Rash Impulsivity predicts lower anticipated pleasure response and a preference for the supernormal.

Belinda C. Goodwin [ab]

Matthew Browne [a]

Matthew Rockloff [a],

Natalie J. Loxton[cd]

[a]School of Human, Health, & Social Sciences, Central Queensland University, Australia

[b] Health Collaborative Research Network, Australia

[c]School of Applied Psychology, Griffith University, Brisbane, Australia Q. 4122

[d]Centre for Youth Substance Abuse Research, The University of Queensland, Brisbane, Australia Q. 4072

Corresponding author:
Belinda Goodwin
School of Psychology, Central Queensland University, Australia
b.goodwin@cqu.edu.au

Abstract

Alcohol, other psychoactive substances, high calorie foods, media entertainment, gaming, and retail products are all forms of modern supernormal stimuli. They exhibit exaggerated features that activate evolved reward systems more so than the natural stimuli for which these systems are adapted. Recent findings suggest that people may vary in the strength of their preference toward supernormal stimuli. The current study assessed whether the two-factor model of impulsivity (Dawe & Loxton, 2004) predicts a preference for supernormal stimuli. A cross-sectional survey design (n=5389) was used to measure anticipatory pleasure for both supernormal and natural-reward experiences; and their hypothesized antecedents: Rash impulsivity (RI) and reward drive (RD). As predicted, RI was positively associated with preference for supernormal stimuli and negatively associated with general anticipatory pleasure ratings. In contrast, RD was positively associated with general pleasure ratings, but explained little to no variance in supernormal preference when controlling for RI. The findings link trait rash impulsivity with increased sensitivity to supernormal stimuli, and provide new insights into both constructs.

Keywords: impulsivity, reward drive, supernormal stimuli, health behaviour.

1. Introduction

Alcohol, other psychoactive substances, high calorie foods, media entertainment, gaming, and retail products are often consumed in excess, contributing to poorer health outcomes for many people. Rash impulsivity (RI) and reward-drive (RD) are associated with excess consumption of such products (Gullo, Loxton, & Dawe 2014; Kane, Loxton, Staiger, & Dawe, 2004). This has lead to the suggestion that these traits may play a role in some people's general propensity for excessive and unhealthy consumption (Goodwin, Browne, Rockloff, & Donaldson, 2015a; Kane et al., 2004). Recently, factor analytic studies have uncovered a potential latent trait reflecting individual differences in general consumption of hedonic stimuli (Goodwin et al., 2015a) and preferences toward particular types of reward (Goodwin, Browne, & Rockloff, 2015b). In this paper, we link these reward preferences to trait/personality measures of RI and RD.

1.1 Supernormal Stimuli

Human beings often consume unhealthy stimuli, despite an awareness of subsequent negative consequences (e.g., obesity, pain, financial debt, etc.). One explanation for this based in evolutionary theory, is that human reward systems evolved to suit an environment in which resources were scarce and self-limiting consumption was not adaptive. In non-natural environments, where resources are plentiful, humans (along with other species) retain a tendency towards uncontrolled consumption of stimuli that are interpreted as conferring fitness: a phenomenon labeled as 'selection asymmetry' (Staddon, 1975; Ward, 2013). In this model, "supernormal" stimuli - those that posses exaggerated versions of naturally rewarding features, ought to be particularly attractive. For example, processed foods that contain concentrated and refined sugars and carbohydrates are attractive because they exaggerate the features found in seeds and fruits – a valuable and fitness-conferring resource in natural environments. For modern humans, highly appetitive experiences exist in a variety of artificial consumer products that have been carefully designed to maximize desirability. This broad range of products can be understood as supernormal-stimuli due to one common property; they invoke an evolved pre-disposition to respond to a degree not found in natural stimuli (Barrett, 2010). For example, psychoactive drugs (e.g., cocaine) are thought to mimic adaptive rewards by giving off a false and exaggerated sense of fitness and vitality (Nesse & Berridge, 1997). Industrially manufactured foods are carefully designed to provide enhanced appearance, smell, texture, and taste characteristics that can stimulate reward pathways more so than more natural food sources. More speculatively, television shows (Barrett, 2010), digital social networking (Ward, 2013) and various retail products (Etcoff, Stock, Haley, Vickery, & House, 2011; Morris, Reddy, & Bunting, 1995) have also been discussed as forms of modern supernormal stimuli due to properties that increase feelings of social status and belonging.

