Université de Montréal

Sensation Seeking and the Perception and Reaction to Emotional Facial Expressions

par

Mariia Talalaievska

Département de Psychologie, Faculté des arts et sciences

Mémoire présenté en vue de l'obtention du grade de Maîtrise

en Psychologie

Décembre, 2022

Université de Montréal

Faculté des arts et des sciences: Département de psychologie

Ce mémoire de maîtrise intitulée

Sensation Seeking and the Perception and Reaction to Emotional Facial Expressions

Présentée par

Mariia Talalaievska

A été évaluée par un jury composé des personnes suivantes

Martin Arguin

Président-rapporteur

Sébastien Hétu
Directeur de recherche

Floris van Vugt
Membre du jury

Résumé

Le présent mémoire de maîtrise porte sur la relation potentielle entre le trait de personnalité de recherche de sensations et le traitement des expressions faciales émotionnelles, en particulier la perception (intensité et valence perçues) et la réaction (excitation) aux expressions faciales émotionnelles des autres. Nous examinons si les différences individuelles dans la recherche de sensations sont liées aux variations dans la perception et les réactions aux émotions faciales positives, négatives et neutres chez autrui. Nous recherchons également si les différences de perception ont un rôle à jouer dans la relation entre la réaction d'excitation et la recherche de sensations. Un échantillon de jeunes adultes (N=77) a rempli le formulaire V de l'échelle de recherche de sensations (SSS-V) et a évalué l'intensité et la valence d'expressions faciales émotionnelles tirées de la banque de visages émotionnels dirigés de Karolinska (KDEF). Les participants ont également rapporté leur réponse d'excitation émotionnelle perçue à ces stimuli. En utilisant des régressions hiérarchiques, nous montrons que la recherche de sensations est liée à une réponse d'excitation perçue plus élevée aux expressions faciales émotionnelles positives, négatives et neutres. Une recherche de sensations plus élevée était également associée à une intensité perçue plus élevée, mais uniquement pour une expression faciale neutre, cette relation médiant entièrement l'association entre la recherche de sensations et la réponse d'excitation. Cette thèse de maîtrise fournit les premières données sur la relation entre le trait de personnalité de recherche de sensations et les différences individuelles dans le traitement des émotions chez les autres. Elle ouvre la porte à de futures recherches sur l'impact potentiel du trait de personnalité de recherche de sensations sur le fonctionnement social chez les jeunes adultes.

Mots-clés: recherche de sensations, perception des émotions, excitation, stimuli sociaux, expression émotionnelle faciale, valence

Abstract

The present master's thesis focuses on the potential relation between sensation seeking and the processing of emotional facial expressions, specifically the perception (perceived intensity and perceived valence) and reaction (arousal) to emotional facial expressions in others. We investigate whether individual differences in sensation seeking are related to the variations in perception and reactions to positive, negative, and neutral facial emotions in others. We also investigate if differences in perception have a role to play in the relationship between the self-reported arousal response and sensation seeking. A sample of young adults (N=77) completed the Sensation Seeking Scale Form V (SSS-V), and rated the intensity and valence of facial emotional expressions taken from the Karolinska Directed Emotional Faces (KDEF) set. Participants also reported their perceived emotional arousal response to these stimuli. Using hierarchical regressions, we show that sensation seeking is related to higher self-reported arousal response to positive, negative, and neutral emotional facial expressions. Higher sensation seeking was also associated with higher perceived intensity but only for neutral facial expression, this relation fully mediated the association between sensation seeking and arousal response. This master's thesis provides the first data on the relation between sensation seeking trait and individual differences in processing of emotions in others. It opens the door to future research on the potential impact of the sensation seeking personality trait on social functioning in young adults.

Keywords: sensation seeking, emotion perception, arousal, social stimuli, facial emotional expression, valence

Table of Contents

List of Tables

Scientific Article

List of Figures

Scientific Article

List of Abbreviations

BS	Boredom Susceptibility (Sensation Seeking Subscale)
CCSA	Canadian Centre on Substance Abuse
DIS	Disinhibition (Sensation Seeking Subscale)
ES	Experience Seeking (Sensation Seeking Subscale)
KDEF	Karolinska Directed Emotional Faces set
SS	Sensation Seeking
SSS-V	Sensation Seeking Scale, Form V
TAS	Thrill and Adventure Seeking (Sensation Seeking Subscale)
WHO	World Health Organization

Acknowledgments

To begin, my most profound appreciation goes to my scientific supervisor Sébastien Hétu, who has helped me immensely to acclimatize to the Canadian scientific environment. He supported me along the way both as a supervisor and a friend. His help and criticisms were constructive, and I greatly appreciate his efforts.

I would like to give special thanks to two professors that I had in my Ukrainian university during my bachelor degree studies. Svitlana Pashchenko, a professor and a deputy dean of the psychology department of Taras Shevchenko national university of Kyiv, set me up for success that directly translated into my opportunity to pursue further education and conduct my research in Canada. And Karine Malysheva, my scientific supervisor for my bachelor thesis paper, is a contributor to my scientific interests, without whom I would not have discovered sensation seeking.

In addition, I would like to thank Jonathan Doherty, Audrey Bernier, and Domiziana Casale – members of the NECS laboratory for their technical assistance, invaluable feedback, and support, without which this project would not have been the same.

Finally, I extend my thanks to my family who has been there for me as I have worked on my project. I feel the need to thank my parents for believing in me enough to pour their lifelong savings into my education in Canada. Last but not least, I would like to express my gratitude to my husband, who has suffered through multiple readings of my papers, even if at times he felt like he was reading them in a foreign language. I would not have been able to do this without you.

Introduction

General Introduction

Personality traits, an integral part of the trait approach within personality psychology, are generally regarded as psychological dimensions of an individual, shaped through hereditary and genetic, as well as environmental, including cultural, influences, that differentiate people from one another on a continuous scale (Vazire et al., 2014). Traits, in their variety, have been useful in understanding and predicting behavioral and thinking patterns, as well as feelings. And while there have been multiple attempts to create universal theories (i.e., psychodynamic, social-cognitive, humanistic theories, etc.) and catalogues of personality traits, researchers are still adding more theoretical background and empirical data to the field. Sensation seeking is one of the relatively newer additions to the catalogue of human personality traits, defined by Marvin Zukerman in the mid 90ies (Zuckerman, 1994). While sensation seeking has been a popular research topic in the area of behavioral deviations (Cyders et al., 2009; Poordarsaraie et al., 2014; Lydon-Staley & Geier, 2018), through which the theoretical basis for it has been significantly developed, areas such as interpersonal relationships remain understudied. Understanding if and how sensation seeking influences human interactions is crucial in discerning the implications of this personality trait, as well as associated traits (i.e., impulsivity), in healthy or problematic interpersonal relations. More precisely, this master's thesis focuses on the relationship between sensation seeking and the processing of facial emotion perception. The first section of this thesis will concentrate on the theoretical background of the sensation seeking trait, perception and reaction to stimuli in the context of sensation seeking, as well as background for facial expression processing. The second section will consist of the manuscript of a scientific paper exploring the relationships between sensation seeking and three domains of facial emotion processing (the arousal response to these stimuli; the perception of their intensity; the perception of their valence).

Lastly, the third section will present a general discussion, theoretical and practical significance of the current research, address the limitations of this project, and outline prospects for future research on this topic.

Sensation Seeking: theoretical context

Marvin Zuckerman describes sensation seeking as: "a trait defined by 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 experience" (Zuckerman, 1994). However, Zukerman's attempt has not been the first in defining this trait. A. R. Mawson at the end of the 1970s defined stimulus seeking (stimulation seeking) as an activity that enhances contact between sensory receptors of an organism and external objects (Mawson, 1978). Therefore, stimulation seeking can be characterized by the tendency towards behavior aimed at obtaining new information, emotion, and experience in a sensory way but not boiled down to modal perception. As such, sensation seeking has been closely tied to impulsivity (Zuckerman, 1993; Zuckerman & Aluja, 2014; Ravert & Donnellan, 2020) and psychopathy (Dickey, 2014; Zeigler-Hill et al., 2016). Additionally, sensation seeking is often associated with various psychiatric disorders, including but not limited to antisocial personality disorder (Frick et al., 1995; Dickey et al., 2014; Mann et al., 2017), bipolar disorder (Cronin & Zuckerman, 1992), borderline personality disorder (Um et al., 2018; Chugani et al., 2020), various depressive symptoms (Farmer et al., 2001; Ortin et al., 2012; Ravert et al., 2013; Lee et al., 2015), psychotic disorders (Peritogiannis, 2015; Katz et al., 2017), and drug abuse (Hopwood et al., 2011; Dickson et al., 2016; Dickson et al., 2018; del Carmen Pérez-Fuentes et al., 2019).

Sensation seeking was reported to be an age-sensitive personality trait, with most researchers agreeing that, although some works have studied sensation seeking during

childhood (Raine et al., 2002; Rezayi, 2014), it is most prominent in adolescents and young adults. As such, some report the timeframe of peak sensation seen in adolescents aged 12-16 years old (Steinberg et al., 2008; MacPherson et al., 2010) or 18-30 years old (Evans-Polce et al., 2018).

Seeing that sensation seeking is often associated with various behavioral deviations, including various risk-taking behaviors, a cross-reference with the World Health Organization and the Canadian Centre on Substance Abuse and Government of Canada reports, adolescents and young adults are indeed subject to various risks that are less pertinent to other age groups. For instance, the World Health Organization (WHO) reports road traffic accident deaths and homicides in men, and HIV/AIDS and maternal mortality as the main causes of death in adolescents and young adults aged 15-29 years old (WHO, 2019). Similarly, the Canadian Centre on Substance Abuse reports higher proneness to cannabis and cocaine drug abuse in youths aged 15 to 24 years old (CCSA, 2020; Government of Canada, 2019). Since the general consensus on the peak of sensation seeking and governmental reports on various behavioral deviations coincide, the study presented in this master's thesis focuses on the slightly generalized age group of young adults aged 18 to 30 years old.

M. Zuckerman outlined four subscales of sensation seeking (thrill and adventure seeking, experience seeking, disinhibition, and boredom susceptibility), each of which has its own implications and interconnections with various behavioral deviances. While thrill and adventure seeking predominance has been linked to risk-taking and the necessity for danger (Fuchs, 2013), experience seeking stimulates seeking new experiences transmitted through music, art, traveling, and new social ties (Wang et al., 2008). Disinhibition corresponds to ignoring social norms through substance use, sexual risk-taking, gambling, and antisocial behaviors (Eachus, 2004). The boredom susceptibility component is characterized by aversion to usual, monotonous states (Eachus, 2004), which may lead to seeking novel

experiences of varying valency, even negative affective states (Bench & Lench, 2019). Looking at the outlined subscales, sensation seeking trait can be characterized by how individuals perceive, react, and behave toward a wide range of stimuli in their environment.

Reaction to and perception of stimuli: Arousal, Intensity, and Valence

Despite the wide range of research into the nature and implications of sensation seeking, most researchers can agree that arousal remains the central notion in defining this trait. Arousal can be defined as the degree to which the sensory system activates enough to result in a reaction (Hofmann et al., 2021). According to Larsen & Buss, the pleasantness of an experience is judged on the coherence of the stimulation or sensory input with the optimal level of catecholaminergic activity (Larsen & Buss, 2008), hypothesized by M. Zuckerman as the optimal level of arousal (Zuckerman, 2007). Zuckerman highlights novelty, intensity, and stimulus significance as the critical factors in the psychophysiology of sensation seeking. According to his observations, high sensation seekers tend to have more pronounced cortical reactions – interpreted as arousal – to more intense sensory stimuli (Zuckerman, 1990). On the contrary, low sensation-seekers tend to exhibit reduced reactions with a smaller increase or even decrease in cortical-evoked potentials regarding increasing visual and auditory non-social stimulus intensity (Zuckerman, 1990). Moreover, distinguishably stronger heart rate response to novel and intense stimuli are present in high sensation seekers, which M. Zuckerman links primarily to experience seeking and boredom susceptibility (Zuckerman, 2004). Other research also supported the claim that high sensation seekers are more responsive to stimulation, as seen from skin conductance response and heart rate data (Smith et al., 1989; De Pascalis et al., 2007). These increased cortical and physiological responses thus suggest that perceiving intense stimuli produce greater arousal in individuals with high levels of sensation seeking. In line with this, Joseph et al. conclude that high sensation

seekers have a strong appetitive motivation, and greater susceptibleness, or hypersensitivity to intense stimuli (but lesser one to stressors; Jozeph et al., 2009). However, according to other researchers, sensation seeking is a key figure in insufficient arousal causing people to seek stimulation through antisocial behavior (Armstong & Boutwell, 2012). Furthermore, others have found that sensation seekers exhibited lower arousal to visual experience-based stimuli classified as "high arousal", and higher to neutral ones (Zheng et al., 2015), or that high sensation seekers did not differ from low sensation seekers in arousal exhibition in drug administration experiment (Carrol et al., 1982). Hence, if most agree that arousal levels are an integral part of sensation seeking if this trait is associated with heightened or reduced arousal levels is still debated. This being said, arousal as the main component of sensation seeking theory seems to be directly connected with various properties of stimuli perception including their intensity and valence.

Intensity of a stimulus describes the magnitude of a stimulus that produces a response from a sensory system on a dynamic range. Intensity is the characteristic that is often the focal point of the sensation seeking theory. In terms of sensation seeking, it is often referred to as the intensity level necessary to achieve the optimal arousal level (Zuckerman, 1994). Several researchers brought attention to sensation seekers' preference for intense stimuli (alongside with novel and complex ones), with the lack of regard towards potential risks associated with them (Zuckerman, 2006; Xu et al., 2019). Other authors tried explaining this tendency with perceived reward deficiency that stimulates high sensation seekers to pursue riskier and more intense stimuli to achieve an adequate level of arousal (Kruschwitz et al., 2012; Tapia León et al., 2019). Indeed, it has been previously established that sensation seekers, compared to sensation avoiders, tend to have an increased approach behavior in combination with reduced avoidance behavior towards intense stimuli in economic rewards contexts (Norbury et al., 2015; Norbury et al., 2016), risky physical activities (Lissek et al.,

2005), drug abuse-associated informative visual and auditory stimuli (Everett & Palmgreen, 1995; Stephenson & Palmgreen, 2001), preference for music genres and art styles that are generally considered as more intense (Zuckerman, 1994; Rawlings et al., 2000). Overall, these results across relevant literature remain consistent, affirming the direct link between sensation seeking and preference for more intense stimuli. Importantly, most researchers focus on the cortical arousability as their general tool of measuring "objective" stimuli intensity but very few have assessed how sensation seeking is associated with subjective perception of the intensity of a stimulus.

The perceived valence of a stimulus also seems to be an important factor related to sensation seeking. The valence of stimuli, that is their rating on a scale ranging from negative to positive, is one of the most fundamental properties of stimulus categorization, through which an individual can plan and execute an appropriate emotional response to said stimulus (Barrett, 2006). Several authors have hypothesized that high sensation seekers have more appetitive reactions to negative stimuli than low sensation seekers (Joseph et al., 2009; Lawson et al., 2012; Norbury, 2016). In line with this, others have found evidence for significant differences between high and low sensation seekers regarding stimuli valence preference, particularly high sensation seekers' preference for negative stimuli (Zaleski, 1984; Grisanzio et al., 2020). It seems that sensation seekers' boredom susceptibility is the most widely accepted cause for their proneness to choose negative stimuli over positive and neutral alternatives (Zaleski, 1984; Bench & Lench, 2019), but other authors rather bring attention to high sensation seekers' hypoarousal to neutral stimuli, which, in turn, impels them to seek more intense, negative, and even threatening stimuli to compensate (Straube et al., 2009). To our knowledge, almost all previous work has looked at valence preference while no research has focused on the subjective perception of stimuli valence in sensation seeking.

Importantly, looking at the literature on stimuli processing in sensation seeking, one can see that an overwhelming number of studies on reaction to (arousal) and perception (intensity and valence) of stimuli have been done using non-social stimuli. This has left an important gap in our knowledge about sensation seeking. Indeed, social stimuli – stimuli related to social interactions – are among the most common and important ones in young adults' daily functioning. Although the processing of social stimuli has been continuously ignored by the sensation seeking literature, sensation seeking can have an important impact on interpersonal relations.

Sensation Seeking and Interpersonal Relations

According to S. Eman, R. I. Nicolson & M. Blades, sensation seeking is an opposite socio-affective personality trait to empathy (Eman et al., 2015). Empathy is a psychological phenomenon that is oriented towards other people. W. Zinn defines it as the act of actively trying to understand the subjective experience of others in the process of sharing it (Zinn 1999), and other researchers define empathy as a cumulative psychological category that includes several psychological phenomena associated with it, such as sympathy, compassion, rapport (Preston & de Waal, 2002). On the contrary, S. Eman et al. mention several researchers defining sensation seeking as a self-oriented emotion targeted at personal gains (Eman et al., 2015). In line with this view, previous research has also investigated the interconnections between sensation seeking and narcissism. More specifically, R. Rogoza et al. include sensation seeking and disinhibition in their research of the narcissism spectrum model (Rogoza et al., 2019). Their results indicate the importance of sensation seeking within the construct of grandiose narcissism. Particularly disinhibition component of sensation seeking seems to be implicated in the social antagonism component, generally characterized by grandiosity, cynicism, hostile or forceful behavior (Lynam & Miller, 2019).

