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# Diagnostic validity of behavioural and psychometric impulsivity measures: An assessment in adolescent and adult populations

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ABSTRACT

This investigation examined how different psychological and behavioural measures can be used to identify impulsive individuals. Five clinical groups split, between adolescents and adults, with varying levels of weight-management issues, were used to validate the impulsivity measures. The measures consisted of two behavioural, an inhibitory control measure (Stop Signal Task) and a Temporal Discounting measure, along with two personality measures, the Temperament and Character Inventory (Cloninger, Przybeck, Svrakic, & Wetzel, 1994) and the adolescent version (The Junior Temperament and Character Inventory) and finally the Barrat Impulsivity Scale (Patton, Stanford, & Barratt, 1995). The most sensitive was the Stop Signal Reaction time, which depicted significant differences in inhibitory control for all but two groups (Adult Lifestyle and Adult Healthy). The psychometric scales were able to sufficiently discriminate between obese and impulsive individuals with healthier participants. The Self-Control and Novelty Seeking subscales on the BIS. The Novelty Seeking subscale of the TCI-R and the JTCI, significantly discriminated between obese and healthy individuals. There was a high degree of association amongst the measures used, identifying that these measures can be used to monitor and measure impulsiveness in obese individuals for use in weight-loss interventions.



## 1. Introduction

Impulsivity denotes a tendency to act without considering consequences, where responses are rapid and without thought, and has been identified to develop with age (Steinberg, 2004), thought to peak at adolescence and decreasing thereafter with the development of cognitive functioning associated with the maturation of the prefrontal cortex (Galvan et al., 2006). Teenage impulsiveness stems from an imbalance between two interconnected brain networks: the incentive processing system, associated with the process of rewards and punishment, and the cognitive control system, which is associated with logical reasoning and impulse regulation (Steinberg, 2008). The incentive processing system begins to develop rapidly with the onset of puberty causing teenagers to overweight rewards, leading to sensation-seeking behaviour (Ernst et al., 2005). In contrast the cognitive control system has a much slower developmental rate, which continues well into the twenties (Steinberg, 2004). The mid-adolescence period in particular is a particularly vulnerable period when the disparity between the two systems is largest.

Measuring impulsivity has important consequences with the healthcare field, where recent evidence in neuropsychology and consumer behaviour has connected impulsivity and addiction behaviour with obesity (Balodis et al., 2014). Obese individuals demonstrate less impulsive control than the healthy population (Nederkoorn, 2014), where obesity is a direct outcome of the neurological and psychological factors that negatively influence an individual's rational decision-making in healthy dieting and exercising decisions (Takahashi, 2004; Weller, Cook, Avsar, & Cox, 2008). Such empirical evidence therefore suggests that measuring impulsivity has clinical advantages in identifying at risk impulsive individuals who are likely to become clinically obese.

There have been numerous investigations into the relationship of obesity and impulsivity. For instance, Sutin, Ferrucci, Zonderman, and Terracciano (2011) identified a relationship between personality measures and impulsivity, specifically measures relating to impulsive behaviour. The researchers found that impulsivity was a major factor in obesity, with an 11 kg weight disparity between the highest and lowest 10% scores on impulsivity measures.

A study to investigate the direct link between impulsivity and obesity was conducted by Guerrieri, Nederkoorn, Schrooten, Martijn, and Jansen (2009), who manipulated impulsive behaviour in participants using a priming task, the researches found a heightened food intake compared to those with higher levels of impulsivity compared to those who were not primed.

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These findings demonstrate how important accurate measures of impulsivity are within a clinical setting. However previous research fail to adopt overarching measures of impulsivity across all ages. For instance, Nederkoorn, Smulders, Havermans, Roefs, and Jansen (2006) examine impulsivity through psychometric (Barrat Impulsivity Scale [BIS] and the Hyperactivity/Impulsivity subscale) in addition to behavioural measures (Stop Signal Task and the Door Opening Task), the study uses a cross-sectional design but focuses on younger population. The researchers found significantly more impulsive behaviours in obese children compared to healthy in the Stop Signal Task, Door Opening Task and the Fun Seeking subscale of the BIS. However such findings are only generalizable to a young population and do not extend towards adults. A secondary aspect is that the use of a cross-sectional design only ascertains an association of obesity and impulsivity, but does not pertain to how impulsive behaviour fairs over time.

A second example is denoted by Rasmussen, Lawyer, and Reilly (2010) examining discounting behaviour of impulsivity in overweight participants. In this study, participants were asked which of two options they prefer, a smaller-certain reward or a larger but uncertain reward. The authors found that individuals with a higher percentage of body fat would discount hypothetical food choices, opting for smaller-sooner bites against larger-later, despite not controlling for hunger, suggesting that impulsive factors could be a cause of obesity. Such findings are consistent with other evidence on discounting behaviour (Davis, Levitan, Muglia, Bewell, & Kennedy, 2004). However a major shortcoming of this study is the use of a sole measure (discounting behaviour) in an adult population. As such, the results are difficult to integrate with other measures (e.g. Stop Signal Task) and generalize towards other younger populations.

