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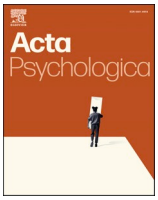

Absorption and dissociation mediate the relationship between direct verbal suggestibility and impulsivity/compulsivity

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ABSTRACT

Direct verbal suggestibility refers to the capacity for an individual to experience perceptual, motor, affective and cognitive changes in response to verbal suggestions. Suggestibility is characterized by pronounced, yet reliable, inter-individual differences. Previous research and theoretical considerations suggest that greater impulsivity and compulsivity is associated to higher suggestibility, but the characteristics and mediating factors of this association are poorly understood. Using established psychometric measures in an online sample, we found positive correlations between the domain comprising impulsivity, compulsivity and behavioural activation, and the domain of suggestibility, dissociation and absorption. We also observed that dissociation and absorption mediated the link between suggestibility and impulsivity, and between suggestibility and behavioural activation, respectively. These results confirm the positive link between suggestibility and the impulsivity/compulsivity domain and shed new light on the characterisation of traits associated with suggestibility.

1. Introduction

Direct verbal suggestibility refers to a unique capacity of individuals to experience pronounced changes in cognition, behaviour, and perception in response to verbal descriptions (suggestions; Oakley et al., 2021). For instance, in the right context, the suggestion 'your arm is now very heavy' or 'you will now hear someone say your name' can cause some individuals to have the corresponding experience. Perhaps the most striking examples of this come from clinical and basic research on pain where it has been repeatedly demonstrated that suggestions for hypoalgesia can reliably produce substantial reductions in pain in some individuals (Milling et al., 2021; Thompson et al., 2019). Although suggestions are typically administered in the context of hypnosis, an induction is not necessary to produce compelling suggestion effects in responsive individuals (e.g., McGeown et al., 2012).

The existence of strong and reliable inter-individual differences in suggestibility is well established (Hilgard, 1965; Laurence et al., 2008; Oakley et al., 2021; Polczyk and Pasek, 2006). It can be measured by suggestibility scales evaluating the magnitude of responses to suggestions and their subjective quality (for a review of hypnotic suggestibility scales, see Acunzo and Terhune, 2021). However, relatively little is known about the mechanisms underlying suggestibility or its relationship to other constructs that vary across individuals (Laurence et al., 2008). A better understanding of suggestibility is likely to help to identify sensitive and vulnerable individuals, in this way benefitting suggestion-based methods in medicine, clinical psychology and well-being (e.g., Milling et al., 2021), and minimizing the negative impact of suggestion in certain contexts, such as nocebo responding (Colloca and Barsky, 2020; Corsi and Colloca, 2017; Nitzan et al., 2015).

One avenue for optimizing the identification of highly suggestible individuals is through the identification of other traits that correlate with suggestibility. In the small existing literature on this topic, suggestibility has been found to reliably correlate with absorption (Jamieson, 2005; Tellegen and Atkinson, 1974), which measures the tendency to become absorbed with rich, internally-generated imaginative experiences. Suggestibility has also been closely linked with the germane propensity to experience dissociative states (dissociative absorption, derealisation/depersonalisation and dissociative amnesia; Frischholz et al., 1992; Wieder and Terhune, 2019; but see Dienes et al., 2009). Moreover, suggestibility is reliably elevated in disorders characterized by pronounced dissociative symptomatology (Bell et al., 2011; Dell, 2019; Wieder et al., 2021, 2022). As dissociation is a transdiagnostic

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symptom associated with a wide range of disorders including depression, anxiety, panic and substance misuse (Ellickson-Larew et al., 2020; Lyssenko et al., 2018), better understanding of these associations may inform differential diagnosis of psychiatric conditions, such as between schizophrenia and dissociative disorders (Mertens and Vermetten, 2018). Given these established links between direct verbal suggestibility, absorption and dissociation, we will refer to these three traits as the suggestibility/dissociation domain.

1.1. Suggestibility and impulsivity/compulsivity

Impulsivity and compulsivity are related concepts but also have marked differences. Impulsivity refers to the tendency to act with little forethought or consideration for the consequences of one's actions. It is associated with sensation-seeking, risk-taking, and disorders such as ADHD, substance misuse disorder, behavioural addiction, mania, and borderline personality disorder (Robbins et al., 2012). By contrast, compulsivity refers to the engagement in behaviour unrelated or detrimental to goal pursuit, such as addiction and checking (Robbins et al., 2012). Impulsivity and compulsivity both relate to the activation of potentially problematic behaviour by the immediate reward it may provide and to poorer inhibition. Both concepts are closely linked to the behavioural activation system sensitivity, which relate to the sensitivity to reward (Carver and White, 1994; Leone and Russo, 2009). We will refer to these three traits (impulsivity, compulsivity, behavioural activation) as the impulsivity/compulsivity domain.

As impulsivity/compulsivity and response to verbal suggestions both relate to self-control over, and potential automaticity of, actions, a link between these traits has been proposed (see Ludwig et al., 2013). Empirical evidence indeed points toward a correlation between suggestibility and impulsivity and binge eating severity (Ray et al., 2020; see also Olson et al., 2020). Hypnotic suggestibility has also been linked to non-planning impulsivity (Ludwig et al., 2013), which is associated with a focus on the present rather than the future (e.g., preference for immediate lower rewards than future higher rewards) and an aversion to complex mental tasks. Further indirect evidence for this association comes from the motor domain where both impulsivity and hypnotic suggestibility have been shown to be characterized by delayed awareness of motor intentions (Caspar and Cleeremans, 2015; Lush et al., 2016).