Psychopathy is another psychological phenomenon linked to sensation seeking (Dickey, 2014). Since sensation seeking is characterized by the susceptibility to boredom, drug and alcohol abuse, gambling, impulsivity, desire for danger and risk-taking behavior (Zuckerman, 2009), and psychopathy shares some of those, primarily impulsivity, susceptibility to boredom, need of stimulation, depraved sexuality, irresponsibility and drug and alcohol abuse (Quayle, 2008), researchers assume a link between them. Therefore, it is possible to assume that sensation seeking, as a trait or a personality tendency, is a factor for predicting reprehensive social behaviors often found in psychopathy such as antisocial behaviors or tendency to commit violent crimes.

Considering such close relationships between sensation seeking and lack of empathy, narcissism, and psychopathy, sensation seeking could hypothetically share the perceptual deficits in processing social information including facial expressions associated with these conditions. Indeed, it is generally understood that individuals possessing various psychopathic and antisocial traits have smaller capacity for facial expression perception, resulting in behavior, often perceived as lacking social skills (Kyranides et al., 2022). More precisely, antisocial personality disorder was found to be an impairing factor in facial emotion recognition, and, as a result, proper reaction to various social cues expressed through facial expressions (Marsh & Blair, 2008; Schönenberg et al., 2016). Similarly, many researchers have reported prevalent impairments of facial expression recognition and perception in psychopathic individuals (Hastings et al., 2006; Wai & Tilliopoulos, 2012; Kyranides et al., 2022). Seeing as the ability to properly perceive, recognize, and subsequently react to others' emotions is crucial in inter-personal relationships, allowing to convey and receive social cues without verbal expression (Blair, 2018), emotional facial expressions may be one of the most important types of social stimuli currently overlooked by sensation seeking literature.

Facial emotion recognition and perception

Human interpersonal relationships have for a long time been an important topic of research. Defined as “reciprocal social and emotional interactions” shared between individuals and their environment (Griffin, JR. et al., 1990), interpersonal relationships seem to be a multidimensional complex psychosocial phenomenon, acquired, maintained, and developed through “micro-events and outcomes of the partners' interactions and their implications for relationship growth” (Berscheid & Regan, 2016). Relationship growth, in turn, is defined as an emotional connection through which individuals in a relationship can express themselves and perceive their partner’s responses (Mikulincer & Shaver, 2005). In this context, facial emotion expression and recognition of these emotions in others are crucial skills for the successful maintenance of social interactions.

Importantly, researchers seem to generally focus on overall facial recognition performance rather than more detailed processing or assessment of presented social stimuli. For instance, most research tends to adhere to facial emotion recognition accuracy rates as the primary dependent variable (Surguladze et al., 2004; Glass & Newman, 2006; Mancini et al., 2018). While it is true that the correct identification of emotions allows an individual to properly assess a certain social scenario and find an appropriate response to it (Isaacowitz et al., 2007), it is equally important to research how one deduces it. Understanding facial expressions is a difficult multidimensional skill that develops with age (Guarnera et al., 2015). While it has been established that emotion recognition is an innate instinct found in humans as early as infancy (Pal et al., 2006; Guarnera et al., 2015), emotion sensitivity in neurotypical individuals develops with age allowing detection of more complex emotions or subtle variations in intensity (Smith et al., 2005). Seeing as more complex social interactions that individuals face with age require the development of greater emotional intensity

sensitivity, how we perceived the intensity of a facial emotion expression seems to be one of the most crucial contributing factors in the correct assessment of this type of stimuli.

The intensity of the facial expressions is a more salient emotion dimension, valence, otherwise known as the pleasantness of emotions, is another important dimension. It is often attributed to a stimulus subconsciously (Yang & Yeh, 2018), allows proper categorization and processing of various stimuli and experiences, and enables the formation of an attitude towards that stimulus (Kauschke et al., 2019). Given that previous studies have linked arousal to both intensity (Lang et al., 1998) and valence of emotions, although through facial mimicry, (Fujimura et al., 2010) it is reasonable to complete the list of important emotion dimensions with arousal response as the aspect of emotion that increases an individual's alertness towards presented stimuli (Vesker et al., 2017).

Impairments in the ability to recognize and analyze facial emotional expressions have long been researched in the context of various psychiatric and neuropsychiatric disorders, such as depression (Mo et al., 2021; Ruihua et al., 2021a; Ruihua et al., 2021b), Alzheimer's disease (Hargrave et al., 2002; Torre-Luque et al., 2021), traumatic brain injury (Wearne et al., 2020), bipolar disorder (Altamura et al., 2016; Priyesh et al., 2022), borderline personality disorder (Herr & Meier, 2021), schizophrenia (Gao et al., 2021; Priyesh et al., 2022), and antisocial personality disorder (Marsh & Blair, 2008; Schönenberg et al., 2016; Kyranides et al., 2022). While most researchers focus on facial emotion recognition in terms of neuropsychiatric disorders, there is a consistent body of literature regarding the relationship and predictability of facial emotion recognition task performance and various personality traits (Jenkins, 2017; Kafetsios & Hess, 2022). In fact, previous research has established relationships between facial emotion recognition and extraversion (Li et al., 2010), locus control (Nowicki & Cooley, 1990; Mimrot, 2018), trait anxiety (Surcinelli et al., 2006), neuroticism (Andric et al., 2015; Saylik, 2018). However, to the best of our knowledge, no

research so far have investigated the possible interconnections between sensation seeking and processing of facial emotion expressions. The present study aims at filling this gap in knowledge by studying if and how sensation seeking is related to reactions to (arousal) and perception (intensity and valence) of facial emotions in others.

Scientific Article

Objective. The study focuses on the following research question: do individual differences in sensation seeking partly explain the variations in perception of and reaction to social stimuli, in particular a) intensity and b) valence of the stimuli, as well as c) the emotional arousal in response to them?

Contributions. This scientific article presented in this Master's thesis paper details the research project conducted by Mariia Talalaievska in the general structure of her Master's degree. The initial idea was pitched by Mariia Talalaievska and shaped by her supervisor Sébastien Hétu to fit within the general direction of the research conducted within the laboratory to with she belongs - Neuroscience En Contexte Social (NECS), focusing on research pertinent to social decision making. As the first author of this scientific article, Mariia Talalaievska put forward the research problem, conducted the sampling and testing of subjects, conducted the statistical analyses and wrote the article. Member of the NECS laboratory Jonathan Doherty was involved in the development of data analysis techniques, primarily mediation analysis. Audrey Bernier helped with the technical development of the web-page on LimeSurvey with the questionnaires used in this study. Professor Dr. Bianca D'Antono helped significantly with the proper documentation and structure of research within the course *Séminaire de projet de mémoire.* Sébastien Hétu guided Mariia Talalaievska and provided support throughout the course of the whole study. The article is currently under review by the authors before the expected submission to the *Frontiers in Psychology* in the next few months.

Sensation Seeking Trait and Facial Emotional Expressions in Others: A Study on the perception of Intensity, Valence and Arousal Response

Mariia Talalaievska[1],

Sébastien Hétu[1,2]

[1] Department of Psychology, Université de Montréal, Montreal, Canada

[2] Centre interdisciplinaire de recherche sur le cerveau et l'apprentissage (CIRCA)

Abstract

Sensation seeking in adolescence and young adulthood is typically associated with various risk-taking and reckless behaviors, drug abuse, unsafe sex practices, and aggressive and violent behaviors, with limited research examining the relation of sensation seeking to social stimuli perception. The present study investigated the possible association between sensation seeking trait and perception of the intensity and valence of facial emotion in others, as well as an individual's self-reported arousal response to these social stimuli. It also explores if potential variations in arousal response could be mediated by the association between sensation seeking and intensity and/or valence perception. 77 young adults (33 females and 44 males; overall Mage=26.72) completed measures of sensation seeking (SSS-V) and rated how they perceived the intensity and valence of positive, negative, and neutral facial expressions taken from the KDEF inventory as well as their perceived emotional arousal response to these stimuli. Hierarchical regression results showed that higher sensation seeking was positively associated with higher self-reported arousal for positive, negative, and neutral emotions. Higher sensation seeking was also associated with higher perceived intensity but only for neutral facial expression, this relation fully mediated the association between sensation seeking and arousal response. Our results show for the first time that sensation seeking trait is associated with individual differences in the processing of emotion in others. These results open the door to future research that should investigate the potential impact of sensation seeking personality trait.

Keywords: sensation seeking, emotion perception, arousal, social stimuli

Introduction

Sensation seeking – the composite psychological phenomenon consisting of thrill and adventure seeking, experience seeking, disinhibition, and boredom susceptibility – has been linked to risk-taking behaviors, including sexual risk-taking (Agilonu et al., 2017; Atombo et al., 2017; Pizam et al., 2004), and drug use (Banerjee & Greene, 2009; Byck et al., 2014) but also various deviations in interpersonal interactions such as antisocial (Mann et al., 2017; Mann et al., 2018) and aggressive behaviors (Pérez Fuentes et al., 2016). A large body of studies has suggested a timeframe of heightened or peak, sensation seeking exhibition, ranging from 12-16 years old (Steinberg et al., 2008; MacPherson et al., 2010) to a wider scope of 18 to 30 years old (Evans-Polce, Schuler, Schulenberg and Patrick, 2018). Drawing from this relationship, several studies have attempted to link sensation seeking to engage in dangerous behaviors and activities in adolescents and young adults (Arnett, 1996; Roth et al., 2005; Yanovitzky, 2005; Cestac et al., 2011; Tani et al., 2020). These studies can be supported by the World Health Organization (WHO) reports that state that people between the ages of 15 and 29 years old, have road traffic deaths and homicides in men, and HIV/AIDS and maternal mortality in women as the main causes of death (WHO, 2019). Similarly, according to the CCSA and Government of Canada reports, youths 15-24 years old are more prone to cannabis and cocaine drug use (CCSA, 2020; Government of Canada, 2018a).

While previous studies have examined a wide range of associations between sensation seeking and various variables such as tourism (Lepp & Gibson, 2008; Pizam et al., 2004), music (McNamara & Ballard, 1999; Nater, Krebs & Ehlert, 2005), and political violence (Nussio, 2017; Schumpe et al., 2020), apart from work on social support (Wang et al., 2018; Su et al., 2021) and peer pressure (Eze et al., 2020; Siraj et al., 2021),very few studies have examined the relationship between sensation seeking and interpersonal interactions. This is

surprising as social interactions are often at the center of most adolescents' and young adults' daily life and individual differences in sensation seeking could thus play an important role in their social functioning. Here we will focus on the possible relation between sensation seeking personality trait and the perception and reaction to emotional facial expression in others – stimuli that are often at the center of our social interactions.

Sensation Seeking and the processing of emotions in others

Emotion perception of visual stimuli and reaction to these stimuli are crucial processes in social relationships that allow adequate interpretation of social scenarios for an appropriate response. Emotional facial expressions in everyday life tend to be rather more ambiguous than the six basic emotions (anger, fear, disgust, joy/happiness, sadness, and surprise) (Vincy, 2009), and as such most social information transmission to the observer occurs through subtle changes and fluctuations in different aspects or dimensions of those emotions (Li et al., 2005). Two prime examples of these dimensions are the perceived intensity and the valence of the observed emotions. Indeed, while in certain contexts different dimensions of emotional facial expressions vary in their contribution to the general perception by an observer, both intensity and valence of emotions are crucial in the arousal response arising in the observer (Liu et al., 2022). This is important as the behaviors following the perception of emotions in others is rooted in an individual's arousal and subsequential judgment of obtained information (Lang et al., 1998; Fujimura et al., 2010). Hence, the study of perceived intensity and valence, in addition to the arousal response to emotions in others both separately and conjointly could significantly enrich our understanding of the potential impact of sensation seeking on social interactions. While to the best of our knowledge, no work has yet investigated the relation between sensation seeking and the processing (perception and response) of facial emotional expressions in others, some previous works have shed some

light on individual differences related to sensation seeking in arousal responses, and to a lesser degree perception of intensity and valence using non-social stimuli.

Arousal response and sensation seeking

The sensation seeking trait, defined as "the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experience" (Zukerman, 1994), has been linked to several behaviors that could lead to altered states of consciousness. Garcia-Romeu and Tart (2013) define altered states of consciousness as "alternate patterns or configurations of experience, which differ qualitatively from a baseline state". This trend could be traced back to the origins of the notion of sensation seeking rooted in a person's need to reach the optimum level of arousal (Willibald & Zukerman, 2001). Due to sensation seekers' boredom susceptibility, they seek more stimulating experiences with higher arousal potential (Perse, 1996). Sensation seekers achieve the optimum level of arousal through various sensory sensations and experiences, the deprivation of which is especially aversive for them (Zukerman & Aluja, 2014). If some authors, such as Armstrong & Boutwell (2012), suggest that sensation seeking is a key figure in insufficient arousal, most research rather suggests that high sensation seekers are more easily arousable (Smith et al., 1989; Joseph et al., 2009). Indeed, previous research has been able to establish that sensation seeking is related to higher arousal to various stimuli such as color preference (Rosenbloom, 2006; Afhami et al., 2021), animated picture choice (Edwards, 1984; Schierman & Rowland, 1985; Tamborini and Stiff, 1987; Hall, 2005; Stephenson et al., 2007), visual art forms preference (Furnham & Avison, 1997; Rawlings, 2003), choice of music genres (Litle & Zuckerman, 1986; Hall, 2005; Nater et al., 2005), television and movies choice (Kleemans et al., 2014; Leone & D'Arienzo, 2000), and gambling (Anderson & Brown, 1984; Dickerson et al., 1987). However, if sensation seeking

is related to variations in arousal response in the context of social interactions and to the specific stimuli embedded in them such as emotional facial expressions in others remains largely unknown. Furthermore, while different causes for variations in arousal responses to non-social stimuli in sensation seekers have been proposed (e.g., more easily excitable central nervous system (Smith et al., 1989); general inability to achieve optimal arousal levels (Schmidt, Mussel, & Hewig, 2013); relatively low baseline arousal level in sensation seekers (Zuckerman, 1994)), if these variations can be related to differences in the perception of intensity and/or valence of the stimuli has seldom been studied.

Sensation seeking and intensity and arousal perception

The intensity of a stimulus is its characteristic most occurring in the discourse on sensation seeking. Zuckerman (1994) suggests that intensity is the primary stimulus characteristic sought after by sensation seekers in order to achieve the optimal level of arousal. Indeed, many authors seem to agree that high sensation seeking is related to increased sensitivity to more intense stimuli (Smith et al., 1990; Zuckerman, 2005; Joseph et al., 2009). The relevant literature remains divided on whether this pattern is due to the sensation seekers' lack of regard toward potential risks (Zuckerman, 2006; Xu et al., 2019) or perceived reward deficiency (Kruschwitz et al., 2012; Tapia León et al., 2019). Nevertheless, it seems to be a general consensus that there is a direct relationship between sensation seeking and preference for more intense stimuli. Crucially for this research, previous results only focused on non-social stimuli so if sensation seeking is also associated with higher perceived intensity for social stimuli such as emotions in others remains an open question.

Boredom susceptibility, as a sensation seeking component, has been reported to influence valence choice of repeated stimuli: it increases preference for negative stimuli (Zaleski, 1984). This result is in line with evidence that the prevalence of choice of a negative

emotion-evoking stimulus (drawn from the International Affective Picture System database) is associated with increasing boredom, and thus novelty seeking (Bench & Lench, 2019). Based on these results, the fact that sensation seekers are drawn to negative (and thus potentially aversive stimuli) could be partly explained by the fact that they exhibit proneness to under-evaluate the negativity in various emotion-evoking stimuli (Bench & Lench, 2019). This being said, how sensation seeking affects valence perception remains largely unknown and this is even more the case for social stimuli such as emotions in others.

While social stimuli are one of the most important and frequent sources of information adolescents and young adults must use in their daily life, data about the association between sensation seeking and individual differences in the processing of this type of stimuli remains strikingly scarce. Hence the overall objective of this paper is to study the relationship between the sensation seeking trait and the processing – perception, and reaction – of facial emotions in others in a healthy sample of young adults. We have three primary aims:

1) To report whether individual differences in sensation seeking are related to the variations in self-reported arousal response to positive, negative, and neutral facial emotions in others. The hypothesis for this aim is that higher sensation seeking will be associated with higher perceived emotional arousal in response to all three types of facial emotional expressions in others.
2) A) To report whether individual differences in sensation seeking are related to the variations in perception of the intensity of positive, negative, and neutral facial emotions in others. The hypothesis for this aim is that higher sensation seeking will be associated with higher perceived intensity of all three types of facial emotional expressions in others.

