



How to pin a compulsive behavior down: A systematic review and conceptual synthesis of compulsivity-sensitive items in measures of behavioral addiction

Ismael Muela^{a,*}, Juan F. Navas^b, José M. Ventura-Lucena^a, José C. Perales^a

^a Department of Experimental Psychology, Mind, Brain and Behavior Research Center (CIMCYC), Universidad de Granada, Spain

^b Department of Personality, Assessment, and Clinical Psychology, Universidad Complutense de Madrid, Spain

ARTICLE INFO

Keywords:

Compulsivity
Habit
Craving
Behavioral addiction
Self-report
Operational definition

ABSTRACT

Experimental models identify the transition from choice to compulsivity as the main mechanism underlying addiction. In behavioral addictions research, however, the adjective *compulsive* is used to describe virtually any kind of excessive or dysregulated behavior, which hinders the connection between experimental and clinical models.

In this systematic review, we adopted a preliminary definition of compulsive behavior based on previous theoretical work. Subsequently, a systematic review following PRISMA guidelines was conducted (a) to identify the validated instruments, currently used in behavioral addictions research, that include items that are sensitive (intendedly or not) to compulsivity, and (b) to categorize those items into differentiable operationalizations of compulsivity.

Six operationalizations of compulsivity emerged from item content analysis: 1. *Automatic or habitual behavior occurring in absence of conscious instrumental goals*; 2. *Behavior insensitive to negative consequences despite conscious awareness of them*; 3. *Overwhelming urge or desire that impels the individual to initiate the activity and jeopardizes control attempts*; 4. *Bingeing, or inability to stop or interrupt the activity once initiated, resulting in an episode substantially longer or more intense than intended*; 5. *Attentional capture and cognitive hijacking*; and 6. *Inflexible rules, stereotyped behaviors, and rituals related to task completion or execution*.

Subsequently, a list of 15 representative items per operationalization was elaborated for independent assessment and identification of delimitation problems. A high degree of agreement was reached in assessing them as instantiating compulsivity, as well as in their assignment to the corresponding categories. However, many of them were also considered overinclusive, i.e., incapable of distinguishing compulsivity from value-based momentary choice.

To increase their discriminative value, items in future compulsivity scales should be refined to explicitly mention disconnection between behavior and declarative goals. Further research on factorial structure of a pool of items derived from these operational definitions is warranted. Such a factorial structure could be used as an intermediate link between specific behavioral items and explanatory psychobiological, learning, and cognitive mechanisms.

1. Introduction

The idea that the transition of goal-driven behaviors towards compulsivity is what turns them into *genuinely* addictive behaviors is present in prominent models of substance addiction. However, the exact meaning of compulsivity and its etiology in the field of behavioral

addictions remain ill-defined (see Perales et al., 2020, for a recent review). Here, we intend to advance in the operationalization of compulsivity in non-substance addictions, to pave the way to develop instruments to measure it, and, eventually, to set conceptual and behavioral boundaries that allow to explore its underlying neuro-cognitive mechanisms.

* Corresponding author at: Department of Experimental Psychology, Mind, Brain and Behavior Research Center (CIMCYC), Universidad de Granada, 18071, Campus de Cartuja s/n, Granada, Spain.

E-mail address: imuela@ugr.es (I. Muela).

<https://doi.org/10.1016/j.addbeh.2022.107410>

Received 28 January 2022; Received in revised form 8 June 2022; Accepted 11 June 2022

Available online 13 June 2022

0306-4603/© 2022 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Compulsive behaviors are repetitive acts characterized by one feeling 'forced' to perform them, despite awareness that these acts are not in line with one's goal (Luigjes et al., 2019). As vividly expressed by William James, referring to alcoholism, "if a bottle of brandy stood at one hand, and the pit of hell yawned at the other, and I were convinced that I would be pushed in as sure as I took one glass, I could not refrain." (James, 1890, p. 537).

This definition is similar to the one proposed by a recent Delphi review of transdiagnostic processes in addiction, namely "repetitive, or automatic behavior, associated with negative outcome expectancy that contributes to the experience of being forced or compelled to act despite negative consequences" (Yücel et al., 2019; pp. 1102–1103). In the same vein, in animal models of substance addiction, drug seeking and self-administration are considered as compulsive when they persist in face of severe punishment (see Lüscher, Robbins, & Everitt, 2020).

According to an influential hypothesis, compulsivity in addictions arises from the formation of habits and a progressive impairment of top-down control over them (Everitt & Robbins, 2022). In Yücel et al.'s (2019) review, however, habits and compulsivity are described as separate constructs, and the former is defined as "sequential, repetitive, motor or cognitive behavior elicited by triggers that, once initiated, can go to completion without constant conscious oversight". This distinction implicitly acknowledges that habit and compulsivity do not exactly overlap. Actually, the account of addictive behaviors as uncontrolled habits has been recently contested, based on evidence that drug demand is sensitive to costs (Hogarth et al., 2019; Hogarth, 2020), addictive drug-seeking can develop in the absence of habit learning (Singer et al., 2018), and drug use in people suffering from addiction remains sensitive to contingency management (Dutra et al., 2008).¹

Nonetheless, that evidence does not necessarily imply that compulsivity is useless to define addiction. For instance, according to Hogarth (2020), addictive behavior can be regarded as excessive goal-directed choice under extremely negative affect. According to this account, when the negative affect passes, it might look like the individual was not sensitive to the negative consequences. Still, even if this approach is correct, the question of why addiction-related outcomes become so dramatically overvalued remains. Possible answers rely on the motivational and emotional states that precede addictive behaviors. Among these, craving is frequently mentioned as the core one, so that craving relief would be the main motivation behind addictive behaviors. In that sense, addictive behaviors would be instrumental and maintained by negative reinforcement, but craving itself is triggered by conditioned cues, and is characterized, not only by overwhelming desire, but also by attentional capture and an automatic tendency to approach such cues (Franken, 2003).

