Sensation Seeking Scale (Form V) developed by Zuckerman et al. (1978); and (3) the Impulsiveness scale of the Impulsiveness-Venturesomeness-Empathy Scale, developed by Eysenck and Eysenck (1978).

### 3.3. *Procedure*

Potential participants for each of the eight sport categories were solicited by varying means and were from various locations within New Zealand. The first step usually consisted of a telephone call to prominent people of the eight sports associations chosen, to explain the nature and aims of the present study. For example: (1) Marathon running—'Executive Director'—Coaching New Zealand; (2) Golf—'Programme Manager'—New Zealand Golf Association; (3) Swimming—New Zealand swimming team coach—Swimming New Zealand; (4) Aerobics—'Executive Director'—Auckland Gym; (5) Automobile racing—'Programme Manager'—Manfield Promotions; 'Committee members'—Local car club; (6) Sky-diving—'Sky-diving instructors'—Palmerston North and Hawkes Bay Aero Clubs; (7) Hang-gliding—'Administrator'—New Zealand Hang Gliding and Paragliding Association; and (8) Mountaineering—'Administrator'—New Zealand Alpine Association.

Typically, a formal letter was requested by the particular sport association from the researcher, explaining the nature of the research and its purpose, following which the telephone numbers and/or the addresses of potential participants were usually obtained. Potential participants were then either telephoned and/or received a cover letter which described the research and requested their voluntary participation.

Each participant was mailed an envelope containing an ‘information sheet’, which provided participants with knowledge about the nature of the study, what was expected of participants in the study, a guarantee of confidentiality, a reminder of the voluntary nature of their decision to participate and where to obtain information regarding the results of the study when it was completed. Together with the information sheet, participants were mailed the five-part questionnaire and a self-addressed, return envelope was additionally included. The questionnaires had a key number so that the particular sport that the participant was involved in could be identified when returned. No information which could identify participants was required. Instructions to the participants were clearly described throughout the questionnaire. Participants were informed (through the information sheet and through the questionnaire) that filling in the questionnaire implied consent.

In order to test the hypotheses regarding the predicted differences between high and low sensation seekers, subjects were classified as either high or low sensation seekers according to their total sensation seeking score (SSS total—possible range 1–40). In the present study, subjects SSS total scores ranged from 4–35. Those subjects whose SSS total fell within the bottom third ( $r = 4–19$ ), were classified as low sensation seekers, whereas, if the subjects’ SSS total score fell in the top third ( $r = 26–35$ ), they were classified as high sensation seekers. This classification procedure (based on previous research as suggested by Zuckerman (1996); pers comm), resulted in a total of 58 (35 male; 23 female) low sensation seekers and 55 (45 male; 10 female) high sensation seekers. Subjects whose SSS total score fell within the middle third ( $r = 17–25$ ), were classified as medium sensation seekers. Table 4 shows the number of subjects classified as either low, medium or high sensation seekers within each sport.

Table 4  
Classification of high and low sensation seekers according to sport

Sport	Number total	Total sensation seekers		
		Low	Medium	High
<b>High-risk</b>				
Hang gliders	25	8	9	8
Mountaineers	22	4	7	11
Sky-divers	11	1	2	8
Automobile racers	32	15	8	9
<b>Total</b>	<b>90</b>	<b>28</b>	<b>26</b>	<b>36</b>
<b>Low-Risk</b>				
Swimmers	22	3	11	8
Marathon runners	11	9	2	0
Aerobics	6	2	0	4
Golfers	34	17	10	7
<b>Total</b>	<b>73</b>	<b>31</b>	<b>23</b>	<b>19</b>

## 4. Results

### 4.1. Descriptive analyses

The mean total sensation seeking score (possible range, 0–40) for males was 22.90 (SD = 6.18) and for females was 19.07 (SD = 7.00). A significant difference was found between these scores ( $t(159) = 3.40, P < 0.001$ ). Differences were also found on the Disinhibition (Dis) and Total Sensation Seeking—Thrill and Adventure Seeking (SSS-TAS) scales. On the Dis scale, the mean score for men was 5.91 (SD = 2.38) and for women was 4.02 (SD = 2.64), a significant difference at the 0.001 level ( $t(154) = 4.30$ ). On SSS-TAS, men had a mean score of 15.54 (SD = 5.02) and women 12.62 (SD = 5.19) ( $t(159) = 3.28, P < 0.001$ ). No significant gender differences were found on the impulsiveness (Imp) dimension ( $P > 0.05$ ).

