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## Examining bias in the impulsive sensation seeking (ImpSS) Scale using Differential Item Functioning (DIF) – An item response analysis

Joseph A. De Leo\*, Nicholas T. Van Dam, Andréa L. Hobkirk, Mitch Earleywine

University at Albany, SUNY, Department of Psychology, Social Sciences 310, 1400 Washington Avenue, Albany, NY 12222, USA

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### ABSTRACT

Impulsive sensation seeking, an important index of the disinhibited pursuit of novelty with minimal concern for potential negative consequences, varies with important health behaviors like drug use and unsafe sex. Previous work reveals associations between impulsive sensation seeking and gender, age, ethnicity and education. Links to these sociodemographic variables should arise from actual differences in the trait and not potential biases in items on the scale. The current study employed item response theory (IRT) analyses to identify differential item functioning (DIF)—a variation in scores that arises from group membership that is independent of genuine differences on the trait. Analyses of data from a large sample of Internet responders revealed DIF on multiple items of a popular index of impulsive sensation seeking. Items showed DIF in analyses related to gender, age, ethnicity and education. These results suggest that sociodemographic differences in impulsive sensation seeking should be interpreted with caution as they may be due to idiosyncratic interpretation of items rather than true group differences on the underlying trait. Future research should explore how these biases might affect links between impulsive sensation seeking and related psychological and behavioral outcomes.

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### 1. Introduction

The study of personality reveals some difficulties related to differential item function (DIF), where a question inaccurately presents one group as higher than another on a given trait simply because of group membership rather than genuine differences in the trait characteristic. Biases related to gender, ethnicity, age, or drug use status have appeared on several measures, including: the Hogan Personality Inventory (Sheppard, Han, Colarelli, Dai, & King, 2006), the Multidimensional Self Concept Scale (Young & Sudweeks, 2005), the NEO-PI (Huang, Church, & Katigbak, 1997), the MMPI (Stacy, Newcomb, & Bentler, 1993; Waller, Thompson, & Wenk, 2000) and the Schizotypal Personality Questionnaire (Earleywine, 2006). The purpose of the present study is to examine potential bias within the Impulsive Sensation Seeking Scale (ImpSS), a component of the Zuckerman Kuhlman Personality Questionnaire (ZKPQ; Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). The current analysis focused on demographic variables previously linked to the scale, including gender, age, ethnicity, and education, and employed an underutilized but effective approach for identifying DIF based on item response theory (IRT) (Kulas, Merriam, & Onama, 2008).

#### 1.1. Impulsive sensation seeking

Impulsive sensation seeking (a personality trait typified by risky activities, a quest for novel, complex, and intense sensations, and a tendency to engage in behaviors without consideration of potential negative consequences (Zuckerman & Kuhlman, 2000)), covaries with biological markers like less monoamine oxidase (MAO) and more testosterone (e.g., Eensoo, Paaver, Pulver, Harro, & Harro, 2004; Hur & Bouchard, 1997). Individuals who score higher on measures of this trait tend to use more drugs (Stacy et al., 1993; Zuckerman, Ball, & Black, 1990; Zuckerman et al., 1993) and have more risky sex (Donohew et al., 2000), perhaps because of heightened sensitivity to the reinforcing effects of risky behaviors (Perkins, Gerlach, Broge, Grobe, & Wilson, 2000; White, Lott, & de Wit, 2005). These links to important health behaviors make eliminating potential bias in the assessment of impulsive sensation seeking critical.

Research reveals consistent differences in impulsive sensations seeking, with men scoring higher than women, youth scoring higher than older participants, and U.S. citizens scoring higher than those from Germany (Aluja et al., 2006; McDaniel & Zuckerman, 2003; McDaniel & Mahan III, 2008). Scores also inversely relate with academic achievement among college students (Spinella & Miley, 2003). These studies highlight the importance of considering how gender, age, ethnicity, and education influence the relation between impulsive sensation seeking and associated behaviors.

\* Corresponding author. Tel.: +1 518 937 4827; fax: +1 518 442 4867.

E-mail address: [jd798667@albany.edu](mailto:jd798667@albany.edu) (J.A. De Leo).

## 1.2. Current study

This study examined potential sources of bias in the ImpSS scale, a popular index of impulsive sensation seeking. The presence of bias in the ImpSS scale was assessed using differential item functioning (DIF), a procedure rooted within the framework of IRT. This procedure assesses whether an individual's response on a particular scale item depends on their trait level (i.e., impulsive sensation seeking) or their group membership (i.e., gender, age, ethnicity, and education). Given research showing differences in gender, age, ethnicity, and education in impulsive sensation seeking, it is important to ascertain whether these observed differences reflect the personality construct or are artifacts of measurement problems. An analysis of potential bias could inform researchers of possible limitations in the measurement of this construct as well as the application of personality constructs similar to the ImpSS scale used as assessment instruments.