A mechanistic link between compulsive behavioural tendencies and suggestibility is perhaps not surprising, as they share common features. Firstly, both are characterized by an aberrant sense of agency (i.e. the feeling of being the agent of one's own actions; see e.g., Moore and Obhi, 2012). Individuals with obsessive-compulsive tendencies report a heightened sense of illusory control whereas indirect psychophysical measures appear to indicate reduced intentional binding (see Oren et al., 2019 and review therein). An altered sense of agency, with the subjective feeling that one's experiences and actions are caused by an external agent (passivity experiences), is considered a hallmark of response to suggestion (Bowers, 1981; Polito et al., 2015; Weitzenhoffer, 1974). For instance, in a positive response to an ideomotor suggestion, such as 'your arm is now rising', moderate-to-highly suggestible participants will reliably report a compelling experience that their arm was rising by itself. These self-reported distortions in the sense of agency have been corroborated with perceptual tasks (Haggard et al., 2004; Lush et al., 2017). Moreover, even outside the context of suggestions, highly suggestible individuals appear to have aberrant metacognition regarding their motor intentions and the factors that modulate their control (Lush et al., 2016; Terhune and Hedman, 2017).

Another shared feature linking compulsive tendencies and suggestibility is dissociation. Although evidence of a direct link between obsessive-compulsive disorders (OCD) and high suggestibility is mixed (Spinhoven et al., 1991; Vanderlinden et al., 1995), OC behaviours correlate with dissociative experiences in non-clinical samples (Watson et al., 2004). In addition, OCD patients often suffer from dissociative symptomatology with high comorbidity between the two conditions (Belli, 2014; Belli et al., 2012; Lochner et al., 2004, 2007; Tatlı et al., 2018), and trait absorption, often conceptualized as a form of dissociation, appears to be a reliable predictor of OC symptoms (Aardema and Wu, 2011; Soffer-Dudek, 2014, 2019).

1.2. The present study

The goals of the current study are to clarify the link between impulsivity-compulsivity and suggestibility and to better understand the role of dissociation and absorption. Using established psychometric indices, we measured direct verbal suggestibility, absorption, dissociation, compulsivity, impulsivity and behavioural activation/inhibition in a non-clinical online sample. We expected to observe moderate-strong correlations within the suggestibility/dissociation domain (suggestibility, dissociation and absorption) and impulsivity/compulsivity domain (impulsivity, compulsivity, behavioural activation), as well as weak-moderate positive correlations between the two domains. An additional prediction was that any relationship between suggestibility and impulsivity might be mediated by absorption, as previously predicted (Ludwig et al., 2013).

2. Methods

The present paper presents analysis of psychometric data collected in the context of an experiment investigating the link between individual differences and incentive salience (i.e. attentional biases to rewarding stimuli), measured using a behavioural task similar to (Anderson et al., 2011). Data from the behavioural task will not be presented here. Methods were pre-registered on OSF *https://osf.io/uzxqg*. All procedures were approved by the University of Birmingham ethical board.

2.1. Participants

One hundred and ten participants were recruited through the Prolific platform (http://prolific.co/; Prolific Academy Ltd., Oxford, UK), sampled from a group of 1105 participants who had already taken part in one of four previous online studies that included the measurement of suggestibility and dissociation (Stein et al., in press; Wieder and Terhune, 2019; and two other manuscripts in preparation). The inclusion criteria for these studies, each comprising between 200 and 300 participants, were that individuals had to be aged 18 or above, UK residents, understand English, and have a Prolific rating of at least 95 %. Our final sample comprised 63 females, 44 males, and 3 participants with other or unreported gender. Age ranged between 18 and 61 ($M = 37.5$, $SD = 11.7$). The target sample size ($N = 112$) was determined by an a priori power analysis on the incentive salience effect and its link to impulsivity reported in Anderson et al. (2011). We assumed a similar effect size for the correlation between suggestibility and incentive salience as for impulsivity and incentive salience ($r = \sim 0.25$). Using a one-tail criterion of $\alpha = 0.05$, and in order to achieve a power of 0.8, we found that $N = 55$ was necessary for measuring incentive salience in the behavioural task, and $N = 96$ for detecting the expected correlation coefficients. As we constructed the sample using groups, we considered two groups of $N = 55$ (+1 so that the medium-low suggestibility group could be constructed with two equal subgroups; see next paragraph), so as to allow for the detection of the incentive salience effect within each group. Further details regarding the power analysis can be found on OSF *https://osf.io/uzxqg/*. Participants were compensated for their participation at a rate of £5/h.

Direct verbal suggestibility varies widely in the population but is roughly normally distributed. Most individuals therefore have medium suggestibility, with small proportions displaying high and low suggestibility. In order to boost statistical power and increase our chances of identifying measures associated with suggestibility, we oversampled high and low suggestible individuals (typically considered as the top and

bottom 15 % respondents, respectively). From the pool of 1105 participants who had completed the BSS and DES in previous studies, we drew one quarter of our participants from those with BSS-C scores below the 42nd percentile, one quarter between the 42nd and the 84th percentile, and half above the 84th percentile to acquire two similarly-sized subgroups of low-medium and high suggestible participants.

2.2. Materials and procedure

Suggestibility and dissociation were measured in previous online studies (Stein et al., in press; Wieder and Terhune, 2019; and two manuscripts in preparation) using the *Brief Suggestibility Scale* (BSS) (Wieder and Terhune, 2019) and the *Dissociative Experiences Scale* (DES-II, Carlson and Putnam, 1993) in randomised order. In addition to the BSS and the DES-II, these previous studies included measures of trauma and attachment (Wieder and Terhune, 2019; time gap between the collection of that study vs the present one: ~3 years; $n = 12$ drawn from this subsample), trauma and environmental symptoms (Stein et al., in press; time gap: ~9 months; $n = 35$ from this subsample), a re-test of the BSS and DES-II along with trauma (manuscript in preparation, time gap: ~1 year; $n = 47$ from this subsample), and the Multidimensional Iowa Suggestibility Scale, a non-behavioural suggestibility measure (manuscript in preparation; time gap: ~1 month; $n = 16$ from this subsample). On average, the measure of the BSS and DES scores preceded the other measures by approximately one year.