As noted in the method section, the high-risk sport sample had a mean age of 31 years and the low-risk sport sample had a mean age of 27.1 years. A significant difference was found between these groups ( $t(116) = 2.05, P < 0.05$ ) on age. With respect to age, younger participants had higher SS scores than older subjects. Subjects aged 19 years or younger ( $N = 40$ ) and those aged 20–29 years ( $N = 54$ ) scored the highest on total sensation seeking and impulsiveness. Table 5 shows the mean scores of the males and females on the SS Scales, Form V within each age group. Figure 1 shows the data for the total score.

Pearson product moment correlation coefficients ( $R$ ) were computed to indicate potential relationships between age and sensation seeking on each of the SS subscales as well as the Total scale and Impulsiveness. Age correlated negatively with Total Sensation Seeking,  $R = -0.30, P < 0.001$ ; and with the Thrill and Adventure Seeking,  $R = -0.31, P < 0.001$ ; Disinhibition,  $R = -0.23, P < 0.01$ ; Boredom Susceptibility,  $R = -0.27, P < 0.001$ ; and Total Sensation Seek-

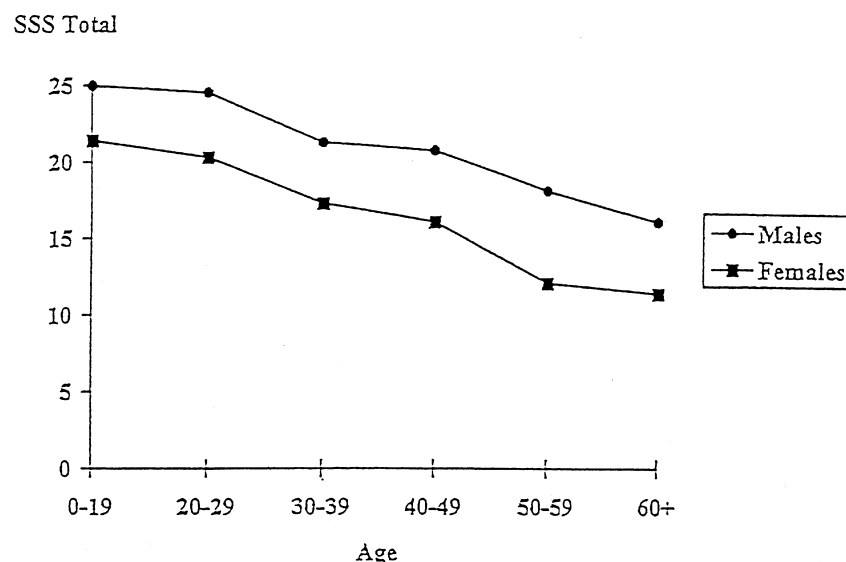


Fig. 1. Changes in total sensation seeking scores as a function of Age.

Table 5  
Mean and standard deviation scores of males and females on the SS scales by age group

Age Groups	N's			Total score		TAS		ES		Dis		BS	
	Male	Female		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
0–19	22	14	<i>M</i>	24.96	21.40	7.84	6.73	5.33	5.67	6.74	4.64	5.12	4.53
			<i>SD</i>	3.97	5.95	7.84	5.95	1.52	2.58	1.91	1.95	1.72	2.17
20–29	36	15	<i>M</i>	24.54	20.27	7.89	7.33	5.65	5.07	6.69	4.73	4.24	3.07
			<i>SD</i>	5.31	6.83	1.65	2.97	2.45	1.94	2.14	3.01	1.96	1.98
30–39	33	9	<i>M</i>	21.20	17.22	7.51	5.78	5.32	5.56	4.75	2.89	3.77	3.00
			<i>SD</i>	6.82	8.36	2.11	3.19	5.32	2.55	2.43	2.67	2.22	2.60
40–49	15	2	<i>M</i>	20.63	16.00	5.56	4.00	6.00	6.50	5.60	3.50	3.73	2.00
			<i>SD</i>	7.90	5.66	2.92	2.83	2.31	.71	2.29	3.54	2.09	1.41
50–59	2	1	<i>M</i>	18.00	12.00	4.50	2.00	4.00	6.00	7.50	1.00	2.00	3.00
			<i>SD</i>	1.41	0	3.54	0	.00	0	2.12	0	2.83	0
60+	1	2	<i>M</i>	16.00	11.33	7.00	4.00	4.00	1.00	2.00	1.50	3.00	1.50
			<i>SD</i>	0	4.16	0	3.65	0	1.00	0	.71	0	1.29

