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Sensation seeking, recognition memory, and autonomic arousal

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ABSTRACT

Substantial evidence shows that sensation seeking impacts memory; however, research has not examined how sensation seeking impacts automatic familiarity and conscious-controlled recollection memory systems. The present study ($N = 80$) examined high and low sensation seekers' familiarity and recollection of high and low arousal images with negative valence using behavioral and skin conductance measures. Low sensation seekers had more accurate familiarity judgments to high than low arousal images, reflecting a heightened aversive motivational system. High sensation seekers showed an opposite pattern with memory enhancement for low arousal images, regardless of old–new status. The lack of any sensation seeking effects in relation to recollection judgments suggests that this personality trait is more influential on automatic than conscious controlled memory systems.

1. Introduction

Sensation seeking (SS) has received considerable interest from researchers and public officials alike because this personality trait is able to index individuals who are more likely to engage in high risk behaviors including gambling, illegal or inappropriate drug use, risky sexual activity, and aggressive and unsocialized behaviors (for recent reviews see Hittner & Swickert, 2006; Wilson & Scarpa, 2011; Zuckerman, 2007). Prevention campaigns are often directed toward high SS individuals by employing high sensation value materials. These materials reflect items that are novel, arousing, complex, rapidly changing, and unexpected. High sensation materials have been shown to decrease illegal and problem behaviors for high sensation seekers (Everett & Palmgreen, 1995; Palmgreen, Stephenson, Everett, Baseheart, & Francies, 2002; Stephenson, 2003).

An important requisite for prevention campaigns is that the high sensation materials are remembered by high SS individuals for later use in making decisions. Indeed, several studies have found that the use of high sensation materials enhance memory for high sensation seekers (e.g., Cimbalo, Clark, & Matayev, 2003; Nierderdeppe, Davis, Farrelly, & Yarsevich, 2007). Everett and Palmgreen (1995) found that while low SS individuals had greater recall overall, high sensation seekers' memory was enhanced for high sensation materials while low SS individuals had the most improved memory for low sensation materials. Additionally, Nierderdeppe et al. (2007) confirmed that stimulus intensity is an important aspect for improving message recall, and research examining responses to graphic horror suggest that high SS individuals recollect highly arousing experiences in a distinctive way (Johnston, 1995).

Memory is also implicated in differentiating drug addicts from non-drug addicts by virtue of repeated drug experiences strengthening implicit memory (Ames, Sussman, Dent, & Stacy, 2005). A large body of research has confirmed that the mesolimbic dopaminergic system plays an important role in SS (Bardo, Donohew, & Harrington, 1996; Zuckerman, 1994), and with glutamate and GABA, is important for strengthening memory associations and reward potentials that lead to compulsive and addictive behaviors (Volkow, Fowler, Wang, & Swanson, 2004).

Although substantial evidence shows that SS impacts memory, research has not examined the extent to which SS differentially impacts automatic and more conscious-controlled memory systems. The purpose of the current study was to examine the impact of SS on automatic and conscious-controlled recognition memory processes. Understanding the impact of SS on these memory systems on will not only add to our understanding of how personality differences impact memory, but also has the potential to facilitate strategies for enhancing memory in high sensation seekers.

The present study examined SS differences in memory using behavioral and skin conductance response (SCR) measures. Skin conductance indexes autonomic nervous system (ANS) activation by measuring small changes in electrodermal activation (i.e., sweating) to a stimulus. Behavioral measures included response time and accuracy. The present study examined both familiarity and recollection memory. Researchers have shown that recognition memory involves at least two psychophysiologically distinct memory systems, one being an automatic *familiarity* system and

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a second more conscious controlled *recollection* memory system (for reviews see Mecklinger, 2000; Paller, 2001; Rugg & Yonelinas, 2003). Familiarity memory is automatic, quickly occurring, and reflects the linking of information in long-term memory without forming any more complex representations. This includes the lack of contextual details of when or where an item had been previously encountered. In contrast, recollection memory is slower, more conscious controlled, and is accompanied by source memories that reflect a more complex representation of an item.

The ANS controls bodily systems that are arousing and alerting in nature, and is responsive to most novel, unexpected, intense, and unusual stimuli (Siddle, 1991). Accordingly, SCR is sensitive to a number of types of processes including orienting cognitive resources to a particular stimulus and emotional/valence reactions (Dawson, Schell, & Filion, 2000; Mauss & Robinson, 2010). Urry, van Reekum, Johnstone, and Davidson (2009) found that electrodermal activation was sensitive to changes in cognitive reappraisal for unpleasant pictures, and this autonomic activation was correlated with medial prefrontal activity reflecting increased conscious controlled processing. Shearer and Mikulka (1996) reported differential electrodermal activity to familiarity and recollection mechanisms during the recognition of facts. Initial electrodermal activation occurred with familiarity face judgments, but then subsequent SCR activation compounded this initial activation when familiar faces were correctly identified. Thus correct recollection of a face increased SCR activation beyond an initial familiarity response. In another electrodermal study, Morris, Cleary, and Still (2008) found that matching the features of a stimulus with stored representations seems to automatically summon additional cognitive resources that support recollection processes. Collectively, these studies show that electrodermal activation can differentiate familiarity and recollection mechanisms, and can provide valuable insights into the allocation of frontal processes in recognition memory.