Supernormal experiences tend to be inherently unhealthy due to eliciting uncontrolled consumption, being synthetic nature, and often encouraging prolonged sedentary behaviour (e.g., media consumption and gambling). This poses an important question for behavioural-health: Are some people generally more sensitive to reward from supernormal stimuli and therefore more susceptible to excess consumption of unhealthy products?

1.2 Individual differences and supernormal stimuli

Evolutionary adaptions to environments are typically species wide, however, many specific traits are associated with both benefits and costs to adaptive fitness and therefore even highly species-typical behaviours vary between individuals and situations (Lewis, 2015). Likewise, whilst virtually all people are prone to the allure of supernormal stimuli, one would expect to observe individual differences in susceptibility. A recent confirmatory factor analytic study analyzed covariance between the consumption of various artificial products: alcohol, drugs, cigarettes, fast food, snacks, TV, Internet, gambling products, caffeine, salt, and processed meat products; as well as several natural products (Goodwin, et al., 2015a). A uni-dimensional latent factor with positive loadings for all artificial (but not natural) products fit the data well, suggesting that this behavioural trait may be interpreted as an orientation towards supernormal stimuli. However, pleasure is felt from a variety of experiences including those that are natural or not markedly artificial (e.g., viewing a landscape or helping others; Snaith et al., 1995). In a subsequent study, Goodwin et al., (2015b) developed a measure of anticipatory pleasure. Factor analysis revealed a clear two factor structure corresponding to two subdomains of anticipatory pleasure: one included items regarding supernormal stimuli (e.g., television and snack food) and the other included items regarding natural stimuli (e.g., smiling faces and attractive landscapes).

Neurological evidence supports the idea that some people are more susceptible to consummatory stimuli than others. For example, those who struggle with weight and eating problems show even greater activation of reward pathways to palatable food and food-related cues (e.g., knives, forks) than normal weight/non-eating disordered individuals (Stoeckel et al., 2008). Thus, individual differences in a general susceptibility to supernormal stimuli would be consistent with some individuals exhibiting sensitive dopamine pathways.

1.3 Reward drive and rash impulsivity

Impulsivity in general has been associated with specific risky behaviours such as substance abuse, problem gambling, and excessive video-gaming (Walther, Morgenstern, & Hanewinkel, 2012), yet varied models of impulsivity derived from different theoretical backgrounds have been applied across previous studies of personality and addiction. For example, and Lyman, (2001) describe multi-factor models of impulsivity largely based on the factor analysis of self-report questionnaire data. Factors include urgency, lack of premeditation, lack of perseverance and sensation seeking (Whiteside & Lyman). More recently, conceptualizations of impulsivity, particularly as related to addictive behaviours, have focused on two distinct dimensions based on separate neural processes (Dawe & Loxton, 2004; Gullo, et al., 2014). While both conceptualizations share similarities, it has been demonstrated that the two-factor model is the more parsimonious approach for understanding addictive behaviours (see Gullo et al., 2014). In this model, the first dimension, reward drive (RD) refers to the tendency of an organism to initiate goal-directed approach behavior in response to signals of reward. Reflecting Gray and McNaughton's, (2000) motivational Behavioral Approach System (BAS), RD involves the mesolimbic dopaminergic pathways; a brain region associated with natural reinforcement as found in response to food, sex and drugs, and moreover, in the prediction of potential reward (Hernandez & Hoebel, 1988; Krüger, Hartmann, & Schedlowski, 2005). There has been a rapidly increasing body of evidence supporting the association between RD and a range of consumption behaviours (see Gullo, et al., 2014 for a review). For example, heightened RD has been consistently associated with binge-eating, having a preference for foods high in fat and sugar, a preference for colourful and varied food, hazardous drinking, and an early age of drug experimentation (Davis. et al., 2007; Dissabandara et al., 2014; Kane, et al., 2004).