B) To report whether individual differences in sensation seeking are related to the variations in perception of the valence of positive, negative, and neutral facial emotions in others. The hypothesis for this aim is that higher sensation seeking will be associated with less negative perceived valence of negative facial emotional expressions in others. Because of the lack of data about neutral and positive stimuli, we did not have specific a priori hypothesis for neutral and positive facial emotional expressions.

3) To explore if the relation between individual differences in sensation seeking and variations in self-reported arousal responses to positive, negative and neutral facial emotional expression in others is mediated by alterations in perception of the intensity and valence of these stimuli. Note that this objective's hypothesis will only be tested if we find a statistically significant correlation between sensation seeking and these variables. The hypothesis of this aim is that the relation between sensation seeking and self-reported arousal response towards positive, negative, or neutral facial emotional expressions will be partially mediated by its relations with the perceived intensity and/or valence of these stimuli.

Materials and methods

Participants

A total of 87 participants were recruited, but we excluded 7 participants who failed to provide a proper response to an Attention Check Question and 3 participants were excluded from further analysis due to extreme results (see details below). The final sample was composed of 77 young adults (33 females, 44 males) with an average age of 26.72±2.91 years. The necessary number of participants was previously calculated through G*power, concluding with 75 participants as the minimum. These participants were recruited through Amazon Mechanical Turk and completed the questionnaires online via LimeSurvey. No specific primary exclusion criteria, other than the age of the participants (18-30 y.o.) were applied. Participants received a small compensation of $2.00 for their time. This research project protocol was reviewed and approved of by the Committee on Research Ethics in Education and Psychology / Comité d'éthique de la recherche en éducation et en psychologie (CEREP) at University of Montreal. All participants electronically signed the information and consent forms.

Measures

Sensation Seeking

We assessed Sensation Seeking via the self-report Sensation Seeking Questionnaire Form V (SSS-V) (Zuckerman et al., 1994). The SSS-V comprises 40 items measuring 4 subscales (Boredom susceptibility, Disinhibition, Experience seeking, and Thrill and Adventure seeking) with 10 items each, presented in the form of 2 answer choices per item that include statements of preference for certain activities or experiences (i.e., #1: A. "I like "wild" uninhibited parties"; B. "I prefer quiet parties with good conversation"). To ensure the reliability of the utilized scales, the calculations of Cronbach's alphas – the values indicating internal reliability, or the ability of the items on a scale measuring a certain construct to

produce consistent scores (Tang et al., 2014) – were examined for the variables in researched in the present study. The acceptable values indicating a reliable scale testing psychological construct vary between 0.5 and 0.7 (Field, 2017). In instances when certain scales have insufficient values, practices known as "scale purification" – a process of eliminating troublesome items from multiple-item scales to increase the Cronbach's alpha values to acceptable levels (Wieland et al., 2017) – are commonly used. Scale purification was used in the present study to increase the Cronbach's alpha value for the sensation seeking scale. Items #33 ("A. Even if I had the money, I would not care to associate with filthy rich persons in the "jet set". B. I could conceive of myself seeking pleasures around the world with the "jet set") and #34 ("A. I like people who are sharp and witty even if they do sometimes insult others. B. I dislike people who have their fun at the expense of hurting the feelings of others") were excluded from analysis, increasing the Cronbach's alpha values from 0.493 to 0.598, as well as subscales of boredom susceptibility (containing item #34) from 0.367 to 0.445, and disinhibition (containing item#33) from 0.294 to 0.469. Cronbach's alphas for sensation seeking and its subscales along with means and standard deviation values are shown in Table 1. The reported Cronbach's alphas for the dependent variables along with their descriptive statistics can be found in Table 2. Note that in the current study, the Cronbach alphas are weaker than those reported in previous studies. Reported Cronbach alpha for the total sensation seeking score has been found to range between 0.83 and 0.86 with the subscales ranging from 0.6 to 0.8 (Zuckerman & Aluja, 2014). However, lower Cronbach alphas for the total sensation seeking score and the subscales have also been reported by other researchers. For example, Efimov et al. (2022) report the total sensation seeking score alpha being 0.62, while Zheng et al. (2011) report subscale alphas ranging from α=0.426 to α=0.685. Hence, even though the obtained Cronbach alphas are lower than in some previous works, they are not out of the ordinary. For the purposes of this study, based

on the formulated hypotheses, we will only use the total sensation seeking score. Although four subscales of sensation seeking comprise the general score of sensation seeking, and may be used separately, for the exploratory purposes of this study, we focus only on the general sensation seeking score. The practice of using only the general sensation seeking score without analyzing the subscales is commonly used in relevant research (i.e., Pizam et al., 2004; Hall, 2005; Nater et al., 2005; Wang et al., 2018). For the purposes of this study, based on the formulated hypotheses, we will only use the total sensation seeking score.

Table 1. Descriptive statistics: Cronbach's alphas, means, std. deviations

Variable	**Cronbach's alpha**	**Mean**	**Minimum**	**Maximum**	**Std. Deviation**
Sensation Seeking	0.598	18.68	9.00	28.00	4.58
Boredom Susceptibility	0.445	3.26	0.00	7.00	1.75
Disinhibition	0.469	4.55	0.00	9.00	1.90
Experience Seeking	0.387	5.17	1.00	9.00	1.90
Thrill and adventure seeking	0.578	5.68	0.00	9.52	2.23

Table 2. Internal reliability and descriptive statistics: perceived intensity, perceived valence, and arousal by type of emotions

Emotions	Variable	Cronbach's alpha	Mean	Std. Deviation	Minimum	Maximum
Positive	Perceived intensity	0.898	5.82	0.98	3.15	8.15
	Perceived valence	0.796	5.81	0.71	4.10	7.80
	Arousal	0.954	5.10	1.47	1.10	8.00
Negative	Perceived intensity	0.950	5.88	0.94	3.40	7.55
	Perceived valence	0.985	4.33	1.53	2.08	7.63
	Arousal	0.974	5.31	1.29	1.05	7.42
Neutral	Perceived intensity	0.951	4.53	1.76	1.00	7.30
	Perceived valence	0.840	5.21	0.93	3.40	7.60
	Arousal	0.943	4.55	1.73	1.00	7.30

Visual stimuli and task

Variables of perceived intensity and valence of the stimuli in addition to emotional arousal response to the presented stimuli, were measured using the task depicted in Fig. 1. Participants had to observe a series of colored photographs of male and female faces and rate the intensity and valence of the emotional facial expressions and the resulting arousal reaction produced by these faces. The images were taken from the Karolinska Directed Emotional Faces (KDEF) set (Lundqvist et al., 1998). In the present task, the participants were presented with a total of 70 photographs: 10 photos (5 of men and 5 of women), for each of the seven emotions presented (negative emotions: fear, anger, disgust, sadness; positive emotions: happiness, surprise; and neutral expression). After each picture presentation lasting 3 seconds, participants were presented with three questions regarding the perceived intensity and valence of the presented emotions, as well as the participants' emotional arousal in response to them in the form of a classic 9-point Likert scale (for

intensity 1=extremely low intensity, 9=extremely high intensity; for valence 1=extremely negative, 5=neutral, 9=extremely positive; for arousal 1=not aroused, calm, 9=extremely aroused/agitated). Participants could take as long as they wanted to answer.

For each participant, perceived intensity, perceived valence, and arousal were averaged separately for positive, negative, and neutral emotions.

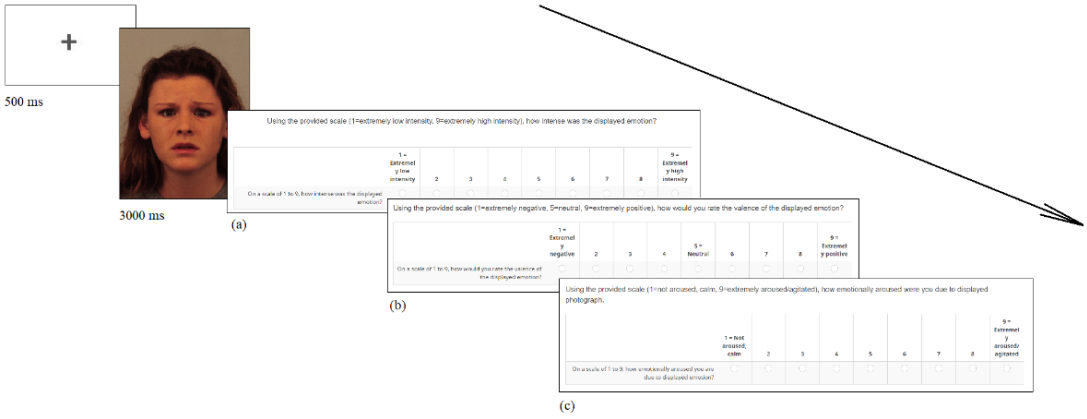

Fig. 1 *The visual stimuli task consisting of the following components: (1) presentation of the fixation cross in the center (500 ms); (2) presentation of the photographs (3000 ms); (3) followed by the three rating-based questions aimed at measuring (a) perceived intensity, (b) perceived valence, and (c)* self-reported *arousal in response to the stimuli.*

Socio-demographic questionnaire

To address the issue of recruitment of participants through Amazon Mechanical Turk, we included a short socio-demographic questionnaire accounting for nine sample features suggested by Levay, Freese & Druckman (2016). As such, the information regarding age, gender, race and ethnicity, income, education, marital status, religion, and partisanship (affiliation with republican, democrat, or independent political ideologies) of the participants were gathered (Appendix A).

Procedure

After the recruitment process through Amazon Mechanical Turk, the participants were invited to participate in a study aimed at assessing the relationship between personality and the evaluation of emotions in others. The full objectives of the study were not disclosed a-priori in order to minimize potential response biases. The participants were informed of the expected duration (approximately 30-35 minutes) and ethical considerations (anonymity, confidentiality, voluntary participation, reimbursement, and the possibility to withdraw from the study at any moment). After, all participants were provided electronic consent forms before proceeding to the questionnaires.

The visual stimuli task was followed by the Sensation Seeking Questionnaire with an approximate duration of 10-15 minutes. Before proceeding to the last section of the questionnaire, all participants were presented with an Attention Check Question ("Research shows that people may not pay attention when answering questions. If you are reading this question, please select the last choice – the one at the very bottom of the list. Thank you for participating and taking the time to read through the questions carefully. What is this study about?"), aimed to measure the participants' engagement and ensure the quality of data. Participants who failed this question were further excluded from the analysis. Finally, participants responded to the socio-demographic questionnaire and provided their unique codes to obtain their reimbursement through Amazon Mechanical Turk.

Data Analysis

All analyses were performed through the Statistical Package for the Social Sciences Software (SPSS), version 26. Preliminary analysis, as recommended by Tabachnick and Fidell (2014), included screening for missing values, outliers, extreme values, and assumptions for necessary statistical analysis. To examine hypotheses 1 and 2 A-B, separate

correlation-based analyses were conducted for positive, negative, and neutral emotional expressions with the heavy focus on hierarchical regression analysis to assess whether sensation seeking may be related to the perceived emotional arousal response, the perceived intensity and valence of the social stimuli above and beyond other variables that could be related to our dependent variables. Specifically, the relations were tested using correlations (or t-tests for dichotomic variables) without multiple comparison corrections and variables found to be associated with our DVs were included in further regression analysis. For hypothesis 3, if we found that sensation seeking was related to self-reported arousal and either perceived intensity or perceived valence of the stimuli, we would use separate mediation models for positive, negative, and neutral expressions to test if sensation seeking's relation with arousal response can be totally or partially explained (indirect path) by either one or both its relation(s) with perceived intensity and valence. Mediation analyses were conducted using Process Macro.

Results

Data preparation and descriptive statistics

No item was excluded from analysis due to an amount of missing data exceeding the set standard of 10% of missing data[1]. The expectation-maximization (EM) algorithm was used to generate values to substitute the missing data.

To test for extreme values, the Z scores were utilized with the set Z score limits within the 95% confidence interval. Based on the obtained Z-scores, 3 participants were found to have extreme values in the sensation seeking variable and were excluded from further analysis.

[1] More precisely, a total of 47 items had 1 missing value (% of missing data = 1.25%), of which 36 were present in the emotion perception task, and 11 in the sensation seeking scale. 7 items had 2 missing values (2.5%), of which 4 were in the emotion perception task, and three were present in the sensation seeking scale. Four items had three missing values (3.75%), and one had 4 missing values (5%) in the sensation seeking scale.

Preliminary Analysis

Descriptive statistics for dependent variables (self-reported arousal, intensity, and valence) for positive, negative, and neutral emotions can be found in Table 2, while descriptive statistics on sensation seeking and socio-demographic variables can be found in Table 3. Correlations between our variables can be found in Table 4. The False Discovery Rate (FDR) correction was used to limit the number of falsely positive results to an acceptable level (standard set at 10%). All statistically significant correlations had the False Discovery Rate values within the set standard.

Our sample was on average 26.72±2.91 years old, consisting of slightly more men (57.1%) than women (42.9%). Most participants were Caucasian (81.8%), either married (58.4%) or never married (40.3%), having finished a bachelor's degree (63.6%). Most participant's household income varies between $30,000 and $89,999 (79.3%). As for ideological identities, most participants belonged to different branches of Christianity (55.8% Catholic, 18.2% Christian Orthodox, and 13.0% Protestant), as well as predominantly democrat-affiliated (69.7%). Note that the only sociodemographic variables that will be included in the following analyses are sex and age.

The Student's T-test was used to compare male and female participants on the nine dependent variables (perceived intensity in positive, negative, and neutral emotions; perceived valence in positive, negative, and neutral emotions; self-reported arousal in positive, negative, and neutral emotions). The participants' sex will be coded in a dichotomous fashion (0=male, 1=female). Their results were statistically significantly different only in perceived intensity of neutral expressions. On average, male participants have higher results than female participants $t=1.236$ ($p=0.032$) with a mean difference of 0.50. Thus, sex will be included in regression analysis for perceived intensity of neutral expressions.

Sensation seeking was found to be statistically significantly correlated with arousal for all three types of emotions with higher total sensation seeking score being associated with higher arousal: for positive emotions ($r=0.291$, $p=0.010$, $pFDR=0.1$),) negative emotions ($r=0.459$, $p<.001$; $pFRD<0.001$), and in neutral emotion ($r=0.383$, $p=0.001$, $pFDR=0.001$). Sensation seeking was also statistically significantly correlated with perceived intensity of neutral stimuli ($r=0.330$, $p=0.003$, $pFDR=0.003$) with higher sensation seeking score being associated with higher perceived intensity. No other relations were found with total sensation seeking scores. For positive emotions, their perceived intensity was also positively related to the perceived valence ($r=0.315$, $p=0.005$, $pFDR=0.005$) and self-reported arousal ($r=0.407$, $p<0.001$, $pFDR<0.001$), while perceived valence also was found to have a positive relationship with arousal ($r=0.487$, $p<0.001$, $pFDR<0.001$). No other relation was found with perceived intensity, valence, and arousal for positive emotions. For negative emotions, only perceived valence and self-reported arousal were positively related ($r=0.525$, $p<0.001$, $pFDR<0.001$). For neutral expression, it was found that perceived intensity has a positive relationship with perceived valence ($r=0.531$, $p<0.001$, $pFDR<0.001$) and self-reported arousal ($r=0.772$, $p<0.001$, $pFDR<0.001$), while perceived valence also had a relationship with self-reported arousal ($r=0.510$, $p<0.001$, $pFDR<0.001$).

Table 3. Descriptive statistics: sensation seeking and socio-demographic variables

Variable	Categories	N (%)	Mean	Std. Deviation
Sensation Seeking			19.09	4.13
Age			26.72	2.91
Sex	Male	44 (57.1%)		
	Female	33 (42.9%)		
Ethnicity	Caucasian	63 (81.8%)		
	Black	9 (11.7%)		
	Asian	4 (5.2%)		
	Multiple races	1 (1.3%)		
Marital Status	Married	45 (58.4%)		
	Separated	1 (1.3%)		
	Never married	31 (40.3%)		
Education Level	Some college, no degree	6 (6.5%)		
	Associate degree	7 (9.1%)		
	Bachelor degree	49 (63.6%)		
	Master's degree	16 (20.8%)		
Household Income	$10,000-$29,999	8 (10.4%)		
	$30,000-$49,999	19 (24.7%)		
	$50,000-$69,999	22 (28.6%)		
	$70,000-$89,999	20 (26.0%)		
	$90,000-$109,999	4 (5.2%)		
	$110,000-$129,999	3 (3.9%)		
	$130,000 or more	1 (1.3%)		
Religion	Catholic	43 (55.8%)		
	Protestant	10 (13.0%)		
	Christian Orthodox	14 (18.2%)		
	Jewish	1 (1.3%)		
	Muslim	1 (1.3%)		
	Atheist	8 (10.4%)		
Partisanship	Democrat	53 (69.7%)		
	Republican	12 (15.8%)		
	Independent	11 (14.5%)		

Table 4. Correlation coefficients between sensation seeking, age, and dependent variables

	1	2	3	4	6	7	9	10
1. Sensation Seeking								
2. Age	0.112							
3. Perceived intensity (positive)	-0.081	0.199						
4. Perceived valence (positive)	0.005	0.050	0.315**					
5. Arousal (positive)	0.291*	0.184	0.407**	0.487**				
6. Perceived intensity (negative)	0.116	0.079						
7. Perceived valence (negative)	0.149	0.012			-0.083			
8. Arousal (negative)	0.459**	0.038			0.187	0.525**		
9. Perceived intensity (neutral)	0.330**	0.173						
10. Perceived valence (neutral)	0.157	0.058					0.531**	
11. Arousal (Neutral)	0.383**	0.067					0.772**	0.510**

All significant relationships at $p<0.01$ are labeled with two stars; all significant relationship at $p<0.05$ are labeled with one star.