*N*'s = Numbers; *M* = Mean; *SD* = Standard Deviation; TAS = Thrill and Adventure Seeking; ES = Experience Seeking; Dis = Disinhibition; BS = Boredom Susceptibility.

ing, Thrill and Adventure Seeking,  $R = -0.24$ ,  $P < 0.01$ , scales for the whole sample. In these correlations, younger participants had higher scores on Total Sensation Seeking, Thrill and Adventure Seeking, Disinhibition, Boredom Susceptibility and Total Sensation Seeking minus Thrill and Adventure Seeking (Table 5).

Similar analysis found that age for males correlated negatively with Total Sensation Seeking,  $R = -0.31$ ,  $P < 0.001$  and with the Thrill and Adventure,  $R = -0.31$ ,  $P < 0.001$ , Disinhibition,  $R = -0.29$ ,  $P < 0.01$ , Boredom Susceptibility,  $R = -0.27$ ,  $P < 0.01$  and Total Sensation Seeking, Thrill and Adventure,  $R = -0.25$ ,  $P < 0.01$ , scales. For the female sample, age correlated negatively with the Boredom Susceptibility,  $R = -0.38$ ,  $P < 0.01$ , Thrill and Adventure-Out,  $R = -0.40$ ,  $P < 0.01$ , Total Sensation Seeking,  $R = -0.44$ ,  $P < 0.01$  and Impulsiveness,  $R = -0.48$ ,  $P < 0.001$  scales.

#### 4.2. Main analyses

As hypothesized, the high sensation seekers scored significantly (0.001 level) higher than the low sensation seekers on impulsiveness ( $M = 13.47$ ,  $SD = 4.31$ ;  $M = 7.58$ ,  $SD = 4.60$ ;  $t(108) = -6.92$ ,  $P < 0.001$ ) and Boredom Susceptibility ( $M = 5.53$ ,  $SD = 1.71$ ;  $M = 2.44$ ,  $SD = 1.56$ ;  $t(110) = -10.00$ ,  $P < 0.001$ ). Table 6 presents the correlations between the sensation seeking scales and impulsiveness for the sample as a whole. The impulsiveness scale exhibits moderate positive relationships with the sensation seeking subscales and total scale. A positive and significant correlation coefficient was found between Total sensation seeking and Boredom Susceptibility ( $R = 0.67$ ,  $P < 0.001$ ) indicating a moderate to strong relationship between this scale and total sensation seeking. Based on these analyses, the first hypothesis was supported.

Table 6  
Correlations between the sensation seeking scales and impulsiveness

	Impulsiveness
SSS-V	
TAS	0.26*
ES	0.31*
Dis	0.51*
BS	0.56*
TAS-OUT	0.61*
SSS total	0.58*

\*  $P < 0.001$ .

Table 7  
Means and standard deviations for sport risk categories on the SS scales and Imp

Test components	High-Risk ( $N = 93$ )		Low-Risk ( $N = 73$ )	
	<i>M</i>	SD	<i>M</i>	SD
SSS-V				
TAS	7.41	2.16	6.64	2.78
ES	5.90	2.29	4.86	1.91
Dis	5.60	2.56	5.12	2.62
BS	4.14	2.16	3.67	2.10
SSS-TAS	15.64	5.45	13.54	4.68
SSS total	23.03	6.04	20.26	6.37
IMP	10.87	4.89	10.50	5.20

TAS = Thrill and Adventure Seeking; ES = Experience Seeking; Dis = Disinhibition; BS = Boredom Susceptibility; TAS-OUT = Total Sensation Seeking minus TAS; and SSS total = Total Sensation Seeking; Imp = Impulsiveness.