Electrodermal activation has a long tradition in identifying psychophysiological differences in SS (Zuckerman, 1994). Focusing on SCR activation, Zuckerman (1990) proposed that SCR indexes approach and defensive reactions among high and low SS individuals. Approach reactions include orienting to and seeking out stimuli while defensive reactions include alarm, aversive, and avoidance behaviors. High SS individuals often have stronger SCR than low SS individuals to stimuli that are novel (Neary & Zuckerman, 1976; Smith, Davidson, Smith, Goldstein, & Perlstein, 1989; Smith, Perlstein, Davidson, & Michael, 1986) and that are low to moderate intensity when aversive stimuli are used (Feij, Orlebeke, Gazendam, & van Zuilen, 1985), reflecting an augmented appetitive motivational system characteristic of the personality trait. In contrast, Zuckerman (1990) argued that low SS individuals have greater SCR reactions than high SS individuals when intense stimuli evoke defensive reactions in low sensation seekers. Indeed, studies utilizing morbid and violent stimuli have found greater increases in SCR for low than high SS individuals (Lissek & Powers, 2003; Lissek et al., 2005; Zuckerman, 1994). Low sensation seekers also tend to have prolonged SCR activation to aversive or anxious stimuli in comparison to high sensation seekers, who show quick SCR habituation (Davidson & Smith, 1989). The SCR habituation reported for high sensation seekers is attributed to a higher level of tolerance for aversive stimuli than for low sensation seekers (Feij et al., 1985).

Given that SCR is sensitive to differences in arousal, memory, and SS, this study utilized SCR to examine differences in sensation seekers' familiarity and recollection of negative valence images. High arousal negative valence images used in the study depicted violent and graphic scenes because this type of material has been repeatedly reported to have high sensation value (Johnston, 1995; Tamborini & Stiff, 1987; Zuckerman, 1988) and has been shown to differentiate high and low sensation seekers (Lissek & Powers, 2003; Lissek et al., 2005). Participants in the current study initially studied photographs in two separate lighting contexts: when the study room and monitor background was dimly lit or brightly lit. They were then given a recognition task that included both previously studied and new photographs. Familiar responses were followed by recollection judgments concerning the lighting context. This design allowed for the examination of both recognition processes that rely on familiarity judgments and recollection processes that reflect source memory (i.e., bright or dim light context).

It was hypothesized that accuracy would be greater for image recognition (i.e., familiarity judgments) than for correctly recognizing the lighting context (i.e., recollection judgments). It was also expected that ANS activity overall would be greater for high arousal than low arousal images. Based on their differential responses to novelty and arousal, it was expected that high and low sensation seekers would engender differential memory to high and low arousal images. Low sensation seekers were hypothesized to have defensive reactions to high arousal images, characterized by greater memory accuracy and SCR activation to those images. High sensation seekers were hypothesized to have improved memory for new pictures. Last, we hypothesized that high SS individuals would have stronger SCR activation for low arousal new images than low SS individuals, reflecting heightened approach reactions for high sensation seekers.

2. Method

2.1. Participants

Participants included 80 undergraduate students (53 women, 27 males, M_{age} = 22, age range: 18–45 years) recruited from a midwest university. Inclusion criteria included normal or corrected to normal vision, no history of neurological disorders or head trauma, no history of a psychological illness, and no history of learning disabilities. Participants were administered the eight item Brief Sensation Seeking Scale (Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002) to determine SS status. Possible scores ranged from 8 to 40, with higher scores reflecting higher sensation seeking. All participants consented to participate in the study and received course credit for their participation.

2.2. Materials

2.2.1. Stimuli and lighting

Stimuli consisted of 80 colored photo images having a negative valence from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008). Half of the images were low arousal (M = 3.85) and half were high arousal (M = 6.15) on a 1 (lowest) to 9 (highest) scale (Fig. 1). Stimuli from both arousal categories were equally subdivided among the study and memory tasks. The size of each picture was adjusted to be 6 in. wide or 6 in. tall while maintaining the original height–width proportion in the IAPS. Each image was displayed on a 17 in. computer monitor with white, black, or a neutral-gray background to correspond to bright, dim and neutral lighting conditions of the room. The bright and dim lighting contexts were administered in the study portion, and the neutral lighting context was used during the memory task. The light levels in the test suite was ~2000 lux for the bright condition, ~10 lux for the dim condition, and ~500 lux for the neutral condition.

2.2.2. Study task

The study task consisted of two study blocks, with each block having 10 low arousal and 10 high arousal images (40 studied