Thus, although reinforcement accounts of compulsivity do not require the formation of habits, they do require hypothesizing some learning mechanism(s) by means of which environmental cues acquire the capacity to elicit the core state that motivates the addictive behavior (e.g., incentive sensitization, Berridge & Robinson, 2016).

Before considering how compulsivity can be operationalized, it is important to distinguish compulsivity as understood here (i.e., as an acquired feature of specific behaviors) from compulsivity as a transdiagnostic trait. The latter can be broadly defined as "a tendency towards repetitive, habitual actions, which an individual feels compelled to perform, and are repeated despite adverse consequences" (Hook et al., 2021, p. 455; italics added), and is measured by psychometric instruments as the Cambridge-Chicago Compulsivity Trait Scale (Chamberlain & Grant, 2018; for a review see Hook et al., 2021), or the Brief Assessment Tool for Compulsivity Associated Problems (BATCAP;

¹ Still, the effectiveness of contingency manipulation for addictive behaviors is generally more modest than for other operant behaviors, and drug reinforcers with abuse potential are particularly resistant to substitution (Epstein, 2020; Ersche et al., 2016; Hursh & Roma, 2016).

Albertella et al., 2019). Trait compulsivity can also be detected by means of neuropsychological and lab-based tasks (Chamberlain & Grant, 2018; van Timmeren et al., 2018; Albertella et al., 2019; Albertella et al., 2020; Albertella et al., 2020), seems to predate the development of specific compulsive behaviors, and could actually play a causal role in vulnerability to addiction. And the other way round, people showing compulsive behaviors in one or more domains will tend to present high trait scores. Still, trait compulsivity scales only indirectly serve our aim of identifying specific behaviors that can be conceptualized as compulsive (see, however, the discussion section for a more detailed consideration of the BATCAP).

2. The present study

If transition towards compulsivity is crucial for understanding the etiology of substance addiction, it must also be so to understand behavioral addictions (Robbins & Clark, 2015; Figuee et al., 2016). Unfortunately, in the field of non-substance addictive processes, 'compulsive' is frequently considered a synonym of excessive, problematic, or maladaptive, when applied to activities as buying (Mestre-Bach et al., 2017; Kyrios et al., 2018), sexual behavior and pornography use (Stark et al., 2018; Antons & Brand, 2021), or exercising (Goodwin et al., 2011; Goodwin et al., 2014), without making any commitments regarding its specific meaning.

Not even the minimum agreement regarding the operationalization of compulsivity we have previously seen in substance addictions exists in non-substance ones. In view of this state of affairs, the main goals of the present study were (a) to identify specific items in current instruments that can be regarded as instances of compulsive behavior, (b) to classify them in conceptually separable operationalizations, and (c) to identify the potential delimitation problems of such operationalizations. More specifically, we first identified the studies in the current literature describing or using self-report instruments that could be considered sensitive to compulsivity. Once extracted from the articles, the available instruments were inspected in a search for specific items that realize the concept of compulsivity.

We adopted a set of criteria to identify compulsivity-sensitive items. These criteria were based on the elements that distill from the brief review outlined above. The first criterion, (a) *perseverative behaviors for which the individual is consciously aware of negative consequences*, directly arises from the definition of compulsivity proposed by Yücel et al. (2019). The second criterion, (b) *items referring to initiation or continuation of behaviors perceived as unintended or disconnected from their consequences*, is based on the concept of habit. We are aware that, according to animal models, habit is behavior that persists despite outcome devaluation (Balleine & Dickinson, 1998; Dolan & Dayan, 2013), whereas our criterion implies assuming that such insensitivity results from a transition of behavior from requiring the pre-representation of outcomes to being goal-detached. Despite this inferential step, we believe this is a reasonable translation of habit into human behavior (De Houwer et al., 2018; Heyes & Dickinson, 1990; Robbins & Costa, 2017). The third criterion relates to the pivotal role of craving in compulsivity: c) *urges, or behaviors motivated by an experience of craving intense enough to compromise control*. Finally, the fourth and fifth criteria arise from the idea that compulsivity can result from the capacity of conditioned cues to automatically trigger specific components of addictive behaviors, namely d) *automatic orientation of attention towards activity-related cues that interferes with other tasks requiring attentional/cognitive resources*; and e) *behaviors automatically triggered by exteroceptive or interoceptive stimuli*.

These criteria are partially overlapping, and intentionally over-inclusive. The contents of the selected items were subsequently examined to classify the identified items into differentiable categories or operationalizations. So, over-inclusiveness was intended to leave room for the definitive operationalizations to emerge from content analysis, and, subsequently, to allow us to zoom in on each of them, in order to identify potential delimitation problems.