The second dimension, rash impulsivity (RI) refers to difficulties in inhibiting one's behavior following the activation of an approach response despite potential negative consequences. The second facet is proposed as involving dysfunction in the orbitofrontal cortex and the ventromedial prefrontal cortex; areas associated with impulse control and decision-making (Dawe & Loxton, 2004). RI has been associated with chronic alcohol and poly-drug use (Gullo, et al., 2011), pathological gambling (Walther, et al., 2012) and compulsive shopping (Black, Shaw, McCormick, Bayless, & Allen, 2012).

These findings have prompted research into the unique contributions of each of these dimensions to health and lifestyle choices. When both constructs are considered as predictors in the same model, RI and RD both explain unique variance in alcohol use and drug use.

However, RI appears to be the stronger predictor of the two (Gullo et al., 2011; MacLaren, et. al., 2012). Highly reward driven individuals experience heightened positive affect in rewarding situations and have been found to report greater psychological well-being and hope, and to experience greater sociability and less loneliness (Clark, Loxton, & Tobin, 2015; Harnett, Loxton, & Jackson, 2013). This suggests that RD can be involved in both functional and less desirable reward outcomes. High RD individuals might therefore be likely to experience high anticipatory pleasure for all rewarding experiences, whether or not those experiences could be construed as supernormal. RI, on the other hand, is primarily associated with more dysfunctional behaviours such as substance use, gambling, excessive retail shopping, and binge-eating (Black, et al., 2012; Dawe et al., 2004; Kane et al., 2004; Walther, et al., 2012). All of these dysfunctional behaviours would appear to fall into the supernormal category of stimuli. Thus, high RI individuals should anticipate more pleasure from supernormal stimuli, rather than reward stimuli in general.

1.4 The current study

Impulsive personality characteristics are consistently associated with unhealthy behaviours (Gullo et al., 2014); and more recently, research has focused on the unique effects of two separate dimensions of impulsivity on functional and clearly dysfunctional behaviours. The supernormal / natural distinction appears to be a useful organizing principle for understanding stimuli that particularly encourage excessive consumption. The aim of this study is to investigate the relationships between the two-factor model of impulsivity (RD and RI) on preferences for supernormal (versus natural) pleasurable stimuli. We tested the following predictions:

1) Reward drive is associated with general anticipatory pleasure, but not preference for supernormal over natural stimuli;

2) Rash impulsivity is associated with a differential preference for supernormal stimuli, but not general anticipatory pleasure.

2. Methods

2.1 Participants and Procedure

Data for the current study was collected as part of a large research project, factor analysis results involving the SNPS items have been published previously in a separate manuscript (Goodwin et al., 2015b). Participants (n = 5391, 51% female) were members of on an online panel set up by an agency specializing in the recruitment of survey participants in Australia (MyOpinions.com.au). Emails were sent to panel members inviting them to participate in the online survey for which they could earn points that could be accumulated and exchanged with the agency for cash. The full survey took approximately 20 minutes to complete. Ages ranged from 18 to 87 years old (M=49.01, SD=16.50). The majority of participants were born in Australia (74%), with the remainder born in either the United Kingdom (8.4%), New Zealand (2.7%) or elsewhere (14.9%).

2.2 Measures

Supernormal and Natural Pleasure: Preference for supernormal pleasure was measured using the Supernormal and Natural Pleasure Scale (SNPS; Goodwin, et al., 2015b). It contains two subscales that measure anticipatory pleasure in response to supernormal stimuli (5 items; e.g., "*Watching my favourite TV show*") and natural stimuli (8 items; "*Seeing other people's smiling faces"*). Participants are asked how much pleasure they anticipate in response to each experience, responding on a 5 point Likert scale (1 = "*none or neutral*" to 5 = "*There is nothing I would enjoy more*"). Items were averaged within each subscale to create aggregate scores. General anticipatory pleasure was calculated via the sum of the two means. Differential preference for supernormal stimuli was calculated by the difference between the two means. Cronbach's alphas for the natural subscale, the supernormal subscale and in total were .88, .78, and .89, respectively.