All measures collected specifically for the current study were collected through the Qualtrics XM platform (http://qualtrics.com; Qualtrics International Inc., Seattle and Povo, USA) in the following order: behavioural inhibition/activation scale (BIS/BAS; Carver and White, 1994), impulsivity scale (S-UPPS-P; Cyders et al., 2014), compulsive behaviour scale (BATCAP; Albertella et al., 2019) and absorption scale (MODTAS; Jamieson, 2005). Five catch questions were embedded within these measures to ensure that participants were reading and answering the questions properly. If two of the catch questions were responded to incorrectly, the experiment ended and these participants' data were not considered further. We grouped the measures into two domains: the suggestibility/dissociation domain, comprising the BSS-C, DES and MODTAS, and the impulsivity/compulsivity domain, which included the S-UPPS-P, the BATCAP and the BIS/BAS. The participants' scores for each scale and subscale are publicly available on OSF *https://osf.io/uzxqg/*.

2.2.1. Suggestibility/dissociation domain

2.2.1.1. Suggestibility (BSS). The Brief Suggestibility Scale (Wieder and Terhune, 2019) consists of a 14 min audio clip in which a female voice actor presents six direct verbal suggestions for minor alterations in motor control and perception. The suggested experiences include arm heaviness, dreaming, hands being pulled to each other, inability to open eyes, arm rigidity, and the hearing of music. Each suggestion is followed by a brief phase during which participants can monitor their behaviour and experience. Subsequently, they are asked to rate how strongly they experienced the suggestions using a visual analogue scale ranging from 0 to 1 (with explicit behavioural/experiential anchors). They are then asked to rate how involuntary the responses felt (to correct suggestibility scores for compliance) using a Likert-type scale ranging from 0 to 5 (Bowers, 1981; Wieder and Terhune, 2019). As in Wieder and Terhune (2019), mean scores for the behavioural and involuntariness subscales were z-transformed before being averaged to form composite scores (BSS-C). This scale has good reliability and its validity is supported by correlations with hypnotic suggestibility (Wieder and Terhune, 2019) and placebo hypoalgesia responsiveness (Parsons et al., 2021).

2.2.1.2. Dissociation (DES). The Dissociative Experiences Scale (DES-II, Carlson and Putnam, 1993) consists of 28 items asking about the frequency of various dissociative experiences, between 0 and 100 % by steps of 10 %. Example items are: 'Some people have the experience of driving or riding in a car or bus or subway and suddenly realizing that they don't remember what has happened during all or part of the trip'; 'Some people sometimes feel as if they are looking at the world through a fog so that people and objects appear far away or unclear.' The total score is defined as the mean across items, yielding a value between 0 and 100.

2.2.1.3. Absorption (MODTAS). The Modified Tellegen Absorption Scale (MODTAS; Jamieson, 2005) is a modified version of the Tellegen Absorption Scale (Tellegen and Atkinson, 1974) and consists of 34 items asking about the frequency of vivid externally driven or imaginative experiences (0 = never, at least once, occasionally, often, 4 = very often). Example items are 'I can change noise into music by the way I listen to it'; 'It is possible for me to be completely immersed in nature or art and to feel as if my whole state of consciousness has somehow been temporarily altered.' The total score is the sum of all items, ranging from 0 to 136.

2.2.2. Impulsivity/compulsivity domain

2.2.2.1. Behavioural activation system (BAS). The Behavioural activation system is a component of the Behavioural inhibition, behavioural activation systems scale (BIS/BAS; Carver and White, 1994) which measures the sensitivity of aversive and appetitive motivation, respectively. Individuals with high BIS sensitivity exhibit increased inhibition of behaviour that may lead to negative outcomes (pain, non-reward or any kind of punishment), whereas those with high BAS sensitivity are prone to engage in action that may lead to positive outcomes. High BAS sensitivity is closely related to the notion of impulsivity (see e.g. Leone and Russo, 2009) whereas the BIS which is more related to stress, anxiety and negative affect (Campbell-Sills et al., 2004; Leone and Russo, 2009; Markarian et al., 2013). For this reason, we only included the BAS within the impulsivity/compulsivity domain. The BIS/BAS scale is composed of 24 items (including 4 fillers) consisting of statements such as 'When I see an opportunity for something I like, I get excited right away' (BAS), 'I feel pretty worried or upset when I think or know somebody is angry at me' (BIS), that are rated using a 4-point Likert scale (1 = very true for me, 2 = somewhat true for me, 3 = somewhat false for me, 4 = very false to me). The total scores for each factor are the sum of the non-filler items, taking into account reversed-scored items. Whereas BIS is a unitary factor, empirical analysis has suggested that BAS can be further divided into three sub-factors: drive (goal-directed behaviour to seek a reward), fun seeking, and reward responsiveness (how reward affects the individual). However, we commonly aggregate BAS scores in core analyses presented below, based on the observation that a.) individual subscales are positively correlated, and b.) BAS subscales are each derived from only a few scale items and are less stable than the aggregate. Additional analyses of BAS subscales, as well as analysis of BIS results, are presented in the Supplementary Materials.

2.2.2.2. Impulsivity (S-UPPS-P). The short version of the UPPS-P Impulsive Behaviour Scale (negative *U*rgency, lack of *P*remeditation, lack of *P*erseverance, *S*ensation seeking, *P*ositive urgency; Cyders et al., 2014) consists of 20 items that are rated on a 4-point Likert scale (1 = Agree Strongly; 2 = Agree Some; 3 = Disagree Some; 4 = Disagree Strongly). Each component of the scale corresponds to a different factor. Positive and negative urgency relate to impulsive behaviour following positive and negative feelings, respectively ('I tend to lose control when I am in great mood'; 'When I feel rejected, I will often say things that I later regret'), whereas sensation seeking relates to risk-taking ('I would like to learn to fly an airplane'). The total score is the sum of the rating of the 20 items (with reverse scoring for some items) yielding a range between 20 and 80.

2.2.2.3. Compulsive behaviour (BATCAP). The Brief Assessment Tool for Compulsivity Associated Problems (BATCAP; Albertella et al., 2019) quantifies obsessive-compulsive (ordering/symmetry, washing, checking) and addiction (alcohol use, Internet use, binge eating, gambling) behaviours. Each behaviour is filtered depending on its frequency. For each behaviour, if a participant reports having engaged in it in the past month, 6 items scored on a 5-point Likert scale (0–4) were presented, asking on the severity and impact of the behaviour on everyday life. The score for obsessive-compulsive behaviour and addiction was defined in earlier work as the maximum mean score within their respective behaviours (Albertella et al., 2019).