The means, standard deviations obtained by the two sport categories on the Sensation Seeking Scale (Form V) and Impulsiveness scale are presented in Table 7. The hypothesis that high-risk sport participants would score significantly higher on (a) Total Sensation Seeking (b) the four subscales of the SSS and (c) impulsiveness compared to low-risk sport participants was tested using one-way analyses of covariance (ANCOVA). The ANCOVA used age as a covariate due to the significant age differences found between the two sport risk groups (i.e. high vs low).

As shown in Table 7, the high-risk sport group scored significantly higher than the low-risk sport group on all of the SSS subscales: SSS total ( $F(1,159) = 14.77, P < 0.0001$ ), TAS ( $F(1,151) = 10.49, P < 0.0001$ ), ES ( $F(1,151) = 12.49, P < 0.001$ ), Dis ( $F(1,151) = 4.60, P < 0.05$ ),

BS ( $F(1,159) = 5.00, P < 0.05$ ), TAS-OUT ( $F(1,159) = 12.49, P < 0.001$ ). The relationship between sensation seeking and high-risk sport participation, found to be significant on both the SSS total and SSS-TAS variables, shows that the significant difference found on the SSS are general and not due solely to the one scale that includes sports activities (i.e. TAS scale). No significant difference between risk groups was found on the Imp variable ( $P > 0.10$ ). Based on this data, high-risk sport athletes have a higher general desire to seek sensations through a variety of experiences as demonstrated on the SSS total score and subscales compared to low-risk sport athletes.

#### 4.2.1. Comparisons between sport groups

Because eight sports were investigated in the present study, it was of interest to examine the different sport groups in more detail, particularly with respect to their scores on the Sensation Seeking Scale and the Impulsiveness Scale. Means and standard deviations are presented in Table 8. Again, due to the differences in age between the eight sport groups, analyses of covariance (ANCOVA) were used.

Bonferroni corrected post-hoc comparisons (28 possible comparisons resulted in an adjusted level of significance of  $P = 0.0018$ ) were applied following a significant ANCOVA to indicate where significant differences were between the eight sport groups (Table 8).

#### 4.2.2. The eight sporting activities

As can be seen in Table 8, of the eight sport groups sky-divers had the highest sensation seeking mean score, followed by mountaineers, swimmers, hang-gliders, aerobic participants, automobile racers, golfers and finally marathon runners. ANCOVA indicated significant differences between the eight sport groups on the following SSS subscales: TAS ( $F(7,150) = 4.55, P < 0.0001$ ), ES ( $F(7,147) = 6.36, P < 0.0001$ ), TAS-OUT ( $F(7,149) = 3.80, P < 0.001$ ), SSS total ( $F(7,149) = 5.28, P < 0.0001$ ). No significant differences were found on the Dis, BS, or Imp subscales.

Following Bonferroni correction procedures, post-hoc comparisons found that hang-gliders, mountaineers and sky-divers all scored significantly higher than the marathon runners on the TAS scale. On the ES scale, the mountaineers scored significantly higher than the automobile racers and golfers. Sky-divers also scored significantly higher than the automobile racers and golfers on the ES subscale.

On SSS-TAS, the sky-divers and the automobile racers both scored significantly higher than the marathon runners and golfers. On the SSS total subscale the hang-gliders, mountaineers, sky-divers and automobile racers all scored significantly higher than the marathon runners. The mountaineers, sky-divers and automobile racers also scored significantly higher than the golfers on the SSS total subscale.

From this data and in terms of rank order, it appears that the marathon runners, as compared to the other seven sport groups, have the lowest desire to seek sensations. At the opposite end of the sensation seeking continuum, sky-divers emerge as the group who had the highest need to seek sensations. This is evident in that they scored the highest on the ES, BS, SSS-OUT and SSS total variables. Mountaineers emerged as having the next highest need for sensation seeking, particularly in Thrill and Adventure seeking. Swimmers, a sport classified as low-risk appeared to be the third highest ranked high sensation seeking group, followed by the hang gliders, automobile racers, aerobic participants and golfers.