This degree of over-inclusivity implies that some of the items identified here as operationalizing compulsivity could also tap onto related constructs. For instance, impulsive behaviors are customarily considered to be rash and inappropriate, but still reward-driven, whereas compulsive ones are normally considered outcome-detached (Fernández-Serrano et al., 2012). However, as noted earlier, transitory states can contribute to the overvaluation of action outcomes that are seen as less valuable when such states vanish. That is, outcomes that are overvalued in a ‘hot’ state, can be regarded as less valuable when the individual is in a ‘cold’ state (intrapersonal hot–cold empathy gap; Ruttan & Nordgren, 2015), leaving the individual with the feeling that behavior is not aligned with one’s goal. This is an important problem we will need to consider in detail once the list of items is available.

In summary, we regard this review and synthesis as an intermediate step for the future development of a scale to measure compulsivity within any given behavioral domain. It could well be that such a scale is multidimensional, and it is also possible that the factorial composition of compulsivity does not mirror our set of operationalizations. Still, once the factorial composition of a set of putative compulsive behaviors is known, the scale could be applied across behavioral domains in order to analyze similarities and differences across candidate behavioral addictions, and the relative contribution of such dimensions to clinically relevant outcomes.

3. Method

A systematic review was conducted following the PRISMA guidelines (Page et al., 2021). The flow diagram depicted in Fig. 1 illustrates the process of study identification and selection. The flowchart for selecting scales from those documents, and items from those scales is depicted in Fig. 2. These diagrams, as well as search algorithms, and files for intermediate results of the whole process, can be downloaded from the OSF link <https://osf.io/waev7/>.

3.1. Eligibility criteria

In this section, selection criteria for articles, self-report instruments extracted from these articles, and items extracted from these instruments are described separately.

The inclusion criteria for articles, as firstly implemented in the automatic search algorithms, were: (IC1) to describe a self-report measure referring to a potential behavioral addiction or some of its components, and (IC2) to mention any of the following compulsivity-related terms: compulsion, compulsive, compulsivity, habit(s), habitual behavior, and craving. The inclusion of craving obeys to the reasons detailed in the introduction, that is, to the fact that craving is commonly associated with feeling forced or compelled to act against one’s utilitarian preferences. Search terms for IC1 and IC2 were restricted to the title and abstract fields.

Exclusion criteria at this stage referred to the characteristics of the contributions, the language of publication, the possibility of accessing the full-text article, and the use or development of self-report measures of interest in the articles found. Retrieved records were excluded if: (EC1) we were unable to retrieve the full-text manuscript; (EC2) the article was not written in English, French or Spanish; (EC3) the article was not a peer-reviewed research report (dissertations, posters, commentaries, books and book chapters, essays, and *corrigenda* or *errata*); (EC4) the scales or questionnaires of potential interest mentioned in the text (i.e., the self-report instruments potentially measuring compulsive behavior) were not sufficiently described in the main text or supplements of the article.

The inclusion criteria for self-report measures mentioned in those articles were: (IC3) to refer to a potential behavioral addiction, and (IC4) to contain at least one item that can be interpreted to be sensitive to compulsivity with the criteria defined earlier.

Exclusion criteria for self-report measures were: (EC5) to refer to substance addictions, but not to a putative behavioral addiction (EC6), not to be written in English, French or Spanish, and (EC7) to be an adaptation of a scale already recorded with no new items. Obviously,