## 2. Method

### 2.1. Subjects and design

Participants responded to an email request to complete an Internet survey on drug use and attitudes. In an effort to target potential drug users, an initial email was sent to members via available listservs linked to three prominent drug policy reform groups. The email requested that willing participants complete the Internet administered questionnaire and upon completion forward the request to others for a chance to win a cash prize. Collected responses were not associated with participants' identifying information. These methods are supported by research examining the equivalence of paper and pencil versus Internet administration of personality measures, such as the ZKPQ (Zuckerman et al., 1993), which found no difference in factor structure or mean score between formats (Aluja, Rossier, & Zuckerman, 2007; Chuah, Drasgow, & Roberts, 2006; Gosling, Vazire, Srivastava, & John, 2004). The local institutional review board approved all study procedures.

### 2.2. Measures

#### 2.2.1. Impulsive sensation seeking

The 19-item ImpSS scale is part of the larger ZKPQ (Zuckerman et al., 1993). The ImpSS scale correlates significantly ( $r = 0.76$ ) with the 40-item Sensation Seeking Scale (SSS) Form V (McDaniel & Mahan III, 2008; Haynes, Miles, & Clements, 2000; Zuckerman, 1994). It shows acceptable internal consistency (alphas above 0.80) in heterogeneous samples (McDaniel & Mahan III, 2008; Zuckerman, 1994) and is 0.78 in the current sample. Participants provided responses to each of the 19 ImpSS scale items by endorsing either "true" or "false". The items were then summed to calculate a composite 'impulsive sensation seeking' score (Zuckerman, 1994). The ImpSS scale presents a number of advantages, such as being a parsimonious measure of sensation seeking with fewer potential confounds than 40-item SSS Form V. For instance, items on the ImpSS scale are not specific in content to potentially objectionable behaviors (e.g., drug use or sex) or culture-bound sporting

activities (e.g., parachuting; Zuckerman, 2007), making it a particularly useful measurement in the current sample population.

#### 2.2.2. Sociodemographic variables

Psychological research has been limited by the use of student samples with restricted age, ethnicity, and education levels. In fact, 67% of the studies published in the *Journal of Personality and Social Psychology* in 2007 sampled undergraduate college students (Arnett, 2008), potentially limiting the generalizability of findings. Thus, we sought a more diverse sample. For DIF analyses, men were compared to women based on reported gender, college-aged youth (ages 18–24) were compared to middle-aged participants (ages 45–64), Caucasians were compared to participants of all other ethnicities (non-Caucasian), and finally, participants reporting 'some college' were compared to those reporting 'some high school' education.

### 2.3. Statistical methods

#### 2.3.1. Population characteristics

The sample included a total of 8187 respondents, 80.5% males ( $n = 6665$ ) and 19.5% females ( $n = 1522$ ). Mean age was 29.9 years old ( $SD = 12.9$ ). The majority of respondents were Caucasian (88%), followed by Latino/Hispanic (6%), Native American (3%), African American, (2%), and Asian (1%). Approximately 41% of participants reported some college experience, 14% a bachelor's degree, 14% completed high school, 9% an associates degree, 8.5% some high school, 5% an advanced degree, and 3.5% some graduate training. The aggregate mean ImpSS scale score was 8.34 ( $SD = 4.38$ ) from a range from 0 to 19, with a mode of 7. Mean scores for all sociodemographic groups are displayed in Table 1. The current sample scored lower on this scale than cocaine abusers ( $M = 9.4$ ) and undergraduate college students ( $M = 9.5$ ) in other studies (Ball, 1995). Similar age and gender effects were observed in the current study in a manner consistent with previous research.

#### 2.3.2. Item response theory

Item Response Theory (IRT) is an advantageous alternative to classical test theory (see e.g., de Ayala, 2009; Embretson & Reise, 2000). One notable advantage of IRT is that estimations are based on responses to individual items and are theoretically sample invariant. Theoretical sample invariance means that the item should apply similarly across all samples, assuming no DIF is present. A primary objective of IRT is to predict the relationship between an individual's trait level and the probability of choosing a particular response (e.g., Van Dam, Earleywine, & Borders, 2010). This relation is depicted by an item characteristic curve (ICC) for each item. As the standardized estimate of trait level ( $\theta$ ) increases, the probability of endorsing a given response typically increases.

#### 2.3.3. IRT likelihood-ratio tests for differential item functioning

In the current study, IRT likelihood-ratio tests were used to test for invariance of item response parameters across several sociodemographic variables on the ImpSS scale. Data were analysed using IRTLRDIF v2.0b (Thissen, 2001). IRTLRDIF computes the likelihood-ratio statistic to test the null hypothesis that item parameters do not differ between groups. A significant result indicates the

**Table 1**  
ImpSS scale sociodemographic group descriptives.

	Mean	SD		Mean	SD	P value	Cohen's <i>d</i>
Males	8.56	4.33	Females	7.34	4.42	<.001	0.28
College-age	9.62	4.22	Middle-age	6.18	3.95	<.001	0.84
Caucasians	8.32	4.36	Non-Caucasians	8.53	4.44	>.10	0.05
Some college	8.67	4.49	Some high school	9.48	4.46	<.001	0.18

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