2.3. Predictions

In light of past research showing positive links between suggestibility, absorption and dissociation (Bell et al., 2011; Dell, 2019; Frischholz et al., 1992; Tellegen and Atkinson, 1974; Wieder et al., 2021; Wieder and Terhune, 2019), we expected that these three measures would positively correlate with one another. Similarly, we predicted that the BAS, impulsivity and compulsivity measures within the impulsivity/compulsivity domain would positively correlate (Carver and White, 1994; Zermatten and Van der Linden, 2008). In addition, and more critically, we predicted that measures comprising the suggestibility/dissociation domain would correlate positively with those in the impulsivity/compulsivity domain. This was motivated by the positive links between OC behaviours and dissociation/absorption (Aardema and Wu, 2011; Belli, 2014; Belli et al., 2012; Lochner et al., 2004, 2007; Tatlı et al., 2018; Watson et al., 2004), and empirical evidence implying a link between suggestibility and impulsivity/compulsivity (Ludwig et al., 2013; Olson et al., 2020; Ray et al., 2020). Finally, following the theoretical considerations developed in the introduction and predictions from the literature (Ludwig et al., 2013), we expected that absorption and/or dissociation would mediate the association between suggestibility and the traits in the impulsivity/compulsivity domain.

2.4. Data analysis

Data pre-processing was performed using MATLAB R2017 (The Mathworks, Natick, USA). Due in part to inflated sampling in high BSS-C scorers and the strongly skewed BATCAP distribution, assumptions of heteroscedasticity and normality of the residuals for linear regressions were violated. Analyses were therefore based on non-parametric analyses and ranked-transformed data, with ties assigned to their mean rank (Iman and Conover, 1979).

We first investigated pairwise correlations between the total scores using Spearman correlations. In addition, in order to assess the independent contributions of suggestibility, dissociation and absorption, we performed partial Spearman correlations between each of these three measures of the suggestibility/dissociation domain on the one hand and each measure of the impulsivity/compulsivity domain, partialling out the influence of the other two measures from the suggestibility/dissociation domain in each calculation. Our expectation was that all scales would correlate positively with one another, and we therefore employed one-tailed tests with Bonferroni correction to reduce family-wise error.

To assess the potential mediating role of dissociation and absorption in linking suggestibility with the impulsivity/compulsivity domain, we performed a series of exploratory regression-based mediation analyses of the rank-transformed data. We used the PROCESS macro (www.processmacro.org; Hayes, 2018) in SPSS (IBM, Armonk, USA), model 4 (multiple parallel mediators model) (see Fig. 2). We report unstandardised regression coefficients for direct paths (noted c), and the product of regression coefficients for indirect paths (noted ab and a'b'). For statistical inference, we report 95 % confidence intervals calculated from percentiles using 5000 bootstrap iterations. Complementary exploratory analyses on the dissociative disorders taxon (Waller and Ross, 1997) and DES subscales, in particular dissociative absorption (Soffer-Dudek et al., 2015), are reported in the Supplementary Materials.

3. Results

Table 1 shows Cronbach's alpha for each scale and subscale. All scales had acceptable internal consistency, albeit with borderline values (0.60–0.70) for the fun seeking and reward responsiveness subscale of the BAS, and for the sensation seeking subscale of the S-UPPS-P. Table 2 shows the mean score for the two BSS subscales and the composite BSS-C score, for each suggestibility group and for the full sample. By construction, mean BSS-C scores increase from the low to the high group. In addition, the full sample's mean score is positive, as half of the sample belongs to the high suggestibility group. Table 3 displays the descriptive statistics for each scale for the whole sample. Table 4 shows pairwise Spearman correlations, and Fig. 1A presents a visual representation of the correlations. Following correlation magnitude guidelines for individual differences research (Gignac and Szodorai, 2016), the results indicate (i) moderate-to-large magnitude correlations between the three scales in the suggestibility/dissociation domain (BSS-C, DES, MODTAS), particularly between the latter two; (ii) moderate-to-large magnitude correlation between BATCAP and the S-UPPS-P of the impulsivity/compulsivity domain; (iii) multiple moderate-to-large magnitude associations between the two domains (BATCAP vs MODTAS; BAS vs MODTAS; S-UPPS-P vs DES) as well as smaller trend-level correlations that did not survive our multiple comparisons correction (BATCAP vs BSS-C; BAS vs BSS-C; S-UPPS-P vs MODTAS). All correlations were positively signed as expected, though not all achieved statistical significance. Broadly speaking, these results corroborate our predictions that measures within the suggestibility/dissociation and impulsivity/compulsivity domains would be moderately-to-strongly related.

To better understand the relations between these two domains, we decomposed the significant correlations identified above by using the subscales of the impulsivity/compulsivity measures. We found that BSS-C specifically correlated with BAS reward responsiveness ($rho = 0.24$, $p = .005$), and MODTAS correlated with both BAS drive ($rho = 0.27$, $p = .002$) and BAS reward responsiveness ($rho = 0.25$, $p = .003$). By contrast, BIS correlations with MODTAS and BSS-C were non-significant ($rho = 0.03$, $p_{2\text{-tailed}} = 0.77$; $rho = 0.08$, $p_{2\text{-tailed}} = 0.43$ respectively; see Table S1). This suggests that greater behavioural activation is linked to the suggestibility/dissociation domain. Dissociation correlated with both addiction ($rho = 0.26$, $p = .003$) and OC behaviours ($rho = 0.26$, $p = .003$) whereas MODTAS only correlated with OC behaviours ($rho = 0.34$, $p < .001$). Finally, the link between dissociation and impulsivity was moderately and specifically driven by correlations with urgency, both positive ($rho = 0.41$, $p < .001$) and negative ($rho = 0.33$, $p = .002$) (see Supplementary Materials for all subscale correlations). Collectively, these results indicate that the two domains are specifically linked by a few factors within each scale.