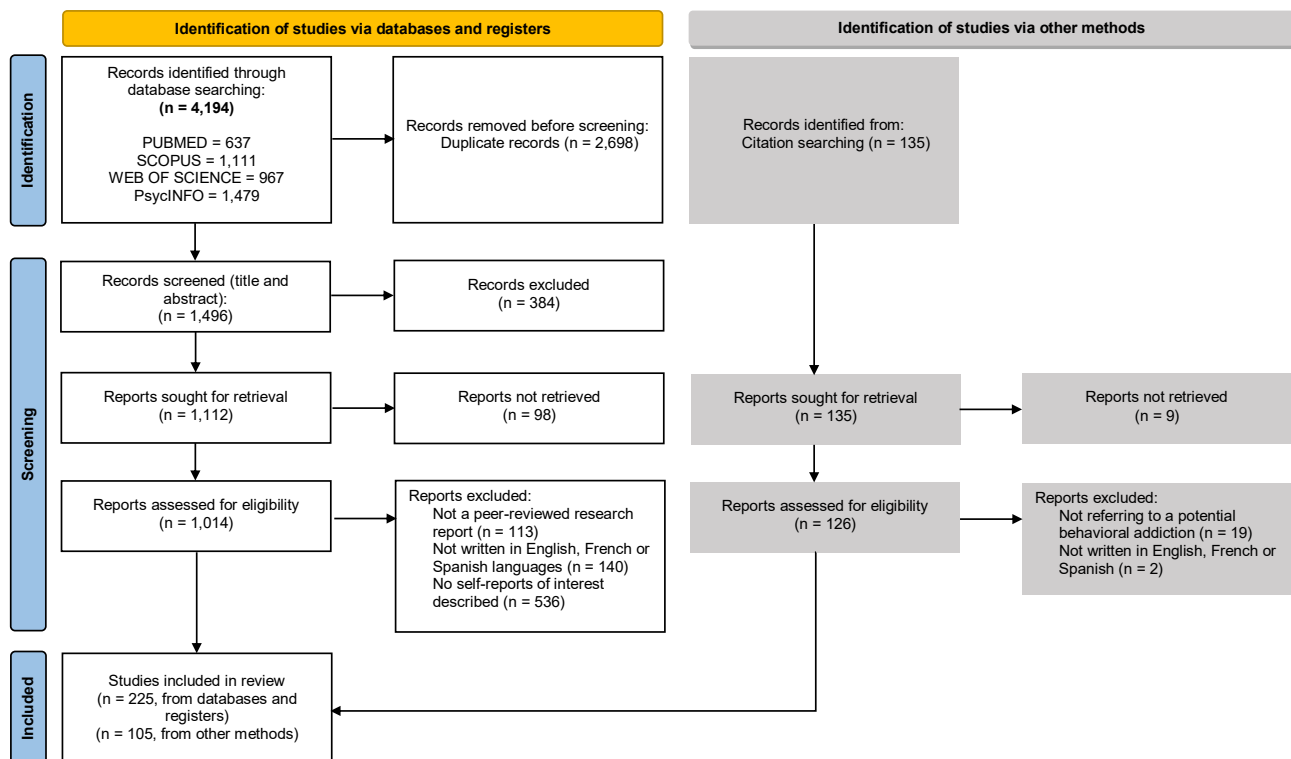
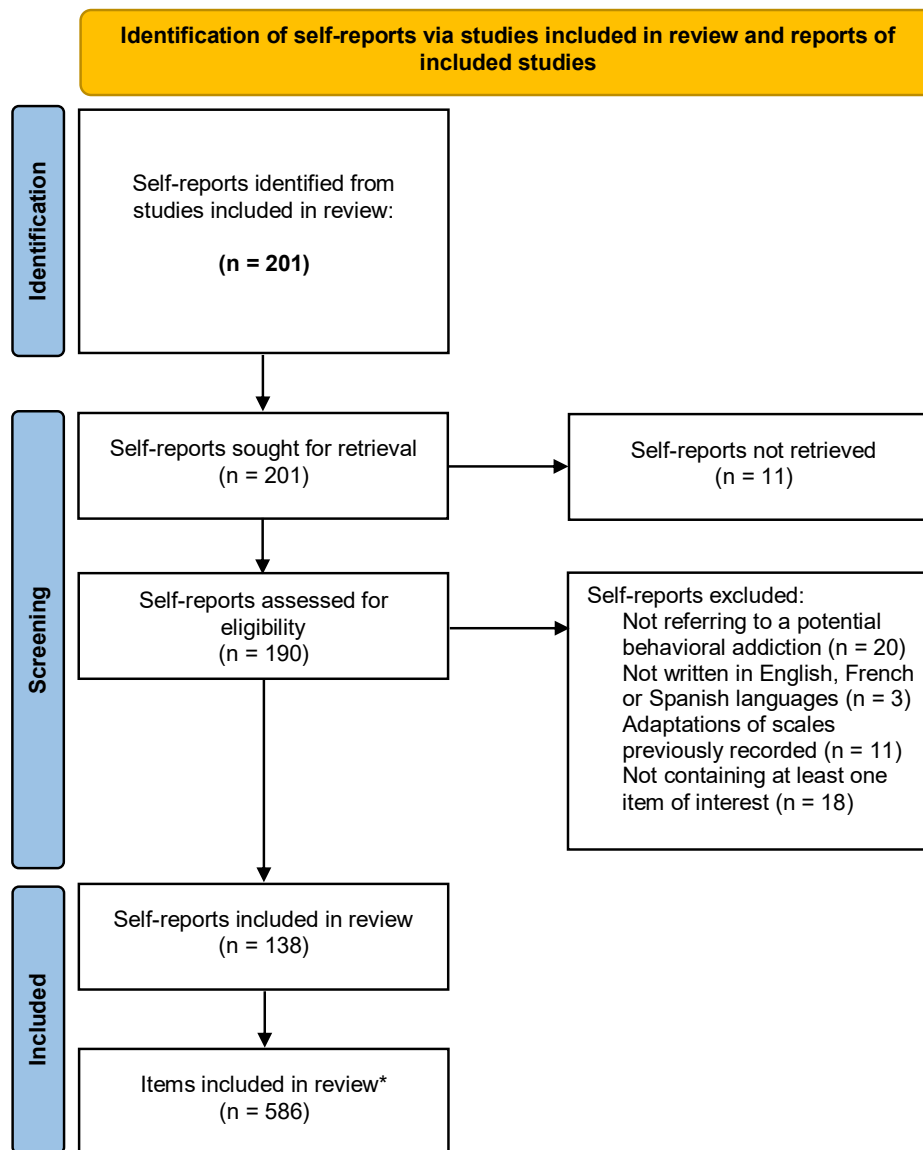


Fig. 1. PRISMA flowchart for article selection.



* The process carried out to identify, filter and select the items included in the review can be checked in sections 3.1., 3.4., and 3.5. of the manuscript.

Fig. 2. PRISMA flowchart for scale and item selection.

application of IC3, IC4, and EC5-EC7 required scrutinizing the scales in full. Hereafter, we use the term putative addiction to refer to conditions that have been proposed as addictive disorders, regardless of whether they are included or not as such in main psychiatric nosologies.

The only selection criterion for individual items from the previously identified self-report instruments was to instantiate compulsive behavior. This condition was interpreted to hold even when the coincidence was partial, that is, when the item referred to at least one of the six criteria specified in Section 2.