Hierarchical regression analyses

To assess whether individual differences in sensation seeking trait correlate with the variations in self-reported arousal reactions to positive, negative and neutral facial emotions in others, a set of hierarchical regression models was created, one for each type of emotion. In the present study we want to control for two things: differences in perception and individual characteristics. These two categories were added in two different blocks. All results from our regression analyses can be found in Table 5.

For arousal after observing positive emotions, the final regression model included perceived intensity and valence of positive emotions in block 1, and sensation seeking in block 2. The two first were included in the regression model with full understanding that they could not be mediatory variables due to lack of relationship with sensation seeking, but rather predictors of their own. The final resulting regression model has a high correlation with arousal $R=0.637$, is capable of explaining 40.6% of variation within arousal ($R^2=0.406$), and is statistically significant ($p<0.01$). Sensation seeking input in the second block increases the variance explained from 30.8% to 40.6%. The perceived valence of positive emotions seems to be the most significant contributor in this model (with more positive valence being associated with higher arousal; ß=0.387, $p<0.01$), followed by sensation seeking (with higher sensation seeking being associated with higher arousal; ß=0.315, $p<0.01$), and perceived intensity (with higher intensity being associated with higher arousal; ß=0.310, $p<0.01$).

For arousal after observing negative emotions, the regression analysis included perceived intensity and valence of negative emotions in block 1, and sensation seeking in block 2. Similarly to the model predicting arousal in positive emotions, sensation seeking was able to significantly improve the variance explained from 33.0% to 45.7%. The final model was closely related to the dependent variable of self-reported arousal in negative emotions $R=0.676$, could account for 45.7% of variation within it ($R^2=0.457$), and was statistically significant ($p<0.01$). Perceived valence of negative emotions was the most significant contributor in the model ß=0.486 (with more positive valence being associated with higher arousal; $p<0.01$), followed by sensation seeking ß=0.365 (with higher sensation seeking being associated with higher arousal; $p<0.01$), and perceived intensity ß=0.185 (with higher intensity being associated with higher arousal; $p<0,05$).

For arousal after observing neutral expression, the regression model included perceived valence in block 1, and sensation seeking in block 2. Perceived intensity was not

included in the model due to its correlation with sensation seeking, and thus potential mediating power. The final model was correlated to the dependent variable of arousal to neutral expressions (R=0.595), could explain 35.5% of variance (R^2=0.355), and was statistically significant (p<0.01). The inclusion of sensation seeking in block 2 increased the variance explained from 26.1% to 35.5%. Perceived valence was the more significant contributor to the model with ß=0.462 (with more positive valence being associated with higher arousal; p<0.01), and sensation seeking was second with ß=0.310 (with higher sensation seeking being associated with higher arousal; p<0.01).

The results obtained from the performed hierarchical regression analyses allow us to confirm the hypothesis that higher sensation seeking trait is associated with higher emotional arousal in response to photographs of positive, negative and neutral facial emotional expressions in others.

Regarding our second aim and its hypotheses, no significant correlations were found between sensation seeking and perceived intensity of positive or negative emotions. Hence, the hierarchical analyses were not performed. However, there was a significant relationship between sensation seeking and perceived intensity of neutral expressions. The regression model included perceived valence when viewing neutral expressions, as well as sex in block 1, and sensation seeking in block 2. The self-reported arousal was not included in this model out of regard for multicollinearity due to the relationship between sensation seeking and self-reported arousal in neutral expressions. The model was significantly correlated with intensity (R=0.789), and could explain 35.4% of its variance (R^2=0.354), and was statistically significant (p<0.01). Perceived valence was the most significant contributor with ß=0.490 (with more positive valence being associated with higher perceived intensity; p<0.001), followed by sensation seeking (with higher sensation seeking being associated with higher perceived intensity; ß=0.242, p=0.014), and sex, which lost its statistical significance (ß=-

0.099, p=0.302). Thus, we can conclude that sensation seeking is a significant predictor of perceived intensity of neutral emotional stimuli. As for the valence perception, sensation seeking was not found to be related to perceived valence of positive, negative, or neutral emotions, and thus no hierarchical regression analysis was performed. Our correlational results suggest that sensation seeking is not a significant predictor of valence perception in emotional facial expressions in others.

Table 5. Hierarchical regression analyses predicting arousal in response to positive, negative, and neutral emotional facial expressions.

Contributing factors	R	R^2	ß	F
Arousal in positive emotions				
Step 1: Perception Factors	0.555	0.308		16.459**
PI of positive emotions			0.281**	
PV of positive emotions			0.398**	
Step 2: Sensation Seeking	0.637	0.406		16.650**
PI of positive emotions			0.310**	
PV of positive emotions			0.387**	
SS			0.315**	
Arousal in negative emotions				
Step 1: Perception Factors	0.574	0.330		18.188**
PI of negative emotions			0.232*	
PV of negative emotions			0.545**	
Step 2: Sensation Seeking	0.676	0.457		20.505**
PI of negative emotions			0.185*	
PV of negative emotions			0.486**	
SS			0.365**	
Arousal in neutral emotions				
Step 1: Perception Factors	0.510	0.261		26.430**
PV of neutral emotions			0.510**	
Step 2: Sensation Seeking	0.595	0.355		20.327**
PV of neutral emotions			0.462**	
SS			0.310**	
Intensity in neutral emotions				
Step 1: Perception Factors	0.545	0.297		15.666**
PV of neutral emotions			0.527**	
Sex			-0.125	
Step 2: Sensation Seeking	0.595	0.354		13.318**
PV of neutral emotions			0.490**	
Sex			-0.099	
SS			0.242*	

PI = perceived intensity, PV = perceived valence, SS = sensation seeking; *$p < 0.05$, **$p < 0.01$

As for our third objective, the hypothesis was tested using a mediation model based through the usage of Process Macro. Mediation analysis allows to test the extent to which a third variable affect the relationship between two others (MacKinnon et al., 2007). As per requirements for performing the mediation analysis, the independent variable should be significantly correlated to both the dependent variable and the mediator variable, while, in

turn, the mediator variable should be significantly correlated to the dependent variable (Field, 2017). These requirements allow us to test a single mediation model between sensation seeking and self-reported arousal for neutral stimuli mediated by the perceived intensity of these stimuli. Mediation analysis through the means of Process macro revealed that there is a significant indirect effect of sensation seeking on self-reported arousal of neutral stimuli through perceived intensity of said stimuli (Effect = 0.100; the 95% confidence limits BootLLCI=0.094 and BootULCI=0.376). The total effect of sensation seeking on self-reported arousal response in neutral stimuli is 0.161 (p=0.01) with the direct effect being 0.60 (p=0.064). In this case, due to insignificant direct effect we observed a full mediation of the effect of sensation seeking on self-reported arousal response in neutral stimuli by perceived intensity of these stimuli.

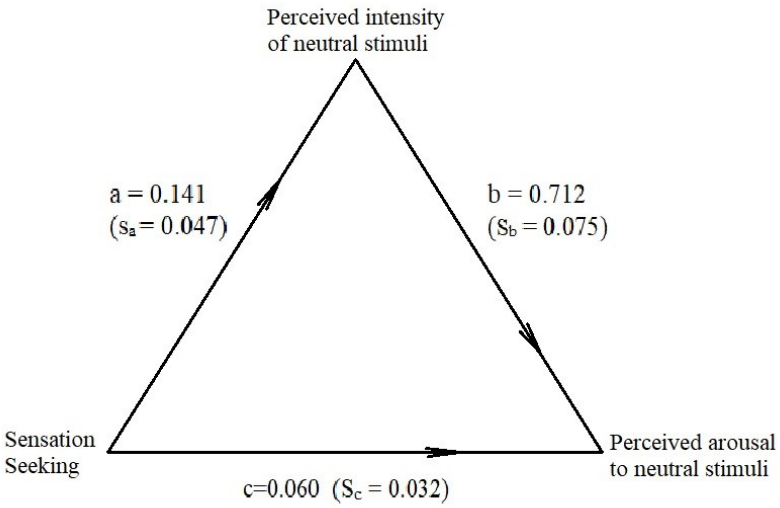

Fig. 2 *Mediation analysis assessing the indirect effect of sensation seeking on* self-reported *arousal to neutral stimuli through perceived intensity of neutral stimuli.*

Discussion

Sensation seeking is generally regarded as a risk factor for various behavioral deviations (i.e., risk-taking and reckless behaviors, drug and alcohol abuse, aggression, etc.). However, the knowledge regarding the social implications of sensation seeking remains very limited, with previous work focusing almost exclusively on various negative behaviors, such as bullying (Graf et al., 2019), political violence (Schumpe et al., 2020), and armed violence (Nussio, 2017) among others. Hence, whether sensation seeking, as foreseen in its original definition, is related to how individuals process social stimuli remains an open question.

Thus, the present study investigates the possible extent to which sensation seeking trait is related to the perception of facial emotion in others through the dimension of intensity and valence, as well as to the self-reported arousal response to these social stimuli. It also explores if potential variations in arousal response could be mediated by the association between sensation seeking and intensity and/or valence perception. We provide data suggesting that higher sensation seeking trait is associated with higher self-reported arousal to positive, negative and neutral emotions expressed by others. Furthermore, our results suggest that higher sensation seeking is also associated with higher perceived intensity but only for neutral facial expression, this relation fully mediating the association between sensation seeking and arousal response. By providing the first data on the association between sensation seeking and the processing of facial emotions in other, our study provides insights into how sensation seeking may influence interpersonal interactions.

Arousal – "a state of physiological activation or cortical responsiveness, associated with sensory stimulation and activation of fibers from the reticular activating system" or "a state of excitement or energy expenditure linked to an emotion" (VandenBos, 2007) – is of particular interest in sensation seeking research as it is one of the central constructs within Zukerman's theory. Furthermore, arousal response has been identified as an important factor

in interpersonal relationships in previous research, with a focus on its role in social transmissions (Berger, 2011), stereotyping (Bodenhausen, 1993), and even judgment of other individuals' emotions (Clark et al., 1984). In the present study, we found significant relationships between individual differences in sensation seeking trait and variations in reported arousal responses to positive, negative, and neutral emotional expressions in others. Hierarchical regression analysis results support our hypothesis that higher sensation seeking is associated with higher arousal to positive, negative, and neutral emotional facial expressions. Our results, are in line with previous results found in studies showing increased arousal response towards non-social stimuli (Zuckerman, 2005; Joseph et al., 2009) and provide, for the first time, evidence that this higher arousal response seems also present for social stimuli. Since we only measure the subjective perception of arousal response, future work should investigate if sensation seeking is also associated with higher physiological arousal responses to social stimuli using more "objective" measures such as heart rate, pupillometry, or skin-conductance measures.

In this study, we also investigated if individual differences in sensation seeking trait would be associated with variations in perceived intensity and perceived valence of positive, negative, and neutral facial emotional expressions in others. For intensity perception, hierarchical regression results support our hypothesis that sensation seeking would be related to higher perceived intensity, although only in neutral stimuli. While it has been previously established that sensation seeking is directly related to increased sensitivity to more intense stimuli (Zuckerman, 2005; Joseph et al., 2009), to the best of our knowledge, no research has found this to be the case with neutral stimuli. Moreover, researchers in the area do not separate intensity from arousal, and often treat them as equal, focusing on objective measures (e.g., fMRI, EEG, heart rate, and skin conductance research). In most cases, intensity variables are predetermined by "high intensity" and "low intensity" stimuli presented to

participants (Norbury & Husain, 2015; Xu et al., 2019). Thus, our study provides the first data regarding the subjective ratings of perceived intensity and provides an opportunity to research the differences between subjective and objective data regarding sensation seekers' intensity ratings and subsequent arousal responses. However, Straube et al. (2009) previously suggested that high sensation seekers' hypoarousal to neutral stimuli impels them to seek more intense, negative, and even threatening stimuli to compensate. Sensation seekers' boredom susceptibility could also influence them to perceive non-emotionally charged (neutral) stimuli as unpleasant, a pattern found in psychopathy, a closely related to sensation seeking phenomenon (Levenston et al., 2000). However, we did not find that sensation seeking was related to perceiving neutral emotional expression as being a more negative valence. Regardless, we currently lack information to fully explain these results, and future research is needed to further explain the trends found in this study.

For valence perception, we found no evidence that would support the hypothesis that sensation seeking could partially explain the variation in the perception of valence in positive, negative, and neutral facial expressions, even though previous research established an association between higher sensation seeking and the preference for negative stimuli over positive and neutral ones (Zaleski, 1984; Grisanzio et al., 2020). A possible explanation for our null results is that previous studies focused on motivation to engage with different stimuli (Grisanzio et al., 2020) and preference for negative or positive stimuli (Zaleski, 1984; Norbury & Husain, 2015; Zheng et al., 2015), rather than self-reported perceived valence ratings. While previous research emphasizes high sensation seekers' tendency to choose negative stimuli over positive and neutral ones, how sensation seeking affects valence perception remains largely unknown and this is even more the case for social stimuli such as emotions in others, for which our study provides the first data.

Lastly, we also wanted to assess if the potential relation between sensation seeking and arousal response to facial emotional stimuli could be explained by variations in the perception of the intensity and/or valence of these stimuli. Since we only observed relations between sensation seeking and the intensity and the arousal for neutral facial expression, a mediation analysis was conducted only for this type of stimuli. Our results suggest that sensation seeking's influence on one's self-reported arousal response to neutral facial expressions is fully mediated by its relation with higher intensity appraisal. Medina et al. (2016) found that among individuals with high psychopathic traits (closely related to sensation seeking) neutral stimuli evoked higher arousal responses than those with low psychopathic traits when viewing emotionally charged pictures drawn from the International Affective Picture System (IAPS). The authors suggested that impaired emotional processing is the primary explanation for the obtained results. However, their results remain controversial seeing as other authors did not find significant differences between emotional and neutral stimuli (Hajcak et al., 2010; Carolan et al., 2013). Nevertheless, our research using the facial expressions in others provides some of the first data on a potential mechanism explaining how personality traits such as sensation seeking could impact arousal response to neutral stimuli, namely by increasing their perceived intensity. Our results also suggest that while higher sensation seeking is associated with higher arousal response to positive, negative, and neutral facial expressions, this higher reactivity is only dependent on variations in perception for neutral expressions. This difference between types of emotions could potentially be explained by sensation seekers' general lack of arousal towards neutral stimuli (Straube et al., 2009), which would thus require additional mediators to influence arousal response, while positive and negative stimuli do not. Further research is required to test this hypothesis and if our results can be replicated using other social and non-social stimuli. Importantly, more work is required to test these hypotheses.

Limits

Certain limitations of this study must be acknowledged. Firstly, we gathered the data through self-report questionnaires as this method is generally viewed as having various limitations, such as the greater possibility of invalid answers, as well as the social desirability bias and response bias (Demetriou et al., 2015). Hence, it would be beneficial for future work to use a more multi-dimensional approach, potentially associating subjective self-reported data with physiological data through the usage of EEG or pupillometry. However, seeing as most of the sensation seeking literature has not looked into how individuals evaluate their perception and their reactions toward social stimuli, the current study provides some of the first data about differences in subjective perception and responses related to sensation seeking.

One limitation lies within the sample of the present study. The range of values of sensation seeking is not large enough (range of min. 9 to max. 28 (out of 0-40) is only within two standard deviation of the mean) to be able to definitively extrapolate the results of the present master's thesis to all variations of sensation seeking. Future research should focus on a broader and more varied sample.

Another limitation consists in the sampling method, which occurred online through the usage of Amazon Mechanical Turk due to the constraints of recruitment due to the outbreak of COVID-19 for the duration of the study. While the socio-demographic data of the sample is consistent with the general population of interest, it would be important to validate the present results using a more controlled research environment.

Conclusion

In conclusion, our study is the first to investigate the potential relations between the personality trait of sensation seeking and processing of social stimuli by measuring the

reaction to and perception of facial expressions in young adults, the population where sensation seeking is at its peak. We show that higher sensation seeking is associated with higher perceived emotional arousal in response to positive, negative, and neutral emotional facial expressions while it does not seem to be related to the perception of the valence of these stimuli and only related to the perceived intensity of neutral faces. Overall, our results suggest that although sensation seeking seems to have a limited impact on how individual perceived facial expressions, it can increase their emotional reactions to these social stimuli. As so, our study provides a base for future studies focusing on the possible impacts of sensation seeking on social functioning.