Rash Impulsivity: Rash impulsivity was measured using a short version of the Barratt Impulsivity Scale (BIS-15; Spinella, 2007) consisting of 15 statements in which participants must rate the extent to which they agree with each statement on a 4-point Likert scale (1, Strongly Disagree; 2, Disagree; 3, Agree; 4, Strongly Agree). The measure includes five questions from three subscales; Attentional (e.g., *"I don't pay attention"),* Motor (e.g., *"I act on the spur of the moment"*), and Non-planning (e.g., *"I am a careful thinker. [inverted]").* Cronbach's alpha in the present sample was .83

Reward Drive: The Behavioral Approach Scale (BAS) from the Behavioural Inhibition and Approach Scale (BIS/BAS) was used to measure RD. This includes three subscales 1) Drive, assessing a persistence in pursuing desired goals (e.g., *"When I want something, I usually go all out to get it"*) and 2) Reward Responsiveness scale, focused on the response to occurrence or anticipation of reward (e.g., *"When I'm doing well at something, I love to keep at it"*) and 3) Fun seeking (e.g, *"I crave excitement and new sensations"*). Items were measured on the 4-point Likert scale described above. Cronbach's alpha coefficients in the current study were all .80 and above (Reward Responsiveness, a = .81, Drive a = .88, Fun seeking, a = .80, Total BAS, a = .81). As reported previously (Dawe & Loxton, 2004), RI and RD were weakly to moderately correlated in the current study (r= .26). Missing data for single items were replaced using a single imputation method before aggregation.

3. Results

As shown in Table 1, females rated natural and general pleasure, and RD significantly higher than males, whereas males exhibited significantly higher supernormal pleasure, supernormal preference, and RI. Younger participants reported significantly lower natural pleasure ratings and higher supernormal ratings and preferences, as well as higher RD, and higher RI scores.

Table 1. *Descriptive statistics by age group, gender and total with t-tests.*

	Total	Male (n= 2592)	Female (n= 2799)			<50 yrs (n= 2611)	≥ 50 yrs^ (n= 2780)		
	M (SD)	M (SD)	M (SD)	*t*	*d*	M (SD)	M (SD)	*t*	*d*
Natural Pleasure	3.58	3.39	3.76			3.47	3.68		
	(0.68)	(0.68)	(0.63)	20.49***	.56	(0.68)	(0.67)	-11.69***	.31
Supernormal Pleasure	2.96	3.09	2.81			3.00	2.93		
	(0.66)	(0.64)	(0.66)	16.04***	.43	(0.67)	(0.66)	3.37***	.11
General Pleasure	3.27	3.10	3.42			3.23	3.31		
	(0.59)	(0.58)	(0.55)	21.00***	.56	(0.60)	(0.58)	-4.79***	.14
Supernormal Pref.	-0.31	-0.29	-0.33			-0.24	-0.38		
	(0.32)	(0.32)	(0.32)	-4.91***	.12	(0.31)	(0.31)	16.04***	.45
Reward Drive#	34.64	34.39	34.87			36.16	33.23		
	(5.86)	(5.69)	(6.00)	03.00**	.08	(5.81)	(5.54)	18.93***	.51
Rash Impulsivity#	32.05	32.23	31.87			32.61	31.52		
	(5.89)	(5.81)	(5.95)	2.20*	.06	(5.85)	(5.88)	6.82*	.19

^Age categories based on median split, # variables based on sum total, others based on mean, *** = p <.001,** = p <.0,1* = p <.05, d = Cohen's d effect size.