3.2. Search strategy and information sources

We examined the databases PsycINFO, PubMed, Scopus and Web of Science in search of eligible studies, entering the following syntax: “(habit OR ‘habitual behavior’ OR ‘habitual behaviour’ OR compulsi* OR craving) AND (scale OR measure* OR questionnaire OR validation

OR self-report*) AND (‘behavioral addiction’ OR ‘behavioural addiction’ OR ‘internet addiction’ OR gambling OR videogames OR ‘video games’ OR ‘compulsive shopping’ OR ‘compulsive sexual behavior’ OR ‘compulsive sexual behaviour’)”. In order to ensure the detection of records about the more thoroughly studied putative behavioral addictions, “video games”, “Internet addiction” and “gambling” were explicitly included in the search terms, apart from the more general “behavioral addiction” term, that should allow the detection of less frequently studied putative behavioral addictions. As suggested by an anonymous reviewer, we also included “compulsive shopping”, and “compulsive sexual behavior”, because these explicitly mention compulsivity as part of the problematic behavioral pattern. (Please note that the inclusion of all possible addictive behaviors proposed to date would have made the output of this initial search virtually unmanageable).

The search was performed on March 29th, 2022 (see the “search

specifications per database” file available at the OSF link <https://osf.io/yqcsd/>, for the exact search algorithms used). Complementarily, we also cross-checked the references of the papers screened to search for scales of interest to identify other records eligible for the goals of the study.

3.3. Study selection

The first and third authors jointly conducted the automatic term-based search, and identified 4194 articles, 1496 of which remained after removing duplicate records. The title and abstract of each of these were explored to double-check for inclusion criteria. In case of doubt, the full text was retrieved if available and examined, so that 1112 records were retained. 98 reports were not retrievable (EC1), which yielded 1014 records. Thereafter, application of exclusion criteria EC2 to EC4 yielded 225 articles.

A citation search was conducted from these references to find articles containing further instruments of interest. Based on this citation search, 135 further articles were identified, 9 of which were not retrievable. After applying exclusion criteria, 105 of them were retained.

The list of references for the 330 articles later used for instrument extraction is available at the OSF link <https://osf.io/5jxnu/> (“Articles scrutinized in search for self-report instruments of interest”).

3.4. Scale selection

The two same authors independently explored all the documents in search for instruments that met the inclusion/exclusion criteria for self-report instruments (IC3, IC4, EC5-EC6; see “flowchart for scale and item selection”). Please note that IC3, EC5, and EC6 criteria are objective, whereas IC4 (“to contain at least one item that can be interpreted to be sensitive to compulsivity”) leaves some room for subjectivity. After applying all but this criterion, there were 156 scales left. For these, inter-judges agreement regarding whether they contained at least one compulsivity-sensitive item was very good according to Cohen’s kappa value ($\kappa = 0.89$). Total agreement was reached by discussion, and 138 self-report measures were finally retained. The self-report instruments included in this final list are available at the OSF link <https://osf.io/dw6ur/> (“Instruments with compulsivity-sensitive items”).

3.5. Identification of items

All items from those scales ($n = 2,693$) were individually assessed by the same two judges. This resulted in a very good agreement between the two experts ($\kappa = 0.90$). The identification of compulsivity-sensitive items finally resulted in the list of 586 items available at the OSF link <https://osf.io/w3vp6/> (“Identified compulsivity-sensitive items”). Note, however, that the actual number of compulsivity-sensitive items is smaller, as many items appear (in almost identical forms) in more than one scale. For the sake of transparency, instances of the same item in different scales are retained in the file. The exclusion criterion EC7 was applied retrospectively here to exclude reduced or adapted versions or previous scales with no new items. Exceptions were made for the Compulsive Online Shopping Scale (COSS; Manchiraju, Sadachar, & Ridgway, 2017), the Food Cravings Questionnaire-Trait-Reduced (FCQ-T-R; Meule, Hermann, & Kübler, 2014), the Internet Gaming Disorder Scale - Short Form (IGD9-SF; Pontes & Griffiths, 2015), and the Modified Yale Food Addiction Scale (mYFAS; Flint et al., 2014) and the Yale Food Addiction Scale for Children 2.0 (dYFAS-C 2.0; Schiestl & Gearhardt, 2018) scales. These were versions of previous instruments, but contain items not included in the original ones. The references for all scales are included in the file for the full list of self-report instruments meeting the eligibility criteria mentioned in the previous section.

3.6. Formulation of operationalizations

The formulation of operationalizations proceeded in two steps. The first one started with the five compulsivity criteria mentioned earlier as preliminary categories. In this first step, the correspondence between items and themes was assessed, so that items that were classifiable in more than one category were identified, and content discrepancies between items classifiable as belonging to the same category were made explicit. In a second step, the first and fourth authors identified discrepancies and overlaps between the categories, based on the output of the first step, and redefined them accordingly.

3.7. Selection and formulation of representative items

In order to externally assess the conceptual soundness of the proposed categories, the first and fourth authors listed 90 items representative of the six categories in a balanced manner. In order to elaborate this list, available at the OSF link <https://osf.io/j8umc/> (“Item selection for external inter-judges assessment”), some original items that mentioned specific behaviors were reworded to be applicable to a wide range of different activities (e.g., gaming, gambling, exercising, etc.). In some cases, items that were present in several scales with very similar forms were unified into a common wording. Additionally, as we did not identify as many as 15 clearly differentiable items for some categories, we elaborated the ones necessary to complete the list. These new items were elaborated to represent the corresponding operationalizations, and then discussed and refined by all the authors.