Table 8  
Means and standard deviations for individual sport categories on the SS scales and Imp

Test components	High-risk sports							
	Hang-gliders ( <i>N</i> = 26)		Mountaineers ( <i>N</i> = 23)		Sky-divers ( <i>N</i> = 11)		Automobile racers ( <i>N</i> = 34)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>5SD</i>
SSS-V								
TAS	8.08	1.38	8.43	1.36	7.70	1.96	6.19	2.49
ES	5.96	2.46	7.14	1.88	7.20	1.99	4.57	1.72
Dis	5.46	2.87	5.29	2.53	6.50	2.32	5.51	2.51
BS	3.96	2.39	4.33	1.91	5.30	2.11	3.94	2.17
TAS-OUT	15.32	6.36	16.76	5.19	19.00	4.55	14.16	4.88
SSS total	23.28	6.83	25.19	5.80	26.70	4.52	20.38	6.68
IMP	8.96	5.09	11.05	4.59	14.20	3.88	11.47	4.80
	Low-risk sports							
	Swimmers ( <i>N</i> = 22)		Marathon runners ( <i>N</i> = 11)		Aerobics ( <i>N</i> = 6)		Golf ( <i>N</i> = 34)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
SSS-V								
TAS	7.91	1.77	4.45	3.70	7.00	2.97	6.45	2.58
ES	5.32	1.55	4.64	2.01	6.17	1.72	4.35	2.03
Dis	6.10	1.90	2.91	2.26	6.60	2.70	5.00	2.73
BS	4.59	1.65	2.00	1.10	3.00	2.35	3.72	2.29
TAS-OUT	15.82	2.87	9.55	2.84	15.00	5.10	13.06	5.21
SSS total	23.73	3.89	14.00	5.76	22.00	6.99	19.68	6.27
IMP	12.19	4.41	8.55	5.70	10.33	5.72	10.09	5.34

## 5. Discussion

The present study set out to investigate the sensation seeking tendencies of high- and low-risk sport participants, in an attempt to test aspects of Zuckerman's (1994) Impulsiveness-Sensation Seeking (ImpSS) theory. For clarity and ease of comprehension, we first provide an integrated summary of the main findings and then present more specific findings.

Findings provided support for the main idea put forward by Zuckerman's (1994) ImpSS theory suggesting that sensation seeking is integrated within a broader trait called—'Impulsive-Sensation Seeking'. Two important findings provided this support: (a) significant differences were found between the high and low sensation seekers on impulsiveness with the high sensation seekers scoring significantly higher and (b) positive and significant correlations were found between the SSS scales (Total score and subscales) and the impulsiveness dimension. Frelxanet (1991) also



found positive and significant correlations between the SSS (form V) scales and impulsiveness. Freixanet's (1991) results are directly comparable with the present findings as Freixanet also utilized the Impulsiveness scale of the Impulsiveness-Venturesomeness-Empathy Questionnaire (Eysenck and Eysenck, 1978).

However, the hypothesis that differences would emerge between the high- and low-risk sport groups on the Impulsiveness scale was not supported. These results are consistent with those of Freixanet (1991) and Kerr and Svebak (1989). Freixanet (1991), found that the target sports groups (alpinists; mountaineering related sportsmen; sportsmen engaged in 'risk' sports—scuba diving, parachuting, hang-gliding, etc.), did not differ from a control group (those not engaged in any risky sports activity) on the Impulsiveness scale. Kerr and Svebak (1989) also found that those engaged in risky sports did not differ from those engaged in non-risky sports on the impulsiveness dimension.

A possible explanation for the non-significant differences found between the high- and low-risk sport participants on the impulsiveness dimension is that Zuckerman's ImpSS theory is particularly focused towards the hypothesized differences between high and low sensation seekers as opposed to high- or low-risk sport participation. Thus, based upon the current findings, it appears that individuals' impulsiveness tendencies (i.e. high vs low) may be related more to their sensation seeking tendencies (i.e. high vs low) rather than their participation in risky sporting endeavors. Research evidence appears to be accumulating that sensation seeking is not simply synonymous with risk-taking. In addition, sensation seeking tendencies may be mediated by other factors that included one's skill and knowledge in coping with the risk involved in a particular sport. Furthermore, it could be hypothesized that individuals who are both high in sensation seeking and impulsiveness would be more prone to risk taking, which in turn may result in negative consequences (e.g. injuries).