To evaluate the independent contributions of suggestibility, absorption and dissociation and each measure of the impulsivity/compulsivity domain, we next performed 9 partial Spearman correlations. As can be seen in Fig. 1B and Table 5, these analyses demonstrate that the previously observed associations appear to be primarily driven by moderate-to-large magnitude associations between absorption and BAS, and DES and BATCAP/S-UPPS-P. Notably, the association between the BSS-C and impulsivity/compulsivity indices was reduced to small non-significant correlations. This suggests that the link between suggestibility and the impulsivity/compulsivity domain is mostly driven by absorption and dissociation.

Our final set of analyses intended to test the hypothesised mediating role of dissociation and absorption in the link between suggestibility and the measures of the impulsivity/compulsivity domain (BAS, BATCAP and S-UPPS-P). To this end, we evaluated parallel mediation models with the two mediator variables MODTAS (path ab) and DES (path a'b'), and BSS-C as either the outcome or the predictor variable (Fig. 2A and

Table 1
Cronbach's alphas for all psychometric measures ($N = 110$).

S-UPPS-P	**Neg Urg**	**Lack Persev**	**Lack Premed**	**Sens Seek**	**Pos Urg**
0.79	0.89	0.73	0.73	0.63	0.86
BIS	**BAS**	**BAS Drive**	**BAS FunSeek**	**BAS RewResp**	
0.83	**0.80**	0.81	0.69	0.66	
BATCAP	**Washing**	**Internet**	**Eating**	**Alcohol**	**Gambling**
	0.93	0.93	0.95	0.85	0.96
	Checking	**Ordering**			
	0.92	0.93			
BSS-C	**Behav**	**Involuntariness**			
0.82	0.77	0.80			
DES-II	**Absorption**	**Depers/Dereal**	**Amnesia**		
0.89	0.85	0.73	0.76		
MODTAS					
0.96					

Notes. The BATCAP does not have a value because of the way it is calculated (see Section 2.2). S-UPPS-P: Short version of the 'negative Urgency, lack of Premeditation, lack of Perseverance, Sensation seeking, Positive urgency' Impulsive Behaviour Scale; BIS/BAS: Behavioural Inhibition/Activation Systems; BATCAP: Brief Assessment Tool for Compulsivity Associated Problems; BSS-C: Brief Suggestibility Scale Composite score.
DES: Dissociative Experiences Scale; MODTAS: Modified Tellegen Absorption Scale.

Table 2
Mean suggestibility scores within and across suggestibility groups.

	BSS Behavioural	BSS Involuntary	BSS-C
Low ($n = 29$)	0.14	1.05	−0.93
Medium ($n = 28$)	0.41	2.53	0.38
High ($n = 53$)	0.64	3.54	1.39
All ($N = 110$)	0.45	2.63	0.52

Note. BSS-C:Brief Suggestibility Scale Composite score.

Table 3
Descriptive statistics for all psychometric measures ($N = 110$).

	M	*SD*
BSS-C	0.52	1.04
DES-II	16.63	12.45
MODTAS	51.25	27.24
S-UPPS-P	38.07	6.87
BATCAP	0.85	0.67
BAS	37.58	4.97

Notes. BSS-C: Brief Suggestibility Scale Composite score; DES: Dissociative Experiences Scale; MODTAS: Modified Tellegen Absorption Scale; S-UPPS-P: Short version of the 'negative Urgency, lack of Premeditation, lack of Perseverance, Sensation seeking, Positive urgency' Impulsive Behaviour Scale; BATCAP: Brief Assessment Tool for Compulsivity Associated Problems; BAS: Behavioural Activation System.

Table 4
Pairwise Spearman correlations and *p*-values between research variables ($N = 110$).

	MODTAS	DES	BATCAP	BAS	S-UPPS-P
BSS-C	0.30 (<0.001*)	0.26 (0.003*)	0.21 (0.014†)	0.17 (0.035†)	0.049 (0.31)
MODTAS		0.50 (<0.001*)	0.29 (<0.001*)	0.32 (<0.001*)	0.16 (0.050†)
DES			0.41 (<0.001*)	0.013 (0.45)	0.35 (<0.001*)
BATCAP				0.13 (0.086)	0.39 (<0.001*)
BAS					0.077 (0.21)

Notes. All *p*-values are one-tailed. S-UPPS-P: Short version of the 'negative Urgency, lack of Premeditation, lack of Perseverance, Sensation seeking, Positive urgency' Impulsive Behaviour Scale; MODTAS: Modified Tellegen Absorption Scale; BAS: Behavioural Activation Systems; BATCAP: Brief Assessment Tool for Compulsivity Associated Problems; BSS-C: Brief Suggestibility Scale Composite score; DES: Dissociative Experiences Scale.
† $p < .050$.
* $p < .0033$ (Bonferroni-corrected alpha).

B). The mediation models with BAS as the outcome variable (Fig. 2C, Table S7) indicated that BSS-C exerts an indirect effect through absorption (ab = 0.12; CI: [0.03, 0.22]), but not through dissociation (a'b' = −0.06; CI: [−0.06, 0.002]). When controlling for BATCAP, S-UPPSP and BIS, the indirect effect through absorption remained. In addition, when repeating the analysis on the subscales of the BAS, we found that absorption mediated the link with BSS-C for each BAS subscale. Moreover, these indirect effects on BAS subscales through absorption were robust when adding BATCAP, S-UPPS-P and BIS as covariates. In addition, the BSS-C exerted a negative indirect effect on reward responsiveness through dissociation, due to a negative effect of Dissociation on Reward Responsiveness (b' = −0.27, CI: [−0.47, −0.06]). Using BIS as outcome variable, we did not find any direct or indirect effect of BSS-C (see Table S7). Notably, the converse models (Fig. 2B) did not show reliable effects of BIS or the BAS on BSS-C (Table S8). Overall, these results suggest a consistent and reliable effect of BSS-C on behavioural activation that is mediated by absorption.