The 90 items in this list were randomly shuffled and submitted for assessment by 4 experts. Although one of the experts has been finally included as the second author of this work (JN), neither they nor any of the other three experts had been involved in phases 1 and 2 (their names and professional/academic credentials are disclosed in the acknowledgements section). For expert assessment, the items were worded using “playing” as the target activity, but the judges were instructed to mentally picture this as gaming, gambling, or any other activity that can be done in excess or in a dysregulated manner. The experts were asked to (a) read the six operationalizations resulting from the previous round, (b) to judge whether each item reflected compulsivity, and (c) to assign each item to one of the operational definitions (1–6). Finally, (d) the experts were given the chance to justify their negative answers to the first question, and (e) to report any difficulties they might have had when categorizing the items.

4. Results

Steps 1 to 6 from the previous section eventually resulted in the definitive set of operationalizations (Table 1, left column).

For the first category, disconnection between behavior and intentions or goals was redefined as *automatic or habitual behavior occurring in absence of conscious instrumental goals*. This operationalization largely mirrors the definition of habit in habit-learning research. Notably, this operationalization left out several items that made an explicit reference to continuity of the activity for longer than intended, but not to automaticity or habit-like behavior.

The second and third operationalizations resulted from identifying two possible meanings of the initial ‘urge’ criterion: one closer to the original one (*overwhelming urge or desire that impels the individual to initiate the activity and jeopardizes control attempts*), and a different one that comprised items referring to the *inability to stop or interrupt the activity once initiated, resulting in an episode substantially longer or more intense than intended (bingeing)*. The latter mostly consists of the items referring to the continuity of the activity for longer than intended that were left out of the first operationalization.

Fourth, awareness of negative consequences was slightly reformulated as *behavior insensitive to negative consequences despite conscious awareness of them*. This formulation makes explicit that the individual

Table 1
Operationalizations of compulsivity, example items, and delimitation problems.

Operationalization	Exemplar item	Delimitation problems
1. Automatic or habitual behavior occurring in absence of conscious instrumental goals	<i>It happens that I am virtually doing something completely different and then, without thinking, start [doing X] (KFN-CSAS-II; Rehbein et al., 2010)</i>	Reference to automaticity or disconnection between behavior and goals not explicit enough in some items.
2. Overwhelming urge or desire that impels the individual to initiate the activity and jeopardizes control attempts	<i>Every so often, I experience a compulsion to [do X] which I can't seem to control (BEQ; Gormally et al., 1982)</i>	In many behavioral items, craving or intense desire is mentioned, but control compromise failure is not. Craving/intense desire can reflect goal overvaluation instead of compulsivity.
3. Inability to stop or interrupt the activity once initiated, resulting in an episode substantially longer or more intense than intended (bingeing)	<i>When I crave [something], I know I won't be able to stop [doing X] once I start (FCQ-Trait; Meule, 2020)</i>	Items referring to sessions or activity episodes that last longer than intended but making no reference to lack of control.
4. Behavior insensitive to negative consequences despite conscious awareness of them	<i>[Doing X] has created significant problems in my personal relationships with other people, in social situations, at work or in other important aspects of my life (PPUS; Kor et al., 2014)</i>	Items referring to negative consequences are not worded in such a way that negative consequences are pitched against potential rewarding outcomes of the activity. Items mostly insensitive to negative utility at the time of choice (local disutility).
5. Attentional capture and cognitive hijacking	<i>I can't stop thinking about [doing X] (OCS; Davis, Flett, & Blesser, 2002)</i>	Automatic orientation of attention towards addiction-related cues, and intrusive/persistent thoughts can be considered as separable. Potential overlap between this category and overwhelming urge or desire.
6. Inflexible rules, stereotyped behaviors, and rituals related to task completion or execution	<i>I feel unsatisfied until I have done everything I want to in a video-game (VGCS; Bodi, Maintenant, & Pennequin, 2021)</i>	Inflexible rules regarding the attainment of goals, task completion, or the way the activity is performed can reflect overvaluation of activity goals instead of compulsivity. Inflexible rules regarding goal attainment and those regarding stereotyped behaviors and rituals could be considered as separable.

Note: *[Do(ing) X]* refers to the potentially problematic activity, which varies across instrument.

sticks to the problematic activity, even in face of substantial punishment. This definition parallels the one used in Lüscher et al. (op. cit.) to characterize compulsivity in animal models of drug self-administration.

Fifth, relatively few items specifically referred to attentional capture. However, while exploring the instruments item-by-item, a large number of items were detected that described activity-related involuntary or unintended thoughts substantially interfering with normal functioning. So, the category was reformulated as *attentional capture and cognitive hijacking*. That is, it was expanded to include any type of excessive attention to internal or external activity-related stimuli, but also pre-occupation, rumination or intrusive and persistent thoughts that cause substantial interference with any willful tasks requiring cognitive resources. All selected scales were reassessed to systematically search for items compatible with this new operationalization.

Finally, we spotted a number of conceptually connected items that were not adequately captured by any of the six initial criteria, but could still be considered instances of compulsive behavior. This led again to revisiting the scales and creating a last operationalization by recovering all items referring to *inflexible rules, stereotyped behaviors, and rituals related to task execution or completion*. As shown in the table, this sixth operationalization includes feeling forced or compelled to perform tasks in a certain way, but also some others relative to the necessity to complete the task or reach certain goals within the session in course. Non-completion or non-adherence causes substantial uneasiness, discomfort, or frustration.