Data Availability

The datasets generated in Microsoft Excel and SPSS 26.0 for this study are available on request to the corresponding author.

Ethics Statement

The study's design was approved by the University of Montreal's Comité d'éthique de la recherche en éducation et en psychologie (CEREP).

References

Agilonu, A., Bastug, G., Mutlu, T., & Pala, A. (2017). Examining Risk-Taking Behavior and Sensation Seeking Requirement in Extreme Athletes. Journal of Education and Learning, 6(1), 330. https://doi.org/10.5539/jel.v6n1p330

Almondes, K. M., Júnior, F. W., Leonardo, M. E., &; Alves, N. T. (2020). Facial emotion recognition and executive functions in insomnia disorder: An exploratory study. Frontiers in Psychology, 11. https://doi.org/10.3389/fpsyg.2020.00502

Anderson, G., & Brown, R. (1984). Real and Laboratory Gambling, Sensation-seeking and Arousal. British Journal Of Psychology, 75 (Prt.3)(3), 401-410. https://doi.org/10.1111/j.2044-8295.1984.tb01910.x

Arnett, J. J. (1996). Sensation seeking, aggressiveness, and adolescent reckless behavior. Personality and Individual Differences, 20(6), 693–702. https://doi.org/10.1016/0191-8869(96)00027-x

Atombo, C., Wu, C., Tettehfio, E., & Agbo, A. (2017). Personality, socioeconomic status, attitude, intention and risky driving behavior. Cogent Psychology, 4(1), 1376424. doi: 10.1080/23311908.2017.1376424Banerjee, S., & Greene, K. (2009). Sensation Seeking and Adolescent Cigarette Smoking: Examining Multiple Pathways in Cross-Sectional Data. The Open Addiction Journal, 2(1), 12-20. https://doi.org/10.2174/1874941000902010012

Bench, S., & Lench, H. (2019). Boredom as a Seeking State: Boredom Prompts the Pursuit of Novel (Even Negative) Experiences. Emotion, 19(2), 242–254. https://doi.org/http://dx.doi.org/10.1037/emo0000433

Berger, J. (2011). Arousal increases social transmission of information. Psychological Science, 22(7), 891–893. https://doi.org/10.1177/0956797611413294

Blechert, J., Testa, G., Georgii, C., Klimesch, W., & Wilhelm, F. H. (2016). The Pavlovian Craver: Neural and experiential correlates of single trial naturalistic food conditioning in humans. Physiology & Behavior, 158, 18–25. https://doi.org/10.1016/j.physbeh.2016.02.028

Bodenhausen, G. V. (1993). Emotions, arousal, and stereotypic judgments: A heuristic model of affect and stereotyping. Affect, Cognition and Stereotyping, 13–37. https://doi.org/10.1016/b978-0-08-088579-7.50006-5

Bradley, M. M. (2009). Natural selective attention: Orienting and emotion. Psychophysiology, 46(1), 1–11. https://doi.org/10.1111/j.1469-8986.2008.00702.x

Bradley, M. M., Keil, A., & Lang, P. J. (2012). Orienting and emotional perception: Facilitation, attenuation, and interference. Frontiers in Psychology, 3. https://doi.org/10.3389/fpsyg.2012.00493

Byck, G., Swann, G., Schalet, B., Bolland, J., & Mustanski, B. (2014). Sensation Seeking Predicting Growth in Adolescent Problem Behaviors. Child Psychiatry & Human Development, 46(3), 466-473. https://doi.org/10.1007/s10578-014-0486-y

Canadian Centre on Substance Use and Addiction. (2019). Cocaine (Canadian Drug Summary). Topic Summary. Available online: https://www.ccsa.ca/cannabis-canadian-drug-summary (accessed on 23 February 2021).

Canadian Centre on Substance Use and Addiction. (2020). Cannabis (Canadian Drug Summary). Topic Summary. Available online: https://www.ccsa.ca/cannabis-canadian-drug-summary (accessed on 23 February 2021).

Carolan, P. L., Jaspers-Fayer, F., Asmaro, D. T., Douglas, K. S., & Liotti, M. (2013). Electrophysiology of blunted emotional bias in psychopathic personality. Psychophysiology, 51(1), 36–41. https://doi.org/10.1111/psyp.12145

Cestac, J., Paran, F., & Delhomme, P. (2011). Young drivers' sensation seeking, subjective norms, and perceived behavioral control and their roles in predicting speeding intention: How risk-taking motivations evolve with gender and driving experience. Safety Science, 49(3), 424–432. https://doi.org/10.1016/j.ssci.2010.10.007

Clark, M. S., Milberg, S., &; Erber, R. (1984). Effects of arousal on judgments of others' emotions. Journal of Personality and Social Psychology, 46(3), 551–560. https://doi.org/10.1037/0022-3514.46.3.551

Corcoran, C. M., Keilp, J. G., Kayser, J., Klim, C., Butler, P. D., Bruder, G. E., Gur, R. C., &; Javitt, D. C. (2015). Emotion recognition deficits as predictors of transition in individuals at clinical high risk for schizophrenia: A neurodevelopmental perspective. Psychological Medicine, 45(14), 2959–2973. https://doi.org/10.1017/s0033291715000902

de Almeida Rocca, C. C., van den Heuvel, E., Caetano, S. C., & Lafer, B. (2009). Facial emotion recognition in bipolar disorder: A critical review. Revista Brasileira de Psiquiatria, 31(2), 171–180. https://doi.org/10.1590/S1516-44462009000200015

De Silva, L. C., Miyasato, T., & Nakatsu, R. (1997). Facial emotion recognition using multi-modal information. Proceedings of ICICS, 1997 International Conference on Information, Communications and Signal Processing. Theme: Trends in Information Systems Engineering and Wireless Multimedia Communications (Cat. No.97TH8237). https://doi.org/10.1109/icics.1997.647126

Demetriou, C., Ozer, B. U., &; Essau, C. A. (2015). Self-report questionnaires. The Encyclopedia of Clinical Psychology, 1–6. https://doi.org/10.1002/9781118625392.wbecp507

Dickerson, M., Hinchy, J., & Fabre, J. (1987). Chasing, Arousal and Sensation Seeking in Off-course Gamblers. British Journal of Addiction, 82(6), 673-680. https://doi.org/10.1111/j.1360-0443.1988.tb00478.x

Eachus P. (2004). Using the brief sensation seeking scale (bsss) to predict holiday preferences, Personality and Individual Differences, 36(1), 141-153, 2004.

Efimov, K., Ntoumanis, I., Kuskova, O., Kadieva, D., Panidi, K., & Kosonogov, V. et al. (2022). Impact of Induced Moods, Sensation Seeking, and Emotional Contagion on Economic Decisions Under Risk. Frontiers In Psychology, 12. doi: 10.3389/fpsyg.2021.796016

Evans-Polce, R., Schuler, M., Schulenberg, J. and Patrick, M. (2018). Gender- and age-varying associations of sensation seeking and substance use across young adulthood. *Addictive Behaviors*, 84, pp.271-277.

Eze, J. E., Chukwuorji, J. B. C., Idoko, S., & Ifeagwazi, C. M. (2020). Does peer pressure and sensation seeking differentially influence substance use for male versus female trauma-exposed youth? Journal of Substance Use, 25(5), 538–544. https://doi.org/10.1080/14659891.2020.1738575

Frenkel, M. O., Brokelmann, J., Nieuwenhuys, A., Heck, R.-B., Kasperk, C., Stoffel, M., & Plessner, H. (2019). Mindful sensation seeking: An examination of the protective influence of selected personality traits on risk sport-specific stress. Frontiers in Psychology, 10. https://doi.org/10.3389/fpsyg.2019.01719

Fujimura, T., Sato, W., & Suzuki, N. (2010). Facial expression arousal level modulates facial mimicry. International Journal of Psychophysiology, 76(2), 88–92. https://doi.org/10.1016/j.ijpsycho.2010.02.008

Garcia-Romeu, A.P., Tart, C.T. (2013). The Wiley-Blackwell Handbook of Transpersonal Psychology (First ed.). John Wiley & Sons, Ltd.

Graf, D., Yanagida, T., &; Spiel, C. (2019). Sensation seeking's differential role in face-to-face and cyberbullying: Taking perceived contextual properties into account. Frontiers in Psychology, 10. https://doi.org/10.3389/fpsyg.2019.01572

Hajcak, G., MacNamara, A., & Olvet, D. M. (2010). Event-related potentials, emotion, and emotion regulation: An integrative review. Developmental Neuropsychology, 35(2), 129–155. https://doi.org/10.1080/87565640903526504

Herr, N. R., & Meier, E. P. (2021). Accuracy for subtle facial emotional expressions among individuals with borderline personality disorder symptoms and diagnoses. Personality Disorders: Theory, Research, and Treatment, 12(2), 150–159. https://doi.org/10.1037/per0000448

Houge Mackenzie, S. (2013). Beyond thrill-seeking: Exploring multiple motives for Adventure Participation. Journal of Outdoor Recreation, Education, and Leadership, 5(2), 136–139. https://doi.org/10.7768/1948-5123.1212

Joseph, J. E., Liu, X., Jiang, Y., Lynam, D., & Kelly, T. H. (2009). Neural correlates of emotional reactivity in Sensation seeking. Psychological Science, 20(2), 215–223. https://doi.org/10.1111/j.1467-9280.2009.02283.x

Kleemans, M., Hendriks Vettehen, P., Eisinga, R., & Beentjes, J. (2014). Enjoyment of arousing television news: The role of age and sensation seeking. *Communications, 39*(1), 89-99. https://doi.org/10.1515/commun-2014-0006

Kruschwitz, J. D., Simmons, A. N., Flagan, T., & Paulus, M. P. (2012). Nothing to lose: Processing blindness to potential losses drives thrill and adventure seekers. NeuroImage, 59(3), 2850–2859. https://doi.org/10.1016/j.neuroimage.2011.09.048

Lang A., Shin M., Lee S. (2005). Sensation seeking, Motivation, and substance use: A dual system approach. Media Psychology, 7, 1-29.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1998). Emotion, motivation, and anxiety: Brain mechanisms and psychophysiology. Biological Psychiatry, 44(12), 1248–1263. https://doi.org/10.1016/s0006-3223(98)00275-3

Leone, C., & D'Arienzo, J. (2000). Sensation-Seeking and Differentially Arousing Television Commercials. *The Journal Of Social Psychology, 140*(6), 710-720. https://doi.org/10.1080/00224540009600511

Lepp, A., & Gibson, H. (2008). Sensation seeking and tourism: Tourist role, perception of risk and destination choice. Tourism Management, 29(4), 740-750. doi: 10.1016/j.tourman.2007.08.002

Levay, K., Freese, J., & Druckman, J. (2016). The Demographic and Political Composition of Mechanical Turk Samples. SAGE Open, 6(1), 215824401663643. https://doi.org/10.1177/2158244016636433

Levenston, G. K., Patrick, C. J., Bradley, M. M., & Lang, P. J. (2000). The psychopath as observer: Emotion and attention in picture processing. Journal of Abnormal Psychology, 109(3), 373–385. https://doi.org/10.1037/0021-843x.109.3.373

Li, S. Z., Jain, A. K., Tian, Y.-L., Kanade , T., & Cohn , J. F. (2005). Facial Expression Analysis. In Handbook of Face Recognition (pp. 247–275). chapter, Springer.

Lissek, S., Baas, J. M., Pine, D. S., Orme, K., Dvir, S., Rosenberger, E., & Grillon, C. (2005). Sensation seeking and the aversive motivational system. Emotion, 5(4), 396–407. https://doi.org/10.1037/1528-3542.5.4.396

Liu, M., Duan, Y., Ince, R. A. A., Chen, C., Garrod, O. G. B., Schyns, P. G., & Jack, R. E. (2022). Facial expressions elicit multiplexed perceptions of emotion categories and dimensions. Current Biology, 32(1). https://doi.org/10.1016/j.cub.2021.10.035

Lundqvist, D., Flykt, A., Ohman, A. (1998). The Karolinska Directed Emotional Faces. *Stockholm: Department of Clinical Neuroscience, Psychology section, Karolinska Institute*.

MacPherson, L., Magidson, J., Reynolds, E., Kahler, C. and Lejuez, C., 2010. Changes in Sensation Seeking and Risk-Taking Propensity Predict Increases in Alcohol Use Among Early Adolescents. Alcoholism: Clinical and Experimental Research.

Mann, F., Engelhardt, L., Briley, D., Grotzinger, A., Patterson, M., & Tackett, J. et al. (2017). Sensation seeking and impulsive traits as personality endophenotypes for antisocial behavior: Evidence from two independent samples. *Personality and Individual Differences, 105*, pp. 30-39. https://doi.org/10.1016/j.paid.2016.09.018

Mann, F., L. Paul, S., Tackett, J., Tucker-Drob, E., & Harden, K. (2018). Personality risk for antisocial behavior: Testing the intersections between callous–unemotional traits, sensation seeking, and impulse control in adolescence. *Development and Psychopathology, 30*(1), 267-282. https://doi.org/10.1017/s095457941700061x

McNamara, L., & Ballard, M. E. (1999). Resting arousal, sensation seeking, and music preference. Genetic, Social, and General Psychology Monographs, 125(3), 229–250.

Medina, A. L., Kirilko, E., & Grose-Fifer, J. (2016). Emotional processing and psychopathic traits in male college students: An event-related potential study. International Journal of Psychophysiology, 106, 39–49. https://doi.org/10.1016/j.ijpsycho.2016.06.004

Munsey, C. (2006). Frisky, but more risky: High sensation-seekers' quest for new experiences leads some to the high-stress jobs society needs done but makes others vulnerable to reckless behavior. PsycEXTRA Dataset, 37(7), 40. https://doi.org/10.1037/e521142006-023

Nater, U., Krebs, M., & Ehlert, U. (2005). Sensation Seeking, Music Preference, and Psychophysiological Reactivity to Music. *Musicae Scientiae*, *9*(2), 239-254. doi: 10.1177/102986490500900205

Norbury, A., & Husain, M. (2015). Sensation-seeking: Dopaminergic Modulation and risk for psychopathology. Behavioural Brain Research, 288, 79–93. https://doi.org/10.1016/j.bbr.2015.04.015

Nussio, E. (2017). The Role of Sensation Seeking in Violent Armed Group Participation. *Terrorism And Political Violence*, *32*(1), 1-19. doi: 10.1080/09546553.2017.1342633

Pérez Fuentes, M., Molero Jurado, M., Carrión Martínez, J., Mercader Rubio, I., & Gázquez, J. (2016). Sensation-Seeking and Impulsivity as Predictors of Reactive and Proactive Aggression in Adolescents. *Frontiers in Psychology*, 7. https://doi.org/10.3389/fpsyg.2016.01447

Perse, E. (1996). Sensation Seeking and the Use of Teievision for Arousal. *Communication Reports,, 9*(1), 37-48. https://doi.org/10.1080/08934219609367633

Pizam, A., Jeong, G., Reichel, A., van Boemmel, H., Lusson, J., & Steynberg, L. et al. (2004). The Relationship between Risk-Taking, Sensation-Seeking, and the Tourist Behavior of Young Adults: A Cross-Cultural Study. *Journal Of Travel Research*, *42*(3), 251-260. doi: 10.1177/0047287503258837

Roth, M., Schumacher, J., & Brahler, E. (2005). Sensation seeking in the community: Sex, age and sociodemographic comparisons on a representative German population sample. Personality and Individual Differences, 39, 1261-1271.

Schumpe, B., Bélanger, J., Moyano, M., & Nisa, C. (2020). The role of sensation seeking in political violence: An extension of the Significance Quest Theory. *Journal Of Personality And Social Psychology*, *118*(4), 743-761. doi: 10.1037/pspp0000223

Schmidt, B., Mussel, P., & Hewig, J. (2013). I'm too calm-Let's take a risk! On the impact of state and trait arousal on risk taking: I'm too calm-Let's take a risk! Psychophysiology, 50(5), 498–503. https://doi.org/10.1111/psyp.12032

Siraj, R., Najam, B., & Ghazal, S. (2021). Sensation seeking, peer influence, and risk-taking behavior in adolescents. Education Research International, 2021, 1–8. https://doi.org/10.1155/2021/8403024

Smith, B. D., Davidson, R. A., Smith, D. L., Goldstein, H., & Perlstein, W. (1989). Sensation seeking and arousal: Effects of strong stimulation of electrodermal activation and memory task performance. Personality and Individual Differences, 10(6), 671–679. https://doi.org/10.1016/0191-8869(89)90226-2

Smith, B. D., Davidson, R. A., Perlstein, W., & Gonzalez, F. (1990). Sensation-seeking: Electrodermal and behavioral effects of stimulus content and intensity. International Journal of Psychophysiology, 9(2), 179–188. https://doi.org/10.1016/0167-8760(90)90072-l

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S. and Woolard, J., 2008. Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: Evidence for a dual systems model. *Developmental Psychology*, 44(6), pp.1764-1778.