The mediation model with BATCAP as the outcome variable (Fig. 2D, Table S9) indicated that BSS-C exerts an indirect effect through dissociation (a'b' = 0.08; CI: [0.02, 0.19]), with no evidence of a significant direct effect (c = 0.09; CI: [−0.09, 0.28]) or of a significant indirect effect through absorption (ab = 0.03; CI: [−0.04, 0.11]). Controlling for BIS, BAS and S-UPPSP yielded the same pattern of results. When breaking down the BATCAP into its OC symptoms and addiction subscales, the results appeared less consistent. We found that the BSS-C exerted an effect on OC symptoms through absorption (ab = 0.08; CI: [0.01, 0.17]) rather than dissociation (a'b' = 0.0265; CI: [−0.0221, 0.0960]). This pattern was robust when controlling for BIS, BAS and S-UPPS-P. BSS-C also exerted an effect on addiction, but through dissociation (a'b' = 0.06; CI: [0.001, 0.14]) and this effect disappeared when controlling for BIS, BAS and S-UPPS-P, which suggests that this subscale effect is likely driven by the strong correlation between addiction and S-UPPS-P (*rho* = 0.32, $p < .001$). No significant effects were found when reversing the order of the paths (model Fig. 2B, Table S10).

Although a significant correlation was not observed between BSS-C and S-UPPSP (see Table 2), the link with dissociation raises the question of whether BSS-C could exert influence on S-UPPS-P indirectly through the DES. Indeed, the mediation model (Fig. 2E) yielded evidence for an indirect effect of suggestibility through dissociation (a'b' = 0.10; CI: [0.02, 0.20]), with no evidence of an indirect effect through

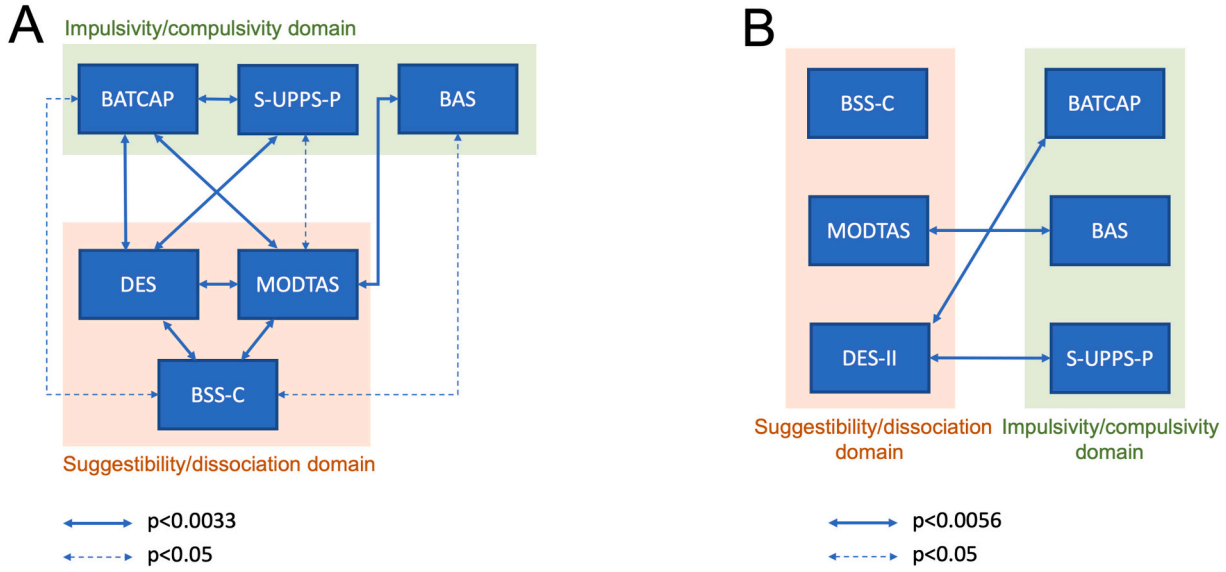

Fig. 1. Visual representation of correlation results between research measures (N = 110). A: Pairwise Spearman correlations. B: Partial Spearman correlations between measures in the two domains, correcting for the two other scales of the suggestibility/dissociation domain. Full arrows denote correlations meeting multiple comparisons (Bonferroni) correction whereas dashed arrows denote correlations meeting a conventional uncorrected threshold.

Table 5
Pairwise partial Spearman correlations (and p-values) between research variables (N = 110). Each suggestibility domain score (BSS-C, MODTAS, DES) was correlated with each impulsivity/compulsivity domain score (BATCAP, BAS, S-UPPS-P), controlling for the other two suggestibility domain scores.

	BATCAP	BAS	S-UPPS-P
BSS	0.10	0.11	−0.04
	(0.16)	(0.12)	(0.68)
MODTAS	0.09	0.34	−0.02
	(0.17)	(<0.001*)	(0.56)
DES	0.30	−0.19	0.32
	(<0.001*)	(0.98)	(<0.001*)

Note. All p-values are one-tailed.
* $p < .005$ (Bonferroni correction).

absorption (ab = −0.01; CI: [−0.07, 0.08]) or of a direct effect (c = −0.04, CI: [−0.23, 0.15]). Moreover, the former indirect effect remained stable when controlling for the BATCAP, BIS and BAS measures. When examining subscales (Table S11), we found that BSS-C still exerted an effect on positive and negative urgency through dissociation, which was robust to BATCAP, BIS and BAS as covariates. Sensation Seeking exerted an indirect effect through absorption, but the effect disappeared when adding the covariates. We did not find any significant effects for models in which BSS-C was the outcome variable (model Fig. 2B), except for an indirect effect of Sensation Seeking through absorption that disappeared when controlling for BIS, BAS and BATCAP (see Table S12).

To summarise these analyses, the data indicate that suggestibility exerts an effect on behavioural activation system sensitivity through absorption, and on impulsivity (positive/negative urgency) and compulsivity through dissociation and absorption. Although the correlational nature of these data preclude strong causal interpretations, these results align with the hypothesis that suggestibility is a precedent for impulsive/compulsive behaviour, acting through absorption and dissociation, rather than the other way around.

