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Neuroticism-Anxiety, Impulsive-Sensation Seeking and autonomic responses to somatosensory stimuli

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Abstract

This study focused on autonomic responding in participants who scored high vs. low on the Neuroticism-Anxiety (N-Anx) and Impulsive-Sensation Seeking (Imp-SS) dimensions of the Zuckerman–Kuhlman Personality Questionnaire—Form III. Participants were presented with series of tones (standards, deviants and novels) and they received a mild electric shock (one, two or three pulses) at each 15th tone. Resting pre-stimulus skin conductance level (SCL) and heart rate (HR) level was recorded, as well as the skin conductance response (SCR) and (anticipatory) HR response to the electric stimuli. The autonomic measures differentiated between high- vs. low Imp-SS participants but failed to discriminate between high- vs. low N-Anx participants, with the exception that high N-Anx participants showed smaller SCRs on some trials compared to the low N-Anx participants. High Imp-SS had a lower pre-stimulus SCL and smaller SCRs to deviant stimuli compared to low Imp-SS participants. Additionally, their HR acceleration was smaller in anticipation of the first and the deviant tones whereas their deceleratory response was larger relative to the HR changes observed for the low Imp-SS participants. This pattern of findings was taken to suggest that high Imp-SS participants are more arousable and less prone to defensive reactions to novel or aversive stimulation.

Keywords: Impulsive-Sensation Seeking; Neuroticism-Anxiety; Skin conductance change; Heart rate change; Orienting response; Defensive response

1. Introduction

Sensation seeking (SS) is a dimension of personality defined by the individual's need for sensory stimulation and the level of risk taken for the sake of such stimulation (Zuckerman, 1994). For high sensation seeking individuals, the reward of the sensation outweighs most punishment and they are willing to take any risk in an effort to satisfy the need for challenging experiences and sensations. It is believed that individual differences in arousal levels prompt individuals to avoid or seek sensation, so as to maintain an optimal level of arousal (Zuckerman et al., 1980; Kohn, 1987).

Electrodermal measures have been employed widely to assess individual differences in arousal level and arousability (Malmo, 1959; Venables and Christie, 1980). Thus, skin conductance level (SCL) and skin conductance responses (SCRs) are used to provide indices of tonic and phasic arousal (e.g., Fowles, 1980; Boucsein, 1992). Studies focusing on tonic arousal, as indexed by SCL, observed a lower SCL in high SS individuals compared to low SS individuals (e.g., Gatzke-Kopp et al., 2002; Plouffe and Stelmack, 1986) supporting the notion that arousal level is lower in high SS individuals. Likewise, SRC discriminates between high and low SS individuals. The typical finding is that high SS individuals respond somewhat more vigorously to initial or novel stimulation than low SS individuals (e.g., Feij et al., 1985; Neary and Zuckerman, 1976; Robinson and Zahn, 1983; Smith et al., 1986). It should be noted, however, that several studies failed to replicate stronger SCRs in high SS individuals (e.g., Cox, 1978; Ridgeway and Hare, 1981; Zuckerman et al., 1988).

Zuckerman (1990) argued that the apparent inconsistencies across studies might be due to the uni-phasic nature of SCR that does not allow differentiating between orienting vs. defensive reactions. In this regard, the bi-phasic heart rate (HR) response might qualify as a more suitable indicator of individual differences in arousability. HR slowing to a stimulus is interpreted in terms of orienting whereas HR speeding is taken to suggest a

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defensive reaction (e.g., Graham, 1979; see review in Turpin, 1986). Likewise, anticipatory HR slowing is suggestive of stimulus intake whereas HR speeding preceding the stimulus is associated with the rejection of external input (e.g., Lacey and Lacey, 1974; see review in van der Molen et al., 1985). Several studies showed that when low-SS individuals respond to intensive stimulation by speeding their HR (indexing a defensive reaction) a slowing of HR (indexing orienting) is seen in high SS individuals (e.g., Orlebecke and Feij, 1979; Ridgeway and Hare, 1981; Robinson and Zahn, 1983). Looking at anticipatory HR responses, Somsen et al. (1983) observed that HR slowing was much more pronounced when participants expected the delivery of an aversive event (shock threat). This finding suggests that anticipatory HR slowing reflects the focus of attention to external input (see also Van der Molen et al., 1996).