A third example is from Houben, Nederkoorn, and Jansen (2014), the authors used the CANTAB Stop Signal Task (SSRT) (Logan, Schachar, & Tannock, 1997), a measure of inhibitory control and a variation which they devised using food-related stimuli. Houben and colleagues found that obese adults (mean age: 26.17 years) demonstrated more impulsive behaviour for food-related response compared to general cues, suggesting that obesity could be characterized by a lack of impulse control to food cues. The researchers here have also utilized a single measure of impulsivity, although they do investigate general and food-related impulsivity. However it is difficult to ascertain how such findings correspond to discounting behaviour and self-reported impulsivity.

Longitudinal studies of impulsive measures have been investigated, for example Kulendran et al. (2014) compared obese and healthy matched adolescents, through a pretest/posttest design using behavioural and psychometric measures. The behavioural measures denoted the Stop Signal Task and a Temporal Discounting Task. The researchers also utilized psychometric, personality measures to assess individual characteristics that predispose impulsive behaviour, this was achieved with the Junior Temperament and Character Inventory (Cloninger, Przybeck, Svrakic, & Wetzel, 1994). The use of psychometric scales offers a novel touch to the design, by expanding the impulsivity measurement framework to include behavioural, neurological and psychological domains. The researchers identified higher discount rates, as well as decreased inhibitory control, in obese participants compared to healthy individuals. Obese adolescents who attended weight loss camp experiences a significant reduction in Body Mass Index (BMI) and impulsivity measures, where age was shown to significantly moderate such effects. However, one major absence of this study is the limited scope of the sample based on adolescent population. Such findings may not apply and generalize to an older population where the cognitive control system is fully developed and integration of the control and incentive based systems are established.

To date, no one study has provided a comprehensive validation of both behavioural and psychological measures of impulsivity amongst obese individuals across both adult and adolescent years. Several studies utilize some measures of impulsivity amongst obese individuals (Nederkoorn, 2014), but these studies often involve either behavioural and psychometric but within a limited sample, or across samples but with limited measures (strictly behavioural or psychometric). No single study uses behavioural measures (discounting and inhibitory control measures), in addition to psychometric based measures across both adolescents and adults.

Assessing the measurement of impulsivity in obese participants actively seeking weight management against a normal, healthy weight subgroup will help to validate the use of the chosen measurement tools of impulsivity and delineate the construct further.

In order to study this, we designed a cross-sectional study using adult and adolescent based populations with varying levels of obesity, and incorporated behavioural and psychometric based measures to identify an overarching, impulsive measurement framework.

## 2. Method

### 2.1. Sample

The sample collected was split across five groups, initially across age (adolescent and adult participants), then divided again into varying degrees of weight. Adolescents comprised of an obese sample and a healthy sample matched by age and sex were recruited from a local secondary school, whilst the adult sample was divided into an obese bariatric sample, obese individuals who required lifestyle management as a weight-reduction interventions, and healthy weight adults. Adults were not matched for age, gender or educational level. A detailed breakdown of the sample is given below (see Table 1).

**Table 1**
Sample breakdown across age and weight.

| Group | | N | Age (years) | | BMI | |
|---|---|---|---|---|---|---|
| | | | Mean | SD | Mean | SD |
| Adolescent | Obese | 47 | 33.22 | 8.05 | 14.28 | 1.69 |
| | Healthy | 50 | 20.56 | 2.13 | 13.82 | 1.70 |
| Adult | Bariatric | 45 | 44.25 | 6.34 | 43.42 | 13.06 |
| | Lifestyle | 20 | 36.24 | 3.63 | 39.65 | 7.65 |
| | Healthy | 40 | 22.06 | 1.37 | 23.83 | 2.35 |

#### 2.1.1. Exclusion criteria

Participants were screened by a single researcher and excluded if they were medically diagnosed with an eating disorder, ADHD, taking neurostimulant medication or had learning or neurological difficulties.

### 2.2. Measures

#### 2.2.1. Stop Signal Task

An adaptation of the CANTAB Stop Signal Task from Logan et al. (1997) was used to directly measure inhibitory control to a pre-biased motor action. The task is divided into two sections: a Go Task and a Stop Task. In the Go Task, participants are initially shown a fixation cross for 500 ms, followed by a directional arrow facing either left or right for 1000 ms. Participants are instructed to press the left or right buttons on the pad as fast as they can, corresponding to the direction of the arrow on screen. Participants are given one practise block comprising of sixteen trials. The Stop Task has an identical design as the Go Task but with the addition of an audible sound, which instructs the participant not to execute a response. The initial stop signal delay was set at 250 ms and then adjusted dynamically depending on the subjects' behaviour. The stop signal reaction time (SSRT) measures the time needed to cancel a go response. A single researcher was present during the task to give instructions and answer any queries.