At this point, one of the initial criteria (contextual dependency, or importance of exteroceptive or interoceptive stimuli at triggering the potentially problematic behavior) was discarded as a separate operationalization, as no items were found to distinctly fit into it. Contextual dependency, however, seems to be transversally present in the operationalizations of compulsivity identified here.

Finally, as previously described in the Methods section (subsection 3.7) a total of 90 items, selected or elaborated to fit the final operationalizations in a balanced manner, were assessed by 4 experts. The percentages of positive answers to the question regarding whether items reflected compulsivity or not were 83% (JN), 96% (SRA), 59% (PM), and 83% (DB). Regarding category assignment, interrater agreement was Fleiss' $\kappa = 0.83$ when our initial categorization was included, and $\kappa = 0.80$ when our categorization was not included (Landis & Koch, 1977).

5. Discussion

The final stage of this review involved identifying potential delimitation problems for the six operationalizations. These problems mainly arose from the experts' objections regarding each item as either reflecting compulsivity, or belonging to the corresponding proposed category, and will be used to make specific recommendations for item wording in future attempts to develop compulsivity measures. Additionally, the six operationalizations will be examined from a theoretical point of view, to take the first step towards ascertaining the cognitive and learning mechanisms underlying different manifestations of compulsivity.

5.1. Automatic or habitual behavior occurring in absence of conscious instrumental goals

This category comprises items like "It is common for me to unconsciously take out my mobile phone to check *Whatsapp*" (translated from Gutiérrez and Morales, 2019) or "I involuntarily touch my smartphone" (Ezoe et al., 2016). This behavior is characteristic of some cases of problematic video gaming, excessive Internet or smartphone use (e.g., "doomscrolling"; Sharma, Lee & Johnson, 2022), and some forms of gambling (e.g., continuous, immersive gambling; Dixon et al., 2018). It is, however, notably absent in problematic patterns of more purposive behavior like working, exercising, or strategic types of video gaming (Delfabbro & King, 2015). When feelings of automaticity are present in these activities, they often adopt the form of positive mindlessness, absorption, or flow, which has been reported to be an ingredient of harmonious passion and engagement (Barberis et al., 2021).

Some of these items were judged by the experts as not well suited to implement the operationalization (e.g., “Often, when I am playing, I find that my mind has drifted”, “I often play spontaneously”; [Flayelle et al., 2019](#); [Rook & Fisher, 1995](#)), as the mention to lack of monitoring or disconnection between behavior and goals was not explicit enough. The operationalization itself, however, remained unchallenged.

As noted earlier, this category conceptually overlaps with the definition of habit in animal learning research. However, recent evidence has challenged the idea that addictive behaviors are mere habits. On the one hand, recent attempts to induce habits in humans and macaques with extensive training have notably failed ([De Wit et al., 2018](#); [LaFlamme et al., 2022](#)). On the other hand, habits seem unnecessary for the development of addictive behaviors. In words of [Singer et al. \(2018\)](#), drug seeking often requires considerable ingenuity and flexibility, thus it cannot be governed by motor habit alone.

If habit formation (understood in this restricted sense; see also [Robbins & Costa, 2017](#)) is neither necessary nor sufficient for drug use to become addictive, the same can be probably said about behavioral addictions. Compulsivity in the form of habit can contribute to certain activities becoming problematic, insofar as their monitoring and control is diminished. However, it is virtually absent or secondary even in *bona fide* behavioral addictions, as, for example, strategic or skill-based forms of disordered gambling.

5.2. Overwhelming urge or desire that impels the individual to initiate the activity and jeopardizes control attempts

The realm of compulsivity, however, is not restricted to habit learning. Craving can be a driving force behind compulsive behavior, at least in two senses. First, craving is automatically triggered by exteroceptive and interoceptive cues, and is thus experienced as occurring itself beyond voluntary control. And second, the overvaluation of the addictive activity resulting from the expectancy of craving relief can make such activity unmistakably disadvantageous in the long term. Accordingly, craving has been systematically shown to be a core component of substance use disorder (SUD), a close indicator of addiction severity, and a predictor of relapse and treatment outcomes ([Stohs et al., 2019](#); [Franken, 2003](#)).

This centrality seems to apply beyond SUDs. Although craving is not included among the DSM-5 diagnostic criteria for gambling disorder, the available evidence strongly suggests that its role and its psychobiological underpinnings are very similar to the ones described for SUDs ([Hormes, 2017](#); [Limbrick-Oldfield et al., 2017](#)), and the term is also frequently used for other putative behavioral addictions ([Cornil et al., 2019](#); [Savci & Griffiths, 2019](#); [Meule, 2020](#)). Accordingly, craving items are frequently included in non-substance addiction scales (e.g., “Sometimes I think there are internal forces that prompt me to shop online”, “The urge is so strong, I cannot help myself from playing this gambling game”; [Huang, Chen, & Sun, 2022](#); [Rousseau et al., 2002](#)).

Recent theoretical models also attribute a central role to craving in the etiology of behavioral addictions, other than gambling disorder. For instance, in the I-PACE model ([Brand et al., 2016](#); [Brand et al., 2019](#)) addictive behaviors are considered to be caused by progressively hyperactive impulsive/reactive neural systems (including the conditioned associations responsible for craving and cue reactivity), accompanied by an also gradual weakening of executive inhibitory control. Although compulsivity is not explicitly mentioned in the model, this transition is hypothesized to underlie feelings of automaticity, and the loss of importance of gratification in motivating the addictive behavior.