Although no significant differences were found between the target sport groups (i.e. high vs low-risk) on the impulsiveness dimension, the athletes who were participating in the high-risk sports (i.e. hang-gliding, mountaineering, sky-diving, automobile racing) did as hypothesized, score significantly higher in Total Sensation Seeking than those participating in the low-risk sports (e.g. swimming, marathon running, aerobics, golf). These results are consistent with the findings of Cronin (1991), Fowler et al. (1980), Freixanet (1991), Hymbaugh and Garrett (1974), Robinson (1985), Straub (1982) and Wagner and Houlihan (1994), who all found that their high-risk sport samples tended to score higher on total sensation seeking than their low-risk sport samples or norm groups. Importantly, the present data also provides support for Zuckerman's (1994) ImpSS model regarding the hypothesis that high sensation seekers are more likely to engage in sports which offer new and potentially arousal increasing experiences.

The high- and low-risk sport participants also differed significantly on the remaining four sensation seeking subscales; (a) Experience Seeking, (b) Total Sensation Seeking Minus the Thrill and Adventure Seeking (SSS-TAS) subscales, (c) Disinhibition and (d) Boredom Susceptibility. Differences on the SSS-TAS indicate that differences on the Scale were general and not due solely to the one scale that included primarily sports activities (i.e. TAS scale). These results are consistent with those of previous studies (Freixanet, 1991; Rowland et al., 1986). The present results provided strong support for the hypothesis that 'high-risk sport participants would score significantly higher than low-risk sport participants on all subscales of the SSS'.

Significant differences on SSS total score and the TAS, ES and TAS-OUT subscales were found

when comparing participation across individual sports. Particularly notable was the finding that the sky-divers and mountaineers commonly scored significantly higher than the marathon runners and golfers on the Sensation Seeking total score and the specific subscales just mentioned. It would appear that sensation seeking is less relevant in these low-risk sport groups than it is in the high-risk sports of sky-diving and mountaineering. Those individuals who participate in specific high-risk sporting activities, especially those of mountaineering and sky-diving, appear to have higher general and specific sensation seeking dispositions than participants in particular low-risk sporting activities.

Taken together, results provided support for the main hypotheses of the present study. That is, the personality dimension of sensation seeking and impulsiveness were significantly related and total sensation seeking tendencies reliably differentiated between high- and low-risk sport participants.

### 5.1. *Limitations and future directions*

Although the results of the present study generally provides support for the notion that high sensation seekers are more attracted to high-risk sports than are low sensation seekers and that sensation seeking is related to impulsiveness, one must nevertheless be aware of limitations of the current study. Several caveats are now noted.

The first limitation involves the characteristics of the sample. Although the present research findings confirm many of the findings of previous research, the generalizability of the findings to the broader population of all high-risk and low-risk sport participants is tentative as the present study involved a selected group of athletes. Therefore, current findings may not be generalized, or 'hold true' across all high and low-risk sport populations.

Second, some of the selected sport activities samples had small ( $N < 15$ ) numbers of participants (i.e. sky-divers  $N = 11$ ; marathon runners:  $N = 11$ , aerobics:  $N = 6$ ). Again, this leads to lack of generalizability within and across these populations. Despite this constraint, the present study did utilize a much larger total sample size ( $N = 166$ ) compared to previous investigations that have typically reported sample sizes of under 50 (Hymbaugh and Garrett, 1974; Cronin, 1991).

The next limitation involves some of the special characteristics of the Sensation Seeking Scale (Form V)—specifically, the 'forced-choice' format. Several participants (approximately 5), made comment on this issue. A typical opinion which illustrates this point of view is as follows:

“... in many of the questions, the two alternatives are not opposites for which I agree with both points. In others, I disagree with both points... (and) many questions express extreme opinions. In most of these questions my opinions are somewhat in the middle”.

Despite these criticisms the present study largely supports the use of the Sensation Seeking Scale as a reliable and valid measure for use with athletes. The SSS has also been used in the overwhelming majority of prior related studies (Rowland et al., 1986; Straub, 1982; Zaleski, 1984; Wagner and Houlihan, 1994). Furthermore, this particular format has been investigated and rated positively by both males and females in a study conducted by Franken et al. (1989). Typically, subjects rated the SSS-V forced-choice format as 'entertaining', 'fun' and 'informative'.

Returning to potential limitations, although only a small number of participants in the present study expressed concern with the scale format, such an issue nevertheless deserves consideration.