Straube, T., Preissler, S., Lipka, J., Hewig, J., Mentzel, H.-J., & Miltner, W. H. R. (2009). Neural representation of anxiety and personality during exposure to anxiety-provoking and neutral scenes from scary movies. Human Brain Mapping. https://doi.org/10.1002/hbm.20843

Su, J., Kuo, S. I.-C., Aliev, F., Chan, G., Edenberg, H. J., Kamarajan, C., McCutcheon, V. V., Meyers, J. L., Schuckit, M., Tischfield, J., & Dick, D. M. (2021). The associations between polygenic risk, sensation seeking, social support, and alcohol use in

adulthood. Journal of Abnormal Psychology, 130(5), 525–536. https://doi.org/10.1037/abn0000568

Tabachnick, B. G., & Fidell, L. S. (2014). Using multivariate statistics (6th ed.). Upper Saddle River, NJ: Pearson Education.

Tani, F., Ponti, L., & Ghinassi, S. (2020). Sensation seeking and gambling behavior in adolescence: Can externalizing problems moderate this relationship? International Journal of Environmental Research and Public Health, 17(23), 8986. https://doi.org/10.3390/ijerph17238986

Tapia León, I., Kruse, O., Stark, R., & Klucken, T. (2019). Relationship of sensation seeking with the neural correlates of appetitive conditioning. Social Cognitive and Affective Neuroscience, 14(7), 769–775. https://doi.org/10.1093/scan/nsz046

VandenBos, G. R. (Ed.). (2007). *APA Dictionary of Psychology.* American Psychological Association.

Vincy, C. (2009). The Perception and Recognition of Emotions and Facial Expression. Journal of Undergraduate Life Sciences, 3(1), 70–72.

Wang, P., Lei, L., Wang, X., Nie, J., Chu, X., & Jin, S. (2018). The exacerbating role of perceived social support and the "buffering" role of depression in the relation between sensation seeking and adolescent smartphone addiction. Personality and Individual Differences, 130, 129–134. https://doi.org/10.1016/j.paid.2018.04.009

Willibald, R., & Zuckerman, M. (2001). Sensation seeking in adolescents. J. Raithel (Hrsg.), Risikoverhaltensweisen Jugendlicher: Erklärungen, Formen Und Prävention., 97-110. https://doi.org/10.5167/uzh-77819

Wishart, D., Somoray, K., &; Rowland, B. (2017). Role of thrill and adventure seeking in risky work-related driving behaviours. Personality and Individual Differences, 104, 362–367. https://doi.org/10.1016/j.paid.2016.08.033

World Health Organization. (2019). World health statistics 2019: monitoring health for the SDGs, sustainable development goals. World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/324835/9789241565707-eng.pdf?ua=1.

Xu, S., Luo, L., Xiao, Z., Zhao, K., Wang, H., Wang, C., & Rao, H. (2019). High sensation seeking is associated with behavioral and neural insensitivity to increased negative outcomes during decision-making under uncertainty. Cognitive, Affective, & Behavioral Neuroscience, 19(6), 1352–1363. https://doi.org/10.3758/s13415-019-00751-x

Yanovitzky, I. (2005). Sensation seeking and adolescent drug use: The mediating role of association with deviant peers and pro-drug discussions. Health Communication, 17(1), 67–89. https://doi.org/10.1207/s15327027hc1701_5

Yoon, K. L., Joormann, J., &; Gotlib, I. H. (2009). Judging the intensity of facial expressions of emotion: Depression-related biases in the processing of positive affect. Journal of Abnormal Psychology, 118(1), 223–228. https://doi.org/10.1037/a0014658

Zaleski, Z. (1984). Sensation-seeking and preference for emotional visual stimuli. Personality And Individual Differences, 5(5), 609-611. https://doi.org/https://doi.org/10.1016/0191-8869(84)90040-0

Zheng, Y., Xu, J., Jia, H., Tan, F., Chang, Y., & Zhou, L. et al. (2011). Electrophysiological correlates of emotional processing in sensation seeking. Biological Psychology, 88(1), 41-50. doi: 10.1016/j.biopsycho.2011.06.006

Zuckerman, M. (1994). Behavioral expressions and biological bases of sensation seeking. New York, NY, USA: Cambridge University Press.

Zuckerman, M. (2005). Psychobiology of personality (2nd ed., rev. & updated). Cambridge University Press. https://doi.org/10.1017/CBO9780511813733

Zuckerman, M., & Aluja, A. (2014). Measures of Sensation Seeking. In G. Boyle, D. Saklofske & G. Matthews, Measures of Personality and Social Psychological Constructs (pp. 352-380). Academic Press.

General Discussion

Objectives, Results, and Scientific Contributions

The goal of this master's thesis was to investigate the potential association between sensation seeking and perception of and reaction to emotional facial expressions in others. We expected sensation seeking to have a positive relationship with arousal when viewing positive, negative, and neutral facial expressions of emotions, as outlined by the original theory of sensation seeking rooted in the notion of the optimal level of arousal. We also expected sensation seeking to be associated with higher perceived intensity for positive, negative, and neutral emotions and less negative perceived valence for negative emotions. Finally, expected that the relation between sensation seeking and self-reported arousal response towards positive, negative, and neutral facial emotional expressions would be partially mediated by its relations with the perceived intensity and valence of these stimuli. To investigate whether such relationships existed we developed a correlation-based study design and recruited a sample of 87 participants ranging in age from 19 to 30 years old, of which 77 were included in the final analysis. This specific age group was chosen based on the relevant literature pinning the peak manifestation of sensation seeking in adolescents and young adults, as well as the World Health Organization and the Canadian Centre on Substance Abuse and Addiction reports pertinent to these age groups. In order to avoid ethical issues associated with sampling adolescents, in the current study we chose to focus on young adults instead. A sensation seeking scale commonly used for testing sensation seeking was presented to all participants to operationalize the main independent variable. While we understand the risks that come with the usage of self-report tools, we chose to proceed with the questionnaires, seeing as most researchers in the field of sensation seeking rely heavily on questionnaires. Additionally, the constraints associated with the COVID-19 pandemic at the

time of the sampling process prompted us to take the study online, performing sampling through Amazon MTurk, and the questionnaire via LimeSurvey. The participants completed a visual stimuli task consisting of 70 photographs, ten (5 male and 5 female subjects) for each of six basic emotions (fear, anger, disgust, joy/happiness, sadness, surprise) and the neutral expression, drawn from the Karolinska Directed Emotional Faces set. While this set is commonly used for the emotion recognition task, this study focused on the three aspects of emotion perception and reaction instead: intensity, valence, and arousal. This more intricate approach allowed us to study the processing of facial emotional expressions in a similar way to what had previously been done in the sensation seeking literature with non-social stimuli. Indeed, our study is one of the first to study the relations between sensation seeking and perception and arousal using social stimuli. Further, our paradigm allowed us to focus primarily on the assessment and perception of emotions rather than just their recognition. This enabled us to gather more in-depth information regarding the potential effect of sensation seeking on interpersonal interactions through the processing of social information via emotional facial expressions. Correlation and regression analyses were used to assess relationships and predicting power of sensation seeking in explaining arousal response, perceived intensity, and valence of positive, negative, and neutral emotional facial expressions. Results revealed that there is indeed a statistically significant relationship between sensation seeking and arousal when viewing and assessing positive, negative, and neutral emotional facial expressions. Although, this relationship was closer in negative emotions than both positive and neutral ones. Sensation seeking was not found to be a significant predictor of variations within the perception of valence and was closely related to perceived intensity only in the neutral expression. This relationship was further supported by the results of hierarchical regression analysis, suggesting the role of higher sensation seeking in the higher perception of the intensity of neutral facial expressions.

Our results suggesting a positive relationship between sensation seeking and self-reported arousal in response to social stimuli, primarily visual stimuli consisting of photographs of emotional facial expressions, are the most interesting results from the performed analysis included in the scientific article for this Master's thesis paper. If replicated by future research, these results allow us to assume that sensation seeking involvement in social interactions could be significant, seeing as higher arousal to emotions in others could be associated with maladaptive reactions or behaviors.

Influences of Sensation Seeking on Reaction to and Perception of Emotional Facial Expressions

Arousal, defined as "a state of physiological activation or cortical responsiveness, associated with sensory stimulation and activation of fibers from the reticular activating system; a state of excitement or energy expenditure linked to an emotion" (VandenBos, 2007), is the desired level of response in sensation seekers, strong or novel enough to cause the optimum level of arousal (Willibald & Zuckerman, 2001; Zukerman & Aluja, 2014). Our results suggest that, indeed, higher sensation seeking is associated with higher arousal response to positive, negative, and neutral emotional facial expressions, although not in an equal manner. Interestingly, this relationship was stronger in negative emotions than in positive and neutral alternatives. While sensation seekers' preference for negative non-social stimuli has been established before (Zaleski, 1984), it was mostly associated with boredom susceptibility, rather than the total sensation seeking score (Bench & Lench, 2019). Our data shows that no relationship, negative or otherwise, was found between sensation seeking and perceived valence of negative emotions, suggesting that sensation seekers do not perceive these negative stimuli as more positive (and potentially more attractive). Since this heightened association between sensation seeking and arousal to negative emotions in others

were obtained in a relatively small sample, we suggest to consider it with caution until this observation is replicated in future research. Overall, our results add to the theoretical understanding of the sensation seeking trait and how it is related to the processing of stimuli, particularly the social ones. We hope that these seminal results can spark interest in future studies that could look into the implications of sensation seeking and related personality traits (i.e., impulsivity, boredom susceptibility, disinhibition, experience seeking, and thrill and adventure seeking) in interpersonal relationships.

In the present study, we also expanded on previous research through empirical assessment of the relationship between sensation seeking and perceived intensity of arousal in response to social stimuli. This is of particular interest due to the intensity of stimuli being outlined as one of the most pertinent aspects of sensation seeking (Zuckerman & Aluja, 2014). Under the theory of optimal arousal level, most researchers agree that high sensation seekers are characterized by their preference for novel and more intense stimuli. However, very few works had looked into the subjective perception of stimuli intensity in sensation seeking, and none with emotional facial expressions in others. We hypothesized that sensation seeking would be associated with higher perceived intensity for positive, negative, and neutral emotional facial expressions. Analysis revealed that there was no statistically significant relationship between sensation seeking and the perceived intensity of positive or negative emotion but there was a positive relation with neutral stimuli which partially supported our hypothesis. It remains unclear why neutral stimuli elicit such a different response, especially taking into consideration the fact that most relevant literature reports result contrary to ours (Straube et al., 2009; Bench & Lench, 2019). Since most previous data came from studies using non-social stimuli, future research should probably directly compare the relationship between sensation seeking and perceived intensity of non-social and social stimuli.

Finally, we tested an additional hypothesis aimed at investigating whether the relationship between sensation seeking and reactions to positive, negative, and neutral emotional facial expressions in others can be explained by the relation between sensation seeking and perception of those stimuli. This hypothesis was to be tested only if there would be found significant associations between sensation seeking and arousal as well as either perceived intensity and valence or both. This assumption was true only for neutral emotions, where sensation seeking was significantly related to both higher arousal and higher perceived intensity. Mediation analysis through the means of multiple regression followed by the Sobel test suggests that sensation seeking's association with higher arousal response to neutral facial expressions is fully mediated by its relation with higher intensity. Hence, contrary to heightened arousal responses to positive or negative emotions which do not seem to be related to perceptual factors (at least intensity or valence), the higher emotional response to neutral facial expressions in sensation seeking seems to come from individual differences in the way people perceive the characteristics of these stimuli. What perceptual, attentional, or other mechanism is implicated in the higher arousal response to positive and negative emotions in others would be an important next step.

Perspectives

Next, we propose potential approach for future research, as well as offer practical interpretations for clinical applications.

Methodological and Data Analysis Perspectives

Firstly, a multidimensional perspective using several methods with the inclusion of several traits could be used. The addition of neurophysiological data, such as EEG for comparison of subjective and objective results would be interesting, and could potentially bring forward conflicting results. In that case, further analysis of the underlying physiological or psycho-social influences on differences between neurophysiological and subjective self-report data would be pertinent. Additionally, comparative personality research, focusing on the differences between high and low sensation seekers could be used. Based on these two points, a different data analysis approach via comparative analysis could be used. However, this suggestion faces a limitation created by the utilized measure (SSS-V), seeing that the questionnaire does not offer a score-based division into high and low sensation seekers. However, future research should be careful as it would need frequency-based division, which could potentially fall victim to improper sampling, and thus, hindering the generalization ability of the obtained results.

Additionally, it remains unclear what causes reactions to stimuli in sensation seekers. Previous research suggests boredom susceptibility as the reason for high sensation seekers to seek more stimulating experiences with higher arousal potential (Perse, 1996), sensation seeker's inherently low base level of arousal (Zuckerman, 1994; Zuckerman & Aluja, 2014), more easily excitable central nervous system (Smith et al., 1989; Joseph et al., 2009) or

inability to achieve optimal arousal levels (Schmidt, Mussel, & Hewig, 2013). Future research could try implementing experimental research designs to address this issue.

Finally, the present study did not take gender-related differences in sensation seeking into account for the set hypotheses. This decision was taken due to inconsistent results regarding gender differences in sensation seeking scores. While some researchers were able to find higher average and scale-specific scores of sensation seeking in men (Hromatko & Butkovic, 2009; Cross et al., 2013; Tekin et al., 2017), others suggested women having higher scores than men (Parra, 2015), and some pointed out to inconsequential differences between men and women (Frick, 2020). Nevertheless, it has been generally accepted that gender does play an important role in facial emotion recognition (Hoffmann et al., 2010; Menezes et al., 2017; Fischer et al., 2018; Wingenbach et al., 2018; Lin et al., 2021), emotion perception (Algoe, et al., 2000; Bauer et al., 2003; Fischer et al., 2018), and emotional intelligence (Shahzad & Bagum, 2012; Fida et al., 2018; Ali et al., 2021). Therefore, future research should control for sex and gender-related differences.

Developmental and Clinical Application Perspectives

Seeing as we used a sample of young adults for this study, further research could focus on a broader age sample, including adolescents that are often considered a high-risk group with peak sensation seeking manifestation. The scientific article included in this Master's thesis paper provides data pertinent to the personality and emotion recognition and interpretation development in young adults. As was mentioned in the introduction, many researchers are conflicted about the exact timeframe of heightened sensation seeking exhibition, although most gravitate towards adolescents and young adults. Therefore, it would be interesting to further compare the obtained results in this study to those of other age groups, primarily those of adolescents and children, as the other two primary groups of

interest in the field of sensation seeking. It could also be interesting to see if the relationship found in our study is also present later in life. Additionally, since sensation seeking in children was previously associated with intelligence development (Raine et al., 2002), it would be interesting to observe whether the association between sensation seeking and emotional responsiveness to emotional facial expressions would be different from that of young adults.

Another question of interest is how the obtained results of this study are pertinent to some psychiatric disorders. As was mentioned in the introduction, sensation seeking is often associated with several clinical diagnoses, including but not limited to antisocial personality disorder (Dickey et al., 2014; Mann et al., 2017), mood disorders (Cronin & Zuckerman, 1992; Ravert et al., 2013; Lee et al., 2015;), anxiety (Surcinelli et al., 2006), narcissistic personality disorder (Rogoza et al., 2019), and drug abuse disorder (Dickson et al., 2018; del Carmen Pérez-Fuentes et al., 2019). Research combining the social implication of sensation seeking and these psychiatric disorders could potentially shed light on social information transmission perception and attempt to identify underlying neurophysiological and behavioral markers associated with them. The obtained results could contribute to improvements and the development of new diagnoses and intervention tools for children, adolescents, and young adults suffering from various mood and personality disorders.

Conclusion

This Master's thesis focused on the processing of social information in sensation seeking and showed that although sensation seeking seems to have a limited impact on how individuals perceived facial expressions, it is related to their emotional reactivity to these stimuli. These results help in filling the gap in current literature regarding the processing of social stimuli in sensation seekers and provide the first details regarding the perception of and response to social stimuli, such as facial expressions in others by sensation seekers.

Bibliographical References

Ackerman, R. A., Witt, E. A., Donnellan, M. B., Trzesniewski, K. H., Robins, R. W., & Kashy, D. A. (2010). What does the narcissistic personality inventory really measure? *Assessment*, *18*(1), 67–87. https://doi.org/10.1177/1073191110382845

Afhami , R., Shahrad , E., Mohr , C., & Bagherzadeh , R. (2021). Investigating the color preference changes of men and women with different levels of sensation seeking. Journal of Color Science and Technology.

Algoe, S. B., Buswell, B. N., & DeLamater, J. D. (2000). Gender and job status as contextual cues for the interpretation of facial expression of emotion. Sex Roles, 42, 183-208.