4. Discussion

Previous research hints at associations between responsiveness to direct verbal suggestions and impulsivity/compulsivity but the robustness of these associations and the potential mediating roles of absorption and dissociation have been unclear. In order to bring greater clarity to this domain, we measured compulsivity, impulsivity, and behavioural activation (impulsivity/compulsivity domain), and dissociation, absorption and suggestibility (suggestibility/dissociation domain). In support of previous research (Frischholz et al., 1992; Jamieson, 2005; Ludwig et al., 2013; Ray et al., 2020; Tellegen and Atkinson, 1974; Wieder and Terhune, 2019), we observed moderate-to-strong positive relationships within each domain, as well as positive weak-to-moderate relationships between absorption and behavioural activation, and between dissociation and compulsivity and the urgency components of impulsivity. We similarly found positive associations between suggestibility and behavioural activation and between absorption and OC behaviour. Exploratory mediation analyses imply that suggestibility exerts an effect on behavioural activation directly as well as through absorption whereas it exerts an effect on compulsivity and urgency indirectly through dissociation. Collectively, these results indicate that suggestibility confers a propensity for impulsive/compulsive behaviours that is mediated by dissociation and absorption.

Although we did not observe the direct link between impulsivity and suggestibility identified in Ludwig et al. (2013), differences in the measures used may explain this disparity. First, Ludwig et al. (2013) used the Barratt Impulsiveness Scale (Patton et al., 1995) as a measure of impulsivity, whereas we used the S-UPPS-P. Second, we measured non-hypnotic suggestibility and corrected for compliance whilst Ludwig et al. (2013) used a hypnotic suggestibility scale (Shor and Orne, 1962) that is somewhat confounded by compliance (Bowers, 1981; Bowers et al., 1988). However, in conceptual alignment with the results of Ludwig et al. (2013), we found a correlation between suggestibility and behavioural activation, particularly reward responsiveness, which is a construct related to impulsivity (see e.g., Quilty and Oakman, 2004). The partial correlation and mediation analyses suggest that absorption mediates this association.

Absorption measures the tendency of individuals to immerse themselves in sensory or imaginative experiences, such as when watching a movie, listening to music or daydreaming, and it has previously been linked with reward responsiveness (Groves et al., 2015; Loxton et al., 2016 for absorption in music; but see Madeo et al., 2015; Santarcangelo et al., 2013, 2016; Varanini et al., 2018). However, this measure has been criticized on the grounds of its variable content and

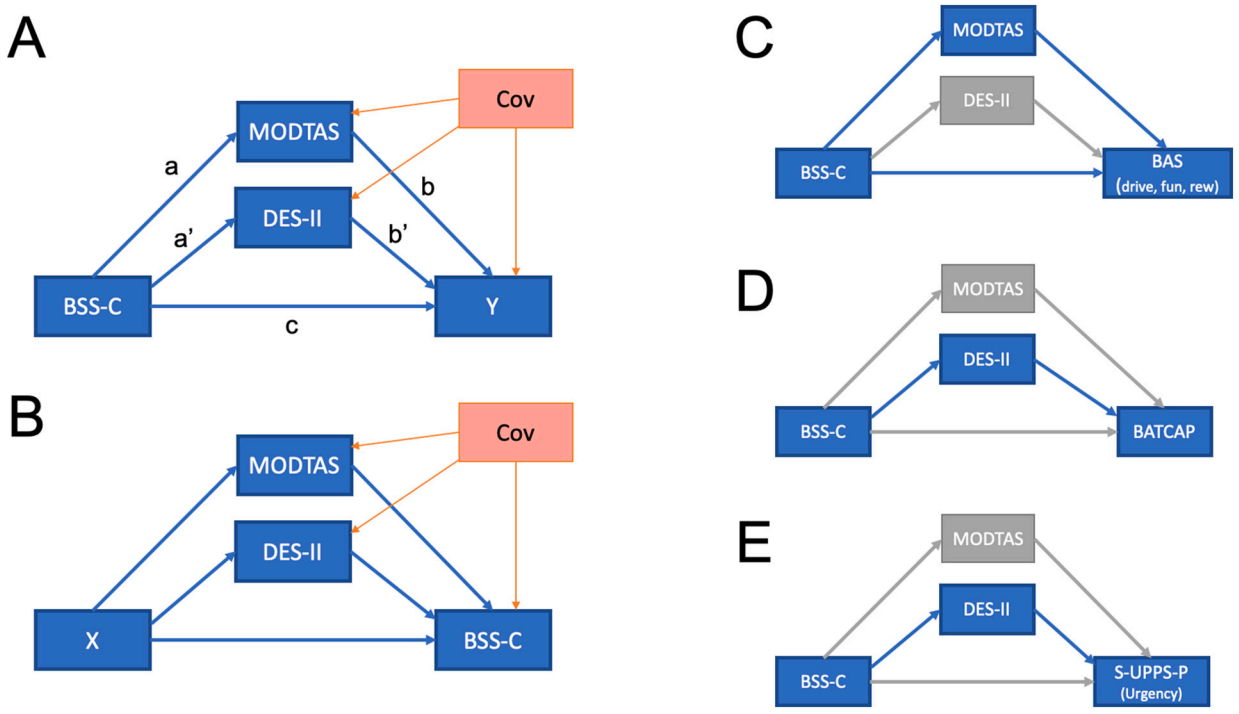

Fig. 2. Mediation analyses between research variables ($N = 110$). A, B: Conceptual mediation models, to which the notation used for the non-standardized regression coefficients were added. In all models, DES and MODTAS are mediating variables. Models were run with and without covariates. A: BSS-C is a predictor, Y is one of the impulsivity/compulsivity scales or subscales, Cov are the other impulsivity/compulsivity scales. B: BSS-C is the outcome variable, X is one of the impulsivity/compulsivity scales or subscales, Cov are the other impulsivity/compulsivity scales. C, D, E: Results of the mediation analyses. Significant paths are shown in blue, non-significant paths in gray. When present, the subscale that appears to drive the effect is presented in parentheses. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

unsubstantiated construct validity (Terhune and Jamieson, 2021). Despite these concerns, one interpretation of the mediating role of absorption in the relationship of suggestibility and reward responsiveness is that individuals high in absorption tend to take pleasure in imaginative and sensory experiences that would be considered mundane by others. The rewarding nature of these experiences encourages these individuals to seek out these experiences and makes them well-practiced, eventually causing them to be easily triggered. Individuals who easily let themselves enter imaginative states because they find them rewarding (i.e., are high absorption individuals who respond to reward) may be those who also engage with an invitation to have sensory experiences (i.e., are highly suggestible).