As an alternative, the present study might have utilized the new, but less validated version of the SSS—the Sensation Seeking Scale (Form VI), which has eliminated the forced-choice format. When using the new scale, subjects are only required to indicate, from a list of 62 activities, which activities they have experienced (part A) and which activities they would/would not like to try in the future (part B). Future research might compare these two scales to determine comparability of responses. The current study was designed to use the SSS-V in order to benefit from its reliability and validity and to be able to compare current findings with previous studies also using the SSS-V. Future research might use both scales.

One of the more pertinent limitations of the present study is the lack of comprehensive validity data for the Impulsiveness scale of the Impulsiveness-Venturesomeness-Empathy Scale. To the researchers' knowledge, the Impulsiveness scale has only been used in one study (Freixanet, 1991) prior to the present study in which no psychometric data was presented. As very little psychometric data has been provided for this scale—apart from indications of adequate  $\alpha$  reliability—one must remain cautious in interpreting the results found through the use of this scale. However, it must also be said that the findings of the current study in relation to this measure have been previously hypothesized by theory—in this way, an increased level of support is provided for the concurrent validity of this scale.

As with most human endeavors, how one selects a sport in which to participate is a complicated area and obviously involves additional factors beyond those investigated by the present study. Thus, future research should try to investigate more fully some factors addressed in this study (e.g. family involvement, physical ability, age) that might mediate sensation seeking, impulsiveness and risk taking. In line with this proposal, future research should attempt to isolate the factors which mediate the choice of socially acceptable ways of meeting sensation seeking needs (e.g., sports) as compared to the use of antisocial means such as substance abuse and criminality. It may be that socially-sanctioned vs non-sanctioned sensation seeking differs on the impulsiveness dimension.

In association with the above suggestion, it is proposed that more observational and qualitative research be undertaken with related studies in the future. This would be an attempt to identify some of the factors influencing more individual involvement in particular sporting activities based upon participant observational study and interviews with the athletes themselves. Such a research design could control for the 'pigeon hole effect' that many current subjects stated as a potentially negative consequence of utilizing questionnaire formats. It could also be used to generate additional hypotheses that would then be further tested with larger samples.

### **Acknowledgements**

This study was funded by the Massey University Graduate Research Fund. We would like to thank those who kindly volunteered to participate in the study.

### **References**

- Bacon, J. (1974). Sensation seeking levels for members of high-risk organizations. Unpublished manuscript (described in Zuckerman, 1979, pp. 207–208).