Ali, A., Saleem, N., &; Rahman, N. (2021). Emotional Intelligence of University Students: Gender Based Comparison. Bulletin of Education and Research, 43(1), 255–265.

Altamura, M., Padalino, F. A., Stella, E., Balzotti, A., Bellomo, A., Palumbo, R., Di Domenico, A., Mammarella, N., & Fairfield, B. (2016). Facial emotion recognition in bipolar disorder and healthy aging. Journal of Nervous & Mental Disease, 204(3), 188–193. https://doi.org/10.1097/nmd.0000000000000453

Andric, S., Maric, N. P., Knezevic, G., Mihaljevic, M., Mirjanic, T., Velthorst, E., & van Os, J. (2015). Neuroticism and facial emotion recognition in healthy adults. Early Intervention in Psychiatry, 10(2), 160–164. https://doi.org/10.1111/eip.12212

Armstrong, T. A., & Boutwell, B. B. (2012). Low resting heart rate and rational choice: Integrating biological correlates of crime in criminological theories. Journal of Criminal Justice, 40, 31-39

Barrett, L. F. (2006). Valence is a basic building block of emotional life. Journal of Research in Personality, 40(1), 35–55. https://doi.org/10.1016/j.jrp.2005.08.006

Bauer, P. J., Stennes, L., & Haight, J. C. (2003). Representations of the inner self in autobiography: Women's and men's use of internal states language in personal narratives. Memory, 11, 27-42.

Bench, S. W., & Lench, H. C. (2019). Boredom as a seeking state: Boredom prompts the pursuit of novel (even negative) experiences. *Emotion, 19*(2), 242–254. https://doi.org/10.1037/emo0000433

Berscheid, E. S. & Regan, P. C. (2016). The psychology of interpersonal relationships. Taylor and Francis.

Blair, R. J. R. (2018). Traits of empathy and anger: Implications for psychopathy and other disorders associated with aggression. Philosophical Transactions of the Royal Society of London. Series B Biological Sciences, 373, 1744.

Canadian Centre on Substance Use and Addiction. (2019). Cocaine (Canadian Drug Summary). Topic Summary. Available online: https://www.ccsa.ca/cannabis-canadian-drug-summary (accessed on 23 February 2021).

Canadian Centre on Substance Use and Addiction. (2020). Cannabis (Canadian Drug Summary). Topic Summary. Available online: https://www.ccsa.ca/cannabis-canadian-drug-summary (accessed on 23 February 2021).

Carrol, E. N., Zuckerman, M., & Vogel, W. H. (1982). A test of the optimal level of arousal theory of sensation seeking. Journal of Personality and Social Psychology, 42(3), 572–575. https://doi.org/10.1037/0022-3514.42.3.572

Chugani, C. D., Byrd, A. L., Pedersen, S. L., Chung, T., Hipwell, A. E., & Stepp, S. D. (2020). Affective and sensation-seeking pathways linking borderline personality disorder symptoms and alcohol-related problems in young women. Journal of Personality Disorders, 34(3), 420–431. https://doi.org/10.1521/pedi_2018_32_389

Cronin, C., & Zuckerman, M. (1992). Sensation seeking and bipolar affective disorder. Personality and Individual Differences, 13(3), 385–387. https://doi.org/10.1016/0191-8869(92)90121-5

Cross, C., Cyrenne, D., & Brown, G. (2013). Sex differences in sensation-seeking: a meta-analysis. Scientific Reports, 3(1). https://doi.org/10.1038/srep02486

Cyders, M. A., Flory, K., Rainer, S., & Smith, G. T. (2009). The role of personality dispositions to risky behavior in predicting first-year college drinking. Addiction, 104, 193-202.

David, D. H., McMahon, T. J., Luthar, S. L., & Suchman, N. E. (2012). Sensation seeking, coping with stress, and readiness to engage in therapy: Does ego development influence the psychosocial functioning of substance-abusing mothers? American Journal of Orthopsychiatry, 82(2), 231–240. https://doi.org/10.1111/j.1939-0025.2012.01146.x

De Pascalis, V., Valerio, E., Santoro, M., & Cacace, I. (2007). Neuroticism-anxiety, impulsive-sensation seeking and autonomic responses to somatosensory stimuli. International Journal of Psychophysiology, 63(1), 16–24. https://doi.org/10.1016/j.ijpsycho.2006.06.004

del Carmen Pérez-Fuentes, M., del Mar Molero Jurado, M., & Jesús Gázquez Linares, J. (2019). Expectations and Sensation-Seeking as predictors of Binge Drinking in adolescents. Anales De Psicología / Annals Of Psychology, vol. 35(№1 (january), 124-130. https://doi.org/http://dx.doi.org/10.6018/analesps.35.1.308511

Dickey, A. D. (2014). The relationship between sensation seeking, psychopathy, and deception . Modern Psychological Studies, 19(2), 1–10. Retrieved June 2022, from https://scholar.utc.edu/mps/vol19/iss2/2.

Dickson P. E., Miller, M. M., Calton, M. A., et al. (2016). Systems genetics of intravenous cocaine self-administration in the BXD recombinant inbred mouse panel. Psychopharmacology (Berl). 2016;233:701-714.

Dickson P.E., Roy T.A., McNaughton K.A., Wilcox T.D., Kumar P., Chesler E.J. (2018). Systems genetics of sensation seeking. Genes, Brain and Behavior. 2018; e12519. https://doi.org/10.1111/gbb.12519

Eachus P. (2004). Using the brief sensation seeking scale (bsss) to predict holiday preferences, Personality and Individual Differences, 36(1), 141-153, 2004.

Edwards, E. (1984). The relationship between sensation seeking and horror movie interest and attendance. Unpublished doctoral dissertation, University of Tennessee, Knoxville.

Eman, S., Nicolson, R., & Blades, M. (2015). Sensation Seeking or Empathy? Physically Aggressive and Non-Aggressive Antisocial Behaviors (ASBs) Amongst University Students. IAFOR Journal Of Psychology & The Behavioral Sciences. https://doi.org/10.22492/ijpbs.1.1.05

Evans-Polce, R., Schuler, M., Schulenberg, J. and Patrick, M. (2018). Gender- and age-varying associations of sensation seeking and substance use across young adulthood. Addictive Behaviors, 84, pp.271-277.

Eze, J. E., Chukwuorji, J. B. C., Idoko, S., & Ifeagwazi, C. M. (2020). Does peer pressure and sensation seeking differentially influence substance use for male versus female trauma-exposed youth? *Journal of Substance Use*, *25*(5), 538–544. https://doi.org/10.1080/14659891.2020.1738575

Farmer, A., Redman, K., Harris, T., Mahmood, A., Sadler, S., & McGuffin, P. (2001). Sensation-seeking, life events and depression. *British Journal of Psychiatry*, *178*(6), 549–552. https://doi.org/10.1192/bjp.178.6.549

Fida, A., Ghaffar, A., Zaman, A., & Satti, A. N. (2018). Gender comparison of emotional intelligence of university students. Journal of Education and Educational Development, 5(1), 172. https://doi.org/10.22555/joeed.v5i1.2046

Fischer, A. H., Kret, M. E., & Broekens, J. (2018). Gender differences in emotion perception and self-reported emotional intelligence: A test of the emotion sensitivity hypothesis. PLOS ONE, 13(1). https://doi.org/10.1371/journal.pone.0190712

Frick, P. J., Kuper, K., Silverthorn, P., & Cotfer, M. (1995). Antisocial behavior, somatization, and sensation-seeking behavior in mothers of clinic-referred children. Journal of the American Academy of Child & Adolescent Psychiatry, 34(6), 805–812. https://doi.org/10.1097/00004583-199506000-00022

Frick, B. (2020). Gender differences in risk-taking and sensation-seeking behavior: Empirical evidence from "ExtremeSports." De Economist, 169(1), 5–20. https://doi.org/10.1007/s10645-020-09373-y

Fuchs G. (2013). Low versus high sensation-seeking tourists: a study of backpackers' experience risk perception, International Journal of Tourism Research, 15(1), 81-92, 2013.

Fujimura, T., Sato, W., & Suzuki, N. (2010). Facial expression arousal level modulates facial mimicry. International Journal of Psychophysiology, 76(2), 88–92. https://doi.org/10.1016/j.ijpsycho.2010.02.008

Furnham, A., & Avison, M. (1997). Personality and preference for surreal paintings. Personality and Individual Differences, 23, 923–935. http://dx.doi.org/10.1016/S0191-8869(97)00131-1

Gao, Z., Zhao, W., Liu, S., Liu, Z., Yang, C., & Xu, Y. (2021). Facial emotion recognition in schizophrenia. Frontiers in Psychiatry, 12. https://doi.org/10.3389/fpsyt.2021.633717

Glass, S. J., & Newman, J. P. (2006). Recognition of facial affect in psychopathic offenders. Journal of Abnormal Psychology, 115(4), 815–820. https://doi.org/10.1037/0021-843x.115.4.815

Goeleven, E., De Raedt, R., Leyman, L., & Verschuere, B. (2008). The Karolinska directed emotional faces: A validation study. Cognition & Emotion, 22(6), 1094–1118. https://doi.org/10.1080/02699930701626582

Griffin, JR., J. B., & Hurst, J. W. (1990). Interpersonal Relationships. In H. K. Walker & W. D. Hall (Eds.), Clinical Methods: The History, Physical, and Laboratory Examinations (3rd ed.). Chapter, Butterworths.

Grisanzio, K. A., Sasse, S. F., Nook, E. C., Lambert, H. K., McLaughlin, K. A., & Somerville, L. H. (2020). Voluntary pursuit of negatively valenced stimuli from childhood to early adulthood. Developmental Science, 24(2). https://doi.org/10.1111/desc.13012

Guarnera, M., Hichy, Z., Cascio, M. I., & Carrubba, S. (2015). Facial expressions and ability to recognize emotions from eyes or mouth in children. Europe's Journal of Psychology, 11(2), 183–196. https://doi.org/10.5964/ejop.v11i2.890

Hargrave, R., Maddock, R. J., & Stone, V. (2002). Impaired recognition of facial expressions of emotion in alzheimer's disease. The Journal of Neuropsychiatry and Clinical Neurosciences, 14(1), 64–71. https://doi.org/10.1176/jnp.14.1.64

Hastings, M. E., Tangney, J. P., & Stuewig, J. (2006). Psychopathy and identification of facial expressions of emotion. PsycEXTRA Dataset. https://doi.org/10.1037/e527802007-001

Herr, N. R., & Meier, E. P. (2021). Accuracy for subtle facial emotional expressions among individuals with borderline personality disorder symptoms and diagnoses. Personality

Disorders: Theory, Research, and Treatment, 12(2), 150–159. https://doi.org/10.1037/per0000448

Hofmann, S. M., Klotzsche, F., Mariola, A., Nikulin, V., Villringer, A., & Gaebler, M. (2021). Author response: Decoding subjective emotional arousal from EEG during an immersive virtual reality experience. https://doi.org/10.7554/elife.64812.sa2

Hopwood, C. J., Morey, L. C., Skodol, A. E., et al. (2011). Pathological personality traits among patients with absent, current, and remitted substance use disorders. Addict Behav. 2011;36(11):1087–90.

Hromatko, I., & Butkovic, A. (2009). Sensation Seeking and Spatial Ability in Athletes: an Evolutionary Account. Journal Of Human Kinetics, 21(1). https://doi.org/10.2478/v10078-09-0001-x

Jenkins, L. (2017). Does personality effect facial emotion recognition? A comparison between the older Ekman emotion hexagon test and a newly created measure. Madridge Journal of Neuroscience, 1(1), 38–46. https://doi.org/10.18689/mjns-1000107

Joseph, J., Liu, X., Jiang, Y., Lynam, D., & Kelly, T. (2009). Neural Correlates of Emotional Reactivity in Sensation Seeking. Psychological Science, 20(2), 215-223. https://doi.org/10.1111/j.1467-9280.2009.02283.x

Kafetsios, K., & Hess, U. (2022). Personality and the accurate perception of facial emotion expressions: What is accuracy and how does it matter? Emotion, 22(1), 100–114. https://doi.org/10.1037/emo0001034

Kafry, D. (1982). Sensation seeking of young children. *Personality and Individual Differences*, *3*(2), 161–166. https://doi.org/10.1016/0191-8869(82)90030-7

Kambouropoulos, N., & Staiger, P. K. (2004). Personality and responses to appetitive and aversive stimuli: The joint influence of behavioural approach and behavioural

inhibition systems. Personality and Individual Differences, 37(6), 1153–1165. https://doi.org/10.1016/j.paid.2003.11.019

Katz, G., Kunyvsky, Y., Lurie, T. H., Raskin, S., & Abramowitz, M. Z. (2017). Impulsivity, sensation seeking and anhedonia as possible explanations for cannabis abuse comorbidity among first psychotic episode inpatients. Journal of Addiction Research & Therapy, 08(02). https://doi.org/10.4172/2155-6105.1000318

Kauschke, C., Bahn, D., Vesker, M., & Schwarzer, G. (2019). The role of emotional valence for the processing of facial and verbal stimuli—positivity or negativity bias? Frontiers in Psychology, 10. https://doi.org/10.3389/fpsyg.2019.01654

Kruschwitz, J. D., Simmons, A. N., Flagan, T., & Paulus, M. P. (2012). Nothing to lose: Processing blindness to potential losses drives thrill and adventure seekers. NeuroImage, 59(3), 2850–2859. https://doi.org/10.1016/j.neuroimage.2011.09.048

Kyranides, M. N., Christofides, D., & Çetin, M. (2022). Difficulties in facial emotion recognition: Taking psychopathic and alexithymic traits into account. BMC Psychology, 10(1). https://doi.org/10.1186/s40359-022-00946-x

Kyranides, M. N., Petridou, M., Gokani, H. A., Hill, S., & Fanti, K. A. (2022). Reading and reacting to faces, the effect of facial mimicry in improving facial emotion recognition in individuals with antisocial behavior and psychopathic traits. Current Psychology. https://doi.org/10.1007/s12144-022-02749-0

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1998). Emotion, motivation, and anxiety: Brain mechanisms and psychophysiology. Biological Psychiatry, 44(12), 1248–1263. https://doi.org/10.1016/s0006-3223(98)00275-3

Larsen, R. J., & Augustine, A. A. (2008). Basic personality dispositions related to approach and avoidance: Extraversion/neuroticism, BAS/BIS, and positive/negative affectivity.

In A. J. Elliot (Ed.), *Handbook of approach and avoidance motivation* (pp. 151–164). Psychology Press.

Lawson, A. L., Gauer, S., & Hurst, R. (2012). Sensation seeking, recognition memory, and autonomic arousal. Journal of Research in Personality, 46, 19-25.

Lee, W. K., Lim, D., Lee, H. A., & Park, H. (2015). Sensation seeking as a potential screening tool for suicidality in adolescence. *BMC Public Health*, *16*(1). https://doi.org/10.1186/s12889-016-2729-2

Li, J., Tian, M., Fang, H., Xu, M., Li, H., & Liu, J. (2010). Extraversion predicts individual differences in face recognition. Communicative &; Integrative Biology, 3(4), 295–298. https://doi.org/10.4161/cib.3.4.12093

Lin, Y., Ding, H., &; Zhang, Y. (2021). Gender differences in identifying facial, prosodic, and semantic emotions show category- and channel-specific effects mediated by encoder's gender. Journal of Speech, Language, and Hearing Research, 64(8), 2941–2955. https://doi.org/10.1044/2021_jslhr-20-00553

Lissek, S., &; Powers, A. S. (2003). Sensation seeking and startle modulation by physically threatening images. Biological Psychology, 63(2), 179–197. https://doi.org/10.1016/s0301-0511(03)00053-x

Lissek, S., Baas, J. M. P., Pine, D. S., Orme, K., Dvir, S., Rosenberger, E., Grillon, C. (2005). Sensation Seeking and the Aversive Motivational System. Emotion 2005, Vol. 5, No. 4, 396-407.

Litle, P., & Zuckerman, M. (1986). Sensation seeking and music preferences. Personality and Individual Differences, 7(4), 575–578. https://doi.org/10.1016/0191-8869(86)90136-4

Lynam, D., & Miller, J. (2019). The basic trait of antagonism: An unfortunately underappreciated construct. https://doi.org/10.31234/osf.io/tgyq6

Lydon-Staley, D. M., & Geier, C. F. (2018). Age-Varying Associations Between Cigarette Smoking, Sensation Seeking, and Impulse Control Through Adolescence and Young Adulthood. Journal of Research on Adolescence, 28, 354-367.

MacPherson, L., Magidson, J., Reynolds, E., Kahler, C. and Lejuez, C., (2010). Changes in Sensation Seeking and Risk-Taking Propensity Predict Increases in Alcohol Use Among Early Adolescents. Alcoholism: Clinical and Experimental Research.