We also found that dissociation was a mediator between suggestibility and impulsivity (most specifically negative and positive urgency) and compulsivity. This is consistent with research demonstrating that dissociative states are related to suggestibility and compulsivity (Somer et al., 2012; Tatlı et al., 2018), as well as the link between dissociation, compulsivity and urgency (Fischer et al., 2003, 2004; Fuller-Tyszkiewicz and Mussap, 2008). We indeed found that positive and negative urgency were strongly correlated with compulsivity. Relatedly, individuals from our sample at a greater risk for dissociative psychopathology also displayed higher suggestibility and absorption, and possibly higher reward responsiveness and negative urgency (exploratory analyses, Suppl. Materials Table S13). This aligns with previous research showing that the prevalence of dissociative psychopathology was ~17 % in highly suggestible individuals (Terhune et al., 2011), which is more than double the prevalence in the general population (~7 %; Kate et al., 2020). These results are similarly congruent with a wealth of data pointing to elevated direct verbal suggestibility in psychiatric conditions characterized by dissociative symptomatology (Bell et al., 2011; Dell, 2019; Wieder et al., 2021, 2022).

Our sample consisted of an adult population oversampled for high and low suggestibility participants. We expect the results to be valid for the general population, but to only replicate with similar statistical power for similarly structured samples. It is to be noted that suggestibility and dissociation were measured weeks or even years before the other measures (absorption, behavioural activation/inhibition, impulsivity and compulsivity). The time gap between measures can be seen both as a strength and a limitation of the design. On the one hand, measuring suggestibility and dissociation in a different session from the other measures excludes context effects (Council, 1993) as an explanation for our pattern of results and indicates that the link between suggestibility and impulsivity/compulsivity is likely to be robust. The reliable correlations between suggestibility and dissociation on the one hand and absorption on the other hand, consistent with past research (Fassler et al., 2006; Jamieson, 2005; Tellegen and Atkinson, 1974), provide indication that the DES and BSS-C scores were still meaningful when participants complete the new measures. However, despite good test-retest reliability of dissociation as measured by the DES (Vanijzendoorn and Schuengel, 1996) and fair stability in suggestibility over years (see e.g., Kekecs et al., 2021; Meyer and Lynn, 2011; Piccione et al., 1989; Spanos et al., 1984), variation of traits in time may have limited our ability to detect more subtle links between the measures. Overall, our results conceptually replicate a previous study on hypnotic suggestibility and impulsivity (Ludwig et al., 2013) and are coherent with the overall literature on hypnotic suggestibility, particularly given reliable associations between hypnotic and non-hypnotic measures of direct verbal suggestibility (Braffman and Kirsch, 1999; Hilgard and Tart, 1966; Wieder and Terhune, 2019). Cumulatively, this suggests that our results are generalisable to hypnotic suggestibility.

The mediating role that dissociation plays between suggestibility and OCD may have implications for strategies to be used in therapeutic contexts. Dissociation in OCD patients has been associated with poor OC symptoms treatment outcome through psychotherapy, possibly because in these cases compulsions occur with particularly little or narrowed attention (Soffer-Dudek, 2014). For these patients, specific techniques

designed to address dissociation, including mindfulness and other focused attention and grounding exercises, have been suggested (see Soffer-Dudek, 2014). Although correlational in nature, mediation analyses permit making prudent causal inferences, and our results support the idea that addressing dissociation may help reducing OC behaviours although it will be imperative to examine whether these effects generalize to patient samples. For those OC patients with high dissociation that also display high suggestibility, hypnotic methods may be particularly suited, in particular when symptoms are associated with traumatic experiences (Belli, 2014). Through longitudinal studies, further research should systematically investigate the hypothesis of a causal relationship between suggestibility, dissociation and OC symptoms. In addition, the effectiveness of mindfulness and hypnotic-based therapeutic methods for OC symptoms in relation to suggestibility and dissociative traits should be studied in clinical trials.

Our results confirm a link between suggestibility and the impulsivity/compulsivity domain (Ludwig et al., 2013; Olson et al., 2020; Ray et al., 2020) and further show that these links are mediated by dissociation and absorption. These results embed trait suggestibility help to refine existing accounts of high suggestibility individuals. In particular, our results suggest that reward responsiveness, negative and positive urgency, and compulsive behaviours may characterize these individuals. Insofar as impulsivity/compulsivity are characterized by the enactment of behaviours that are detrimental to goal pursuit (Robbins et al., 2012), these results are also at odds with the view that direct verbal suggestibility reflects a trait related to goal-directed behaviour (Dienes et al., 2022). The results present clear opportunities for further research regarding how suggestibility relates to impulsivity and compulsivity, particularly in the context of dissociative psychopathology (Soffer-Dudek, 2014). Longitudinal studies will be particularly important in characterizing how suggestibility contributes to impulsive and compulsive behaviours.

Open practices

Pre-registered methods and individual participants' scores on each scale and subscale is publicly available on OSF *https://osf.io/uzxqg/*.

CRediT authorship contribution statement

David Acunzo: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Supervision. **Devin B. Terhune:** Conceptualization, Data curation, Methodology, Writing – review & editing. **Ankita Sharma:** Software, Writing – review & editing. **Clayton Hickey:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

data attached in submission

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2022.103793.

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