- Berlyne, D. E. (1960). *Conflict, arousal and curiosity*. New York: McGraw-Hill.
- Campbell, J. B., Tyrrell, D., & Zingaro, M. (1993). Sensation seeking among whitewater canoe and kayak paddlers. *Personality and Individual Differences*, 14, 489–491.
- Cellini, H. R. (1982). *Doctoral Dissertation*. University of New Mexico.
- Connolly, P. M. (1981). *An exploratory study of adults engaging in the high risk sports of skiing*. Masters Thesis. Rutgers University.
- Cronin, C. (1991). Sensation seeking among mountain climbers. *Personality and Individual Differences*, 12, 653–654.
- Eysenck, S. B. G., & Eysenck, H. J. (1978). Impulsiveness and venturesomeness: Their position in a dimensional system of personality description. *Psychological Reports*, 43, 1247–1255.
- Farley, F. H., & Farley, S. V. (1967). Extraversion and stimulus seeking motivation. *Journal of Consulting Psychology*, 31, 215–216.
- Fowler, C. J., von Knorring, L., & Orelund, L. (1980). Platelet monoamine oxidase activity in sensation seekers. *Psychiatric Research*, 3, 272–279.
- Franken, R. E., Gibbson, K., & Rowland, G. L. (1989). Sensation seeking and feelings about the forced-choice format. *Personality and Individual Differences*, 10, 337–339.
- Freixanet, M. G. (1991). Personality profile of subjects engaged in high physical risk sports. *Personality and Individual Differences*, 12, 1087–1093.
- Garlington, W. K., & Shimona, H. E. (1964). The Change Seeker Index: A measure of the need for variable sensory input. *Psychological Reports*, 14, 919–924.
- Heyman, S. R., & Ross, K. G. (1980). Psychological variables affecting SCUBA performance. In C. H. Nadeau, W. R. Halliwell, K. M., Newell & G. C. Roberts (Eds.), *Psychology of motor behavior and sport*. Champaign, Illinois: Human Kinetics Press.
- Hymbaugh, K. & Garrett, J. (1974). Sensation seeking among skydivers. *Perceptual and Motor Skills*, 38, 118.
- Jackson, D. N. (1967). *Manual, Jackson Personality Inventory*. Goshen, N.Y: Research Psychologists Press.
- Kerr, J. H., & Svebak, S. (1989). Motivational aspects of preference for and participation in, risk and safe sports. *Personality and Individual Differences*, 10, 797–800.
- Kusyszyn, I., Steinberg, P., & Elliot, B. (1974). Arousal seeking, Physical risk taking and Personality. Paper read at the 18th International Conference of Applied Psychology, Montreal Canada.
- Looft, W. R., & Baranowski, M. D. (1971). Analysis of five measures of sensation seeking and preference for complexity. *Journal of General Psychology*, 85, 307–313.
- McCutcheon, L. (1980). Running and sensation seeking. *North. Va Community College Journal, Fall Issue*, 11.
- Pearson, P. H. (1970). Relationship between global and specific measures of sensation seeking. *Journal of Consulting and Clinical Psychology*, 34, 199–204.
- Potgieter, J., & Bisschoff, F. (1990). Sensation seeking among medium and low-risk sports participants. *Perceptual and Motor Skills*, 71, 1203–1206.
- Robinson, D. W. (1985). Stress seeking: Selected behavioral characteristics of elite rock climbers. *Journal of Sport Psychology*, 7, 400–404.
- Rossi, B., & Cereatti, L. (1993). The sensation seeking in mountain athletes as assessed by Zuckerman's sensation seeking scale. *International Journal of Sport Psychology*, 24, 417–431.
- Rowland, G. L., Franken, R. E., & Harrison, K. (1986). Sensation seeking and participation in sporting activities. *Journal of Sport Psychology*, 8, 212–220.
- Stirling (1997). Strength of the nervous system, extraversion–introversion and kinesthetic and cortical augmenting and reducing. Doctoral Dissertation. University of York, England.
- Straub, W. F. (1982). Sensation seeking among high and low risk male athletes. *Journal of Sport Psychology*, 4, 246–253.
- Wagner, A. M., & Houlihan, D. D. (1994). Sensation seeking and trait anxiety in hang-glider pilots and golfers. *Personality and Individual Differences*, 16, 975–977.
- Wykoff, W. L. (1982). Are physical education majors sensation seekers? In M. Zuckerman (1983). Sensation seeking and sports. *Personality and Individual Differences*, 4, 285–293.
- Zaleski, Z. (1984). Sensation seeking and risk-taking behavior. *Personality and Individual Differences*, 5, 607–608.
- Zuckerman, M. (1974). The sensation seeking motive. In B. A. Maher (Ed.), *Progress in experimental personality research* Vol. 7, (pp. 79–148). New York: Academic Press.

- Zuckerman, M. (1979). *Sensation seeking: Beyond the optimal level of arousal*. Hillsdale, NJ: Erlbaum.
- Zuckerman, M. (1983). Sensation seeking and sports. *Personality and Individual Differences*, 4, 285–293.
- Zuckerman, M. (1994). *Behavioral expressions and biosocial bases of sensation seeking*. Cambridge: Cambridge University Press.
- Zuckerman, M., Eysenck, S., & Eysenck, H. J. (1978). Sensation seeking in England and America: Cross-cultural, age and sex comparisons. *Journal of Consulting and Clinical Psychology*, 46, 139–149.
- Zuckerman, M., Kuhlman, D. M., & Camac, C. (1988). What lies beyond E and N? Factor analyses of scales believed to measure basic dimensions of personality. *Journal of Personality and Social Psychology*, 54, 96–107.
- Zuckerman, M., & Kuhlman, D. M., Thornquist, M., & Kiers, H. (1991). Five (or three) robust questionnaire scale factors of personality without culture. *Personality and Individual Differences*, 12, 929–941.
- Zuckerman, M., & Link, K. (1968). Construct validity for the sensation seeking scale. *Journal of Consulting and Clinical Psychology*, 32, 420–426.