Mancini, G., Agnoli, S., Baldaro, B., Bitti, P. E., & Surcinelli, P. (2018). Facial expressions of emotions: Recognition accuracy and affective reactions during late childhood. Emotions and Their Influence on Our Personal, Interpersonal and Social Experiences, 21–39. https://doi.org/10.4324/9781315100319-3

Marsh, A. A., & Blair, R. J. R. (2008). Deficits in facial affect recognition among antisocial populations: A meta-analysis. Neuroscience & Biobehavioral Reviews, 32(3), 454–465. https://doi.org/10.1016/j.neubiorev.2007.08.003

Mawson, A. R. (1978). Attenuating effects of fighting on shock-induced gastric ulceration and hypertension: hypothesis of inhibition by sensory feedback. Med Hypotheses; 4:403-10.

Mikulincer, M., &; Shaver, P. R. (2005). Attachment theory and emotions in close relationships: Exploring the attachment-related dynamics of emotional reactions to relational events. Personal Relationships, 12(2), 149–168. https://doi.org/10.1111/j.1350-4126.2005.00108.x

Mimrot, B. H. (2018). The influence of locus of control and gender on correct recognition of emotions from facial expressions. IAHRW International Journal of Social Sciences Review, 6(6), 1050–1054.

Mo, F., Gu, J., Zhao, K., & Fu, X. (2021). Confusion effects of facial expression recognition in patients with major depressive disorder and healthy controls. Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.703888

Nater, U. R. S. M., Krebs, M., & Ehlert, U. (2005). Sensation seeking, music preference, and psychophysiological reactivity to music. Musicae Scientiae, 9(2), 239–254. https://doi.org/10.1177/102986490500900205

Norbury, A., Valton, V., Rees, G., Roiser, J. P., & Husain, M. (2016). Shared Neural Mechanisms for the Evaluation of Intense Sensory Stimulation and Economic Reward, Dependent on Stimulation-Seeking Behavior. Journal of Neuroscience, 36(39), 10026–10038. https://doi.org/10.1523/JNEUROSCI.1048-16.2016

Nowicki, S., & Cooley, E. L. (1990). The role of locus of control orientation in speed of discriminating facial affect. Journal of Research in Personality, 24(4), 389–397. https://doi.org/10.1016/0092-6566(90)90029-6

Ortin, A., Lake, A., Kleinman, M., & Gould, M. (2012). Sensation seeking as risk factor for suicidal ideation and suicide attempts in adolescence. Journal Of Affective Disorders, 143(1-3), 214-222. https://doi.org/10.1016/j.jad.2012.05.058

Pal, P., Iyer, A. N., & Yantorno, R. E. (2006). Emotion detection from infant facial expressions and cries. 2006 IEEE International Conference on Acoustics Speed and Signal Processing Proceedings. https://doi.org/10.1109/icassp.2006.1660444

Parra, A. (2015). Gender differences in sensation seeking and paranormal/anomalous experiences. The Open Psychology Journal, 8(1), 54–58. https://doi.org/10.2174/1874350101508010054

Patrick, C. (2008). Psychophysiological correlates of aggression and violence: an integrative review. Philosophical Transactions Of The Royal Society B: Biological Sciences, 363(1503), 2543-2555. https://doi.org/10.1098/rstb.2008.0028

Peritogiannis, V. (2015). Sensation/novelty seeking in psychotic disorders: A review of the literature. World Journal of Psychiatry, 5(1), 79. https://doi.org/10.5498/wjp.v5.i1.79

Perse, E. (1996). Sensation Seeking and the Use of Teievision for Arousal. Communication Reports,, 9(1), 37-48. https://doi.org/10.1080/08934219609367633

Poordarsaraie, N., Akbari, B., & Faghirpoor, M. (2014). The relation between level of sensation seeking and approaches to confront with it among addicts under preserver treatment by methadone. Singaporean Journal of Business , Economics and Management Studies, 2(8), 29–42. https://doi.org/10.12816/0003897

Portnoy, J., Raine, A., Chen, F., Pardini, D., Loeber, R., & Jennings, R. (2014). Heart rate and antisocial behavior: The mediating role of impulsive sensation-seeking. Criminology, 52, 292-311.

Preston, S., & de Waal, F. (2002). Empathy: Its ultimate and proximate bases. Behavioral And Brain Sciences, 25(1), 1-20. https://doi.org/10.1017/s0140525x02000018

Priyesh, C., Suryavanshi, C. A., Sasidharan, A., Bhandary, R., Behere, R. V., & Nayak, K. R. (2022). Facial emotion recognition, misattribution, and response time in schizophrenia and bipolar disorder. Neurophysiology, 53(2), 120–131. https://doi.org/10.1007/s11062-022-09923-x

Quayle, J. (2008). Interviewing a psychopathic suspect. Journal of Investigative Psychology and Offender Profiling, 5, 79-91.

Raine, A., Reynolds, C., Venables, P. H., & Mednick, S. A. (2002). Stimulation seeking and intelligence: A prospective longitudinal study. *Journal of Personality and Social Psychology, 82*(4), 663–674. https://doi.org/10.1037/0022-3514.82.4.663

Raskin, R., & Terry, H. (1988). A principal-components analysis of the Narcissistic Personality Inventory and further evidence of its construct validity. *Journal of*

Personality and Social Psychology, 54(5), 890–902. https://doi.org/10.1037/0022-3514.54.5.890

Ravert, R. D., & Donnellan, M. B. (2020). Impulsivity and sensation seeking: Differing associations with psychological well-being. Applied Research in Quality of Life, 16(4), 1503–1515. https://doi.org/10.1007/s11482-020-09829-y

Rawlings, D. (2003). Personality correlates of liking for unpleasant paintings and photographs. Personality and Individual Differences, 34, 395–410.

Rezayi, S. (2014). Sensation Seeking and Social Skills in Children with Autism Disorder and Down-Syndrome. Practice in Clinical Psychology , 2(3), 112–117.

Rogoza, R., Cieciuch, J., Strus, W., & Baran, T. (2019). Seeking a common framework for research on narcissism: An attempt to integrate the different faces of narcissism within the Circumplex of personality metatraits. *European Journal of Personality*, *33*(4), 437–455. https://doi.org/10.1002/per.2206

Rosenbloom, T. (2006). Color preferences of high and low sensation seekers. Creativity Research Journal, 18(2), 229–235. https://doi.org/10.1207/s15326934crj1802_8

Ruihua, M., Hua, G., Meng, Z., Nan, C., Panqi, L., Sijia, L., Jing, S., Yunlong, T., Shuping, T., Fude, Y., Li, T., & Zhiren, W. (2021a). The relationship between facial expression and cognitive function in patients with depression. Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.648346

Ruihua, M., Meng, Z., Nan, C., Panqi, L., Hua, G., Sijia, L., Jing, S., Ke, Z., Yunlong, T., Shuping, T., Fude, Y., Li, T., & Zhiren, W. (2021b). Differences in facial expression recognition between unipolar and bipolar depression. Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.619368

Saylik, R. (2018). Neuroticism related attentional biases on an emotion recognition task. Anadolu Psikiyatri Dergisi, 19(1), 1-6.

Sheaffer, Z., & Brender-Ilan, Y. (2016). Augmenting or diminishing crisis preparedness: Leadership style and sensation-seeking as mediators. Academy of Management Proceedings, 2016(1), 12161. https://doi.org/10.5465/ambpp.2016.12161abstract

Siraj, R., Najam, B., & Ghazal, S. (2021). Sensation seeking, peer influence, and risk-taking behavior in adolescents. *Education Research International*, *2021*, 1–8. https://doi.org/10.1155/2021/8403024

Schierman, M. J., & Rowland, G. L. (1985). Sensation-seeking and selection of entertainment. Personality and Individual Differences, 6(5), 599–603. https://doi.org/10.1016/0191-8869(85)90009-1

Schönenberg, M., Mayer, S. V., Christian, S., Louis, K., & Jusyte, A. (2016). Facial affect recognition in violent and nonviolent antisocial behavior subtypes. Journal of Personality Disorders, 30(5), 708–719. https://doi.org/10.1521/pedi_2015_29_217

Shahzad, S., & Bagum, N. (2012). Gender differences in Trait Emotional Intelligence: A Comparative Study. Business Review, 7(2), 106–112. https://doi.org/10.54784/1990-6587.1207

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S. and Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: Evidence for a dual systems model. Developmental Psychology, 44(6), pp.1764-1778.

Stephenson, M. T., Velez, L. F., Chalela, P., Ramirez, A., & Hoyle, R.H. (2007). The reliability and validity of the Brief Sensation Seeking Scale (BSSS-8) with young adult Latino workers: Implications for tobacco and alcohol disparity research. Addiction, 102(Suppl. 2), 79-91.

Straube, T., Preissler, S., Lipka, J., Hewig, J., Mentzel, H.-J., & Miltner, W. H. R. (2009). Neural representation of anxiety and personality during exposure to anxiety-

provoking and neutral scenes from scary movies. Human Brain Mapping. https://doi.org/10.1002/hbm.20843

Surcinelli, P., Codispoti, M., Montebarocci, O., Rossi, N., & Baldaro, B. (2006). Facial emotion recognition in trait anxiety. Journal of Anxiety Disorders, 20(1), 110–117. https://doi.org/10.1016/j.janxdis.2004.11.010

Surguladze, S. A., Young, A. W., Senior, C., Brébion, G., Travis, M. J., & Phillips, M. L. (2004). Recognition accuracy and response bias to happy and sad facial expressions in patients with major depression. Neuropsychology, 18(2), 212–218. https://doi.org/10.1037/0894-4105.18.2.212

Tamborini, R., & Stiff, J. (1987). Predictors of horror films attendance and appeal: An analysis of the audience for frightening films. Communication Research, 14, 415-436.

Tapia León, I., Kruse, O., Stark, R., & Klucken, T. (2019). Relationship of sensation seeking with the neural correlates of appetitive conditioning. Social Cognitive and Affective Neuroscience, 14(7), 769–775. https://doi.org/10.1093/scan/nsz046

Torre-Luque, A., Viera-Campos, A., Bilderbeck, A. C., Carreras, M. T., Vivancos, J., Diaz-Caneja, C. M., Aghajani, M., Saris, I. M., Raslescu, A., Malik, A., Clark, J., Penninx, B. W., Wee, N. V., Rossum, I. W.-van, Sommer, B., Marston, H., Dawson, G. R., Kas, M. J., Ayuso-Mateos, J. L., & Arango, C. (2021). Relationships between social withdrawal and facial emotion recognition in neuropsychiatric disorders. https://doi.org/10.21203/rs.3.rs-209509/v1

Um, M., Hershberger, A. R., Whitt, Z. T., & Cyders, M. A. (2018). Recommendations for applying a multi-dimensional model of impulsive personality to diagnosis and treatment. Borderline Personality Disorder and Emotion Dysregulation, 5(1). https://doi.org/10.1186/s40479-018-0084-x

VandenBos, G. R. (Ed.). (2007). APA Dictionary of Psychology. American Psychological Association.

Vazire, S., Hart, W., & Reed, R. S. (2014). Personality: A Six-Day unit Lesson Plan for high school psychology teachers. PsycEXTRA Dataset. https://doi.org/10.1037/e506462015-001

Vesker, M., Bahn, D., Degé, F., Kauschke, C., & Schwarzer, G. (2017). Perceiving arousal and valence in facial expressions: Differences between children and adults. European Journal of Developmental Psychology, 15(4), 411–425. https://doi.org/10.1080/17405629.2017.1287073

Wai, M., & Tilliopoulos, N. (2012). The affective and cognitive empathic nature of the dark triad of personality. Personality and Individual Differences, 52, 794–799.

Wang E.S.T., Chen L.S.L., Lin J.Y.C., Wang M.C.H. (2008) The relationship between leisure satisfaction and life satisfaction of adolescents concerning online games, Adolescence, 43(169), 177-184, 2008.

Wearne, T. A., Osborne-Crowley, K., Logan, J. A., Wilson, E., Rushby, J., & McDonald, S. (2020). Understanding how others feel: Evaluating the relationship between empathy and various aspects of emotion recognition following severe traumatic brain injury. Neuropsychology, 34(3), 288–297. https://doi.org/10.1037/neu0000609

Willibald, R., & Zuckerman, M. (2001). Sensation seeking in adolescents. J. Raithel (Hrsg.), Risikoverhaltensweisen Jugendlicher: Erklärungen, Formen Und Prävention., 97-110. https://doi.org/10.5167/uzh-77819

World Health Organization. (2019). World health statistics 2019: monitoring health for the SDGs, sustainable development goals. World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/324835/9789241565707-eng.pdf?ua=1.

Wymer, W., Self, D., & Findley, C. S. (2007). Sensation seekers and civic participation: Exploring the influence of sensation seeking and gender on intention to lead and volunteer. International Journal of Nonprofit and Voluntary Sector Marketing, 13(4), 287–300. https://doi.org/10.1002/nvsm.330

Yang, Y.-H., & Yeh, S.-L. (2018). Unconscious processing of facial expression as revealed by affective priming under continuous flash suppression. Psychonomic Bulletin & Review, 25(6), 2215–2223. https://doi.org/10.3758/s13423-018-1437-6

Zaleski, Z. (1984). Sensation-seeking and preference for emotional visual stimuli. Personality And Individual Differences, 5(5), 609-611. https://doi.org/https://doi.org/10.1016/0191-8869(84)90040-0

Zeigler-Hill, V., Marcus, D. K., Maples-Keller, J. L., Berke, D. S., Few, L. R., & Miller, J. D. (2016). A Review of Sensation Seeking and Its Empirical Correlates: Dark, Bright, and Neutral Hues. In The dark side of personality: Science and practice in social, personality, and clinical psychology. essay, American Psychological Association.

Zheng, Y., Tan, F., Xu, J., Chang, Y., Zhang, Y., & Shen, H. (2015). Diminished p300 to physical risk in sensation seeking. Biological Psychology, 107, 44–51. https://doi.org/10.1016/j.biopsycho.2015.03.003

Zinn W (1993). The empathetic physician. Arch Intern Med 153:306–312

Zuckerman, M. (1990). The psychophysiology of sensation seeking. *Journal of Personality, 58*(1), 313–345. https://doi.org/10.1111/j.1467-6494.1990.tb00918.x

Zuckerman, M. (1993). Sensation seeking and impulsivity: A marriage of traits made in biology? In W. G. McCown, J. L. Johnson, & M. B. Shure (Eds.), The impulsive client: Theory, research, and treatment (pp. 71–91). American Psychological Association. https://doi.org/10.1037/10500-005

Zuckerman, M. (1994). Behavioral expressions and biosocial bases of sensation seeking. Cambridge University Press.

Zuckerman, M. (2007). *Sensation seeking and risky behavior.* American Psychological Association. https://doi.org/10.1037/11555-000

Zuckerman, M., & Aluja, A. (2014). Measures of Sensation Seeking. In G. Boyle, D. Saklofske & G. Matthews, Measures of Personality and Social Psychological Constructs (pp. 352-380). Academic Press.

Appendix A

Socio-Demographic Questionnaire

1. How many close friends an average person should have? (Verification question to detect bots)?
2. Research shows that people may not pay attention when answering questions. If you are reading this question, please select the last choice – the one at the very bottom of the list. Thank you for participating and taking the time to read through the questions carefully. What is this study about? (Verification question to detect bots)
    a. The behavior of politicians
    b. The behavior of athletes
    c. The behavior of actors
    d. Issues of technology
    e. Issues of religion
    f. Issues of geography
3. What is your age?
4. What is your sex?
    a. Female
    b. Male
    c. Other / Prefer not to answer
5. What is your occupation?
6. Are you Caucasian, Black of African-Canadian, Canadian Indian or Native, Asian, Native Hawaiian or other Pacific Islander, or other race?
    a. Caucasian
    b. Black or African-American
    c. American Indian or Native
    d. Asian
    e. Native Hawaiian or other Pacific Islander
    f. From multiple races
    g. Other race (please specify) _____
7. Are you now married, widowed, divorced, separated, or never married?
    a. Married
    b. Widowed
    c. Divorced
    d. Separated
    e. Never married
8. What is the highest level of education you have completed or the highest degree you have received?
    a. Less than high school degree
    b. High school degree or equivalent
    c. Some college but no degree
    d. Associate degree
    e. Bachelor degree
    f. Master's degree
    g. PhD or post-doctorate

9. How much total combined money did all members of your household approximately earned in 2020?
    a. $0-$9,999
    b. $10,000-$29,999
    c. $30,000-$49,999
    d. $50,000-$69,999
    e. $70,000-$89,999
    f. $90,000-$109,999
    g. $110,000-$129,999
    h. $130,000 or more
10. What is your current religion, if any?
    a. Catholic
    b. Protestant (Anglican, Orthodox, Baptist, Lutheran)
    c. Christian Orthodox
    d. Jewish
    e. Muslim
    f. Sikh
    g. Hindu
    h. Buddhist
    i. Atheist (do not believe in God)
    j. Other (please specify) _____
11. Which of the following best describes your partisanship?
    a. Democrat
    b. Republican
    c. Independent
    d. Other (please specify) _____