The goal of the present study was to assess individual differences in SS by using both electrodermal and cardiac indices of arousal level and arousability, and by looking at both anticipatory changes and stimulus-induced responses. Individual differences in SS were examined in the context of the 'five-factor' model developed by Zuckerman and colleagues that is used widely in psychophysiological studies of personality (Zuckerman et al., 1988; Zuckerman et al., 1991; Zuckerman et al., 1993). The five factors distinguished in the Zuckerman model are Sociability (Sy), Neuroticism-Anxiety (NA), Impulsive Sensation Seeking (Imp-SS), Aggression-Hostility (Agg-Host) and Activity (Act). The primary focus in the current study was on Imp-SS and on NA, as the latter factor may interact with Imp-SS in modulating autonomic responsivity. Electrodermal activity and HR were recorded when participants, high vs. low Imp-SS and high vs. low Anx, were counting tones and receiving, occasionally, a mild electric shock. It was anticipated that high Imp-SS participants would show reduced SCRs and HR slowing to novel or aversive stimulation whereas low Imp-SS participants were expected to show pronounced SRCs and reduced HR slowing or even HR speeding.

2. Methods

2.1. Participants

The participants were 67 (35 females and 32 males) students, aged 18–30 years (M=23.5; S.D.=3.0). Four participants had to be excluded from the study due to artifacts in the recordings (2 females and 2 males) two other participants (1 female and 1 male) declined to participate when informed of the nature of the experiment. Testing was carried out between 15:00 and 19:00 h. Participants were administered the Zuckerman–Kuhlman Personality Questionnaire—Form III (Zuckerman et al., 1993) providing Imp-SS and N-Anx scores. Median splits resulted in high vs. low Imp-SS groups (median score was 9) and high vs. low N-Anx groups (median score was 7). Thus, each participant belonged to the high or low Imp-SS group and to the high or low N-Anx group. The resulting distribution of participants is presented in Table 1. All participants reported themselves to be healthy and females were not having their period when participating in the experiment. Before testing, participants signed informed consent but they were naïve regarding the specific hypotheses of the study. The experiment was done respecting the guidelines stipulated in the "Ethical norms of the Italian Association of Psychology" (AIP).

Table 1
Mean scores and standard deviations (STD) for Impulsive-SS (Imp-SS) and Neuroticism-Anxiety (N-Anx) dimensions and n for High Imp-SS/High N-Anx, High Imp-SS/Low N-Anx, Low Imp-SS/High N-Anx, Low Imp-SS/Low N-Anx subjects

Gender	Imp-SS level	N-Anxiety	n	Variable	Mean	STD
F	High IMP-SS	High N-ANX	11	Imp-SS	13.8	2.9
				N-Anx	10.5	1.9
		Low N-ANX	5	Imp-SS	14.2	2.8
				N-Anx	4.4	2.7
	Low IMP-SS	High N-ANX	9	Imp-SS	4.1	2.7
				N-Anx	12.5	4.3
		Low N-ANX	6	Imp-SS	4.2	2.1
				N-Anx	4.7	1.0
M	High IMP-SS	High N-ANX	6	Imp-SS	14.3	2.6
				N-Anx	9.7	0.8
		Low N-ANX	8	Imp-SS	13.4	2.5
				N-Anx	4.2	1.0
	Low IMP-SS	High N-ANX	5	Imp-SS	3.4	0.9
				N-Anx	9.6	4.1
		Low N-ANX	10	Imp-SS	5.4	2.4
				N-Anx	3.3	1.3

2.2. Stimuli

Participants were presented with auditory and somatosensory stimuli. The auditory stimuli were pure tones (rise and decay times of 25 ms)–standards (70 db SPL, 800 Hz), deviants (70 dB SPL, 1500 Hz) or novels (90 dB SPL, 1000 Hz)–of 80 ms duration and presented with 950 ms intervals. Tones were computer generated by using 'Cool Edit Pro' (Phoenix Syntrillium Software Corporation) software and delivered by using 'E-prime' (Schneider et al., 2002) through padded earphones.

Somatosensory stimuli were delivered by applying two silver–silver chloride cup electrodes to the palmar surfaces of the distal and medial phalanges of the middle finger of the right hand. The electrode cup (1 cm in diameter) was filled with an electro-conductive hypoallergic cream and impedance was kept below 30 Kohm. Stimuli consisted of unipolar electrical pulses of 2 ms duration, generated by a constant current stimulator (Digimiter, Mod DS7A).

Sensory thresholds were determined for each participant before testing. Participants received first a series of single, unipolar pulses separated by 10 s intervals, starting with an intensity of .05 mA and increasing with steps of .1 mA until the participant reported that the minimum detectable stimulus was reached. The intensity level of the just noticeable pin-prick was taken as the sensory threshold associated with ascending intensity levels. A similar, but reversed procedure, was used to obtain the sensory threshold associated with descending intensity levels, starting from .5 mA and decreasing with steps of .1 mA. The two thresholds were then averaged to obtain the participant's sensory threshold. A similar procedure was used for obtaining pain and unpleasantness thresholds. Intensity levels were varied in steps of .5 mA and participants had to indicate whether the stimulus was producing a 'distinct sharp painful pin-prick' or a 'distinct sharp