Several multiple regressions were conducted to test the effects of the two-factor model of impulsivity on both general anticipatory pleasure ratings and relative preference for supernormal stimuli. Multi-collinearity was not apparent amongst the variables in each regression analysis with tolerance values well above .2 (Menard, 1995). As shown in Table 2, gender and age alone explained 8% of the variance in general pleasure ratings. RD was a positive predictor of general pleasure ratings β = .370, p < .001, explaining an additional 13% of variance. RI negatively predicted general anticipatory pleasure ratings β = -.071, p < .001, but accounted for very little additional variance after controlling for age and gender. When entered simultaneously, RI β = -.170, p < .001 and RD β = .414, p < .001, accounted for 15% of unique variance in general anticipatory pleasure, with larger standardized beta coefficients compared to when entered singly. This suggests that the ‘pure’ constructs of RD and RI, corresponding to the covariance that is not shared with the other, have the strongest associations (in opposite directions) with general anticipatory pleasure.

Table 2. *Standardized regression coefficients for RI and RD predicting general anticipatory pleasure (n = 5389).*

	β				Zero-order correlations (r)		
Model	(1)	(2)	(3)	(4)	Age	RD	RI
Gender	-.282	-.276	-.277	-.268	.08	-.04^	.03^
Age	.083	.181	.074	.181		-.29	-.11
RD		.371		.414			.27
RI			-.070	-.170			
R^2	.08	.21	.09	.23			
F	243.46	474.34	172.94	415.16			

DV = General anticipatory pleasure; Supernormal mean + Natural mean, All statistics reported in this table are significant at p <.001, except for those marked ^ which are significant at the p <.05 level.

Table 3 compares regression models for differential preference for supernormal stimuli. Gender and age alone explained 7% of the variance. Reward drive alone was a positive predictor of supernormal preference β = .105, p < .001, but explaining only an extra 1% of variance. Rash impulsivity alone positively predicted supernormal preference β = .193, p < .001, accounting for an extra 4% of variance. When entered simultaneously, they together accounted for 4% unique of variance in supernormal preference. Beta coefficients for RI and RD both decreased (RD decreasing more so, and changing sign from positive to negative), when entered simultaneously. This implies that the variance unique to RD that is not shared with RI, has a neutral or negative association with supernormal preference. However, RI maintains a positive relationship with supernormal preference, regardless of whether or not RD is controlled for.

Table 3. *Standardized regression coefficients for RI and RD predicting differential supernormal preference (n = 5389).*

Model	β (1)	(2)	(3)	(4)
Gender	.087	.089	.080	.081
Age	-.256	-.226	-.233	-.218
Reward Drive		.105		-.059
Rash Impulsivity			.193	.179
R^2	.07	.08	.11	.11
F	200.78	154.92	212.95	164.73

DV = Differential Supernormal Preference; Supernormal mean - Natural mean, All statistics reported in this table are significant at p <.001.

4. Discussion

All humans desire pleasure, but the objects of our desire – and our manner of pursuing them - vary considerably. RD and RI describe two dimensions along which people vary in their approach to rewards. Our results show that RD and RI are associated with different patterns of anticipatory pleasure both in general, and specifically for supernormal stimuli. As predicted, RD was a positive indicator of general anticipated pleasure ratings. That is, people high in RD tend to anticipate high levels of pleasure from a general class of rewarding experiences and situations, whether or not they are supernormal. These experiences include those that are socially acceptable and adaptive in the modern environment, which accords with recent research investigating the functional outcomes associated with reward drive (e.g., Clark et al., 2015; Harnett et al., 2013). In contrast, RI was negatively associated with anticipated general pleasure ratings, especially after controlling for RD. Thus, although RD and RI are positively correlated with one another, their unique properties have contrasting associations with one's capacity to anticipate pleasure.

Increased anticipated pleasure associated with RD is consistent with a surplus model: people are more likely to engage in rewarding activities when they anticipate receiving greater pleasure from them. On the other hand, approach behaviour associated with RI may derive from a deficit: that is, RI individuals are compensating for a lack of capacity to anticipate reward, therefore generally expecting less pleasure from all rewarding experiences. This is particularly apparent in heavy drug users. Often excess drug use will lead to diminished dopamine functioning, causing the user to reject other sources of reward, and require higher and more frequent doses of psychoactive substances in order to achieve pleasure (Volkow et al., 2014). Similar processes have been found to occur in the case of excess food (Volkow, Wang, Fowler, & Telang, 2008) and alcohol consumption (Heinz et al., 2014). This is congruent with previous findings in which models predicting drug use, which include both RD and RI, are dominated by RI (Gullo et al., 2011; MacLaren, Fugelsang, Harrigan, & Dixon, 2012). Both high RD and RI individuals have the propensity to readily approach and over-consume unhealthy products (Gullo et al., 2014). It may be that this propensity is driven by two opposing mechanisms. That is; high rash impulsivity may be associated with excess consumption because general anticipated pleasure levels are low, leading to an increased need to stimulate dopamine, whereas high reward drive may be associated with excess consumption due to an increased capacity to anticipate reward.

Findings regarding differential supernormal preference showed the opposite pattern of results: RI positively predicts supernormal preference whilst RD had a very small negative association. This finding is also consistent with the above compensatory model of RI. If individuals high in RI have difficulty in experiencing pleasure, then they ought to prefer more intense and immediate stimulation. Supernormal, as compared to natural stimuli, have exactly these properties. For example, rash impulsivity is associated with substance abuse due partly due to the overvaluing of synthetic reinforcers, and the undervaluing of more natural reinforcers (Dawe et al., 2004). That is, a lack of capacity to experience reward may increase the rash impulsive person's attraction to highly exaggerated, synthetic, and immediately reinforcing products. On the other hand, individuals who are high in RD may be more likely to anticipate enjoyment from reward from a variety of sources, and therefore do not tend to exhibit a preference for the supernormal.

Our findings may also go towards demonstrating one way in which different personality phenotypes might have formed to facilitate adaptive behaviour. As Lewis (2015) notes, certain traits can be associated with both adaptive and non-adaptive behaviour in different context. For example, in our evolutionary past the ability to flee or fight in dangerous situations was adaptive to survival; but in modern times, this response often results in debilitating hyper-vigilance, anxiety or stress disorders. A similar case may be argued for rash impulsivity. In an environment where resources are scarce or competed for, a disposition to act impulsively towards immediate rewards would usually lead to better mating opportunities and nutrition, and thereby fitness. In today's developed-world environment where resources are abundant, this impulsivity may lead to obesity, debt or ill-health. In the same way that evolutionary theory has increased our understanding of anxiety disorders, it may also be useful consider an evolutionary perspective in conceptualising maladaptive health-related behaviours.

4.1 Limitations & Future Research

Caution must be exercised in interpreting significance values due the extremely large sample size used. Although, effect sizes associated with the key findings are small, they are substantial considering it can be difficult to directly predict specific behavioural outcomes based on general attitudes or personality traits (Ajzen & Timko, 1986).

The measurement of impulsivity and related traits continues to be refined and a new revised Behavioural Approach System Scale (rBAS) has been recently developed based on revised reinforcement sensitivity theory (Jackson, 2009). This scale appears to assess the more functional aspects of reward sensitivity/drive (Clark et al., 2015; Harnett et al., 2013; Jackson, 2009). An overlap between the reward drive scale and the measure of impulsivity is expected, in part, due to neurologically shared reward circuitry. However, the total original BAS measure used in the current study includes a fun seeking subscale that is highly correlated with measures of rash impulsivity (Dawe & Loxton, 2004; Gullo et al., 2011). In replicating or extending on this research it is recommended that one use the updated BAS scale (Jackson 5; Jackson, 2009). This may result in more pronounced unique effects of the two factors of impulsivity. Further to this, the current findings highlight the importance of including measures of both RD and RI in future models. In doing this, the overlap between the two measures is accounted for allowing for a more pure interpretation of each trait.

4.2 Conclusions

Preference toward supernormal stimuli has received little empirical attention and studies thus far have not addressed personality factors. Predicting individual variance in preference toward products with exaggerated reward properties; such as desserts, snack foods, and various retail items; provides valuable information regarding those people that may be more prone to unhealthy consumption. The current findings suggest that the two-factor model of impulsivity is useful in predicting an orientation towards supernormal stimuli, and that RI, rather than RD appears to be instrumental in prompting unhealthy lifestyle choices.

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