Despite its importance, the first substantial delimitation problem was identified in relation to this operationalization. Craving items in most scales merely refer to intense desire. However, the idea that intense desire by itself is indicative of compulsivity can be called into question, as it may reflect just the anticipation of reward. Overvaluation of the problematic activity could be boosted by reward immediacy, relative to delayed positive outcomes of abstinence, so that the individual shows

some degree of ambivalence, and thus a certain feeling of acting against one’s goal. This behavior, however, would be better conceptualized as impulsive rather than compulsive. Mostly in accordance with this distinction, the authors of the I-PACE model highlight the importance of carrying out studies to “disentangle potential shifts from craving to compulsion and from expecting gratification to expecting relief from negative states” ([Brand et al., 2019, p. 6](#)), implicitly acknowledging that craving is not necessarily indicative of compulsivity.

This delimitation problem is probably behind the difficulties to incorporate craving into clinical conceptualizations of behavioral addiction. A recent Delphi review ([Castro-Calvo et al., 2021](#)) failed to reach an acceptable level of agreement regarding its diagnostic validity, clinical utility, and prognostic value in gaming disorder. This lack of agreement calls for the need to conduct etiologically informative studies, but these are still scarce. In one of the few available ones, [King et al. \(2016\)](#) asked a sample of individuals with gaming disorder to abstain from gaming for 84 h, and interviewed them using open-ended questions, two of which were explicitly about craving: ‘*Did you experience any desire/craving to play? Can you say briefly what was happening when you felt that desire/craving?*’. Although many respondents answered the first question positively, the second one revealed that craving feelings were primarily associated with boredom and lack of mental stimulation, and also with the individual’s perception of ‘missing out’ or experiencing ‘losses’ if unable to play. In other words, cravings seemed to be tightly linked to overvaluation of the activity, and instrumental motives seemed to significantly contribute to such cravings. Unfortunately, the confirmatory approach customarily used in behavioral addictions research relies on closed questions about desire or urge, so they enforce similarity between potentially separable behavioral processes (see [Billieux et al., 2015](#); [Kardefelt-Winther, 2015](#)).

5.3. Inability to stop or interrupt the activity once initiated, resulting in an episode substantially longer or more intense than intended (bingeing)

The third operationalization of compulsivity is closely related to craving, at least in conceptual terms. Our decision to consider it separately is based on the observation that perceived inability to interrupt the activity is prominent in certain putative behavioral addictions, but totally uncharacteristic of others. Items in this category include, for instance, “Once I have started [doing X], I can’t stop playing unless something external prevents me to”, or “If I get carried away by the temptation to start playing, I lose control” ([Ruiz-Juan, 2013](#); [Meule, 2020](#)). Among the putative behavioral addictions in which bingeing is more evident are, for example, compulsive shopping ([Manchiraju, Sadachar, & Ridgway, 2017](#); [Müller et al., 2015](#)), binge eating ([Schiestl & Gearhardt, 2018](#); [Meule, 2020](#)), binge watching ([Flayelle et al., 2019](#)), and video gaming disorder ([Yilmaz et al., 2017](#)).

This operationalization presents delimitation problems that mirror the ones mentioned for the previous category. Most items refer to sessions or activity episodes that last longer than intended, but excessive duration or intensity of a behavioral episode can be due to purely utilitarian reasons, such as fear of missing the chance to reach a certain goal, or perceived social pressure ([King & Delfabbro, 2014, 2016](#)).

5.4. Behavior insensitive to negative consequences despite conscious awareness of them

Virtually all the questionnaires analyzed here included items worded to assess awareness of the negative consequences of the potentially problematic activity. Some prominent examples are: “I kept consuming the same types or amounts of food despite significant emotional and/or physical problems related to my eating” ([Flint et al., 2014](#)), “I exercise despite persistent physical problems” ([Hausenblas & Downs, 2002](#)), or “Although using smartphone has brought negative effects on my interpersonal relationships, the amount of time spent on the Internet remains unreduced” ([Pavia et al., 2016](#)). These sometimes include ‘internal’

aversive consequences, such as feelings of guilt or regret, resulting from the perceived inability to keep on engaging in an activity that goes against personal moral principles or undermines one's sense of control. Items of this type are frequent, for example, in scales for compulsive sexual behavior (e.g., "You continue to use pornography even though you feel guilty about it"; Kraus et al., 2020).

Variety of wordings reflects the range of contexts and life domains in which negative consequences occur, but awareness of these negative consequences does not necessarily imply that the net utility value of such consequences is negative. An individual can be aware of the negative consequences of a certain activity, and still attribute more value to the positive ones.

Moreover, even if the activity is plainly disadvantageous in the long term, it can be subjectively perceived as advantageous in the short term (Rachlin, 2000). At the local level, the choice is between an immediate (and overvalued) reward and a delayed (and thus discounted) one. The individual can thus be aware of the long-term negative consequences of the activity, and, at the same time, fail to resist temptation because the discounted utility of distant consequences is smaller than the immediate rewarding value of falling into it. For a behavior to be considered compulsive in the strictest sense, it would need to be goal-detached. However, overvaluation of the expected utility of an immediate reward when one is in a 'hot' state can lead the individual to feel forced to do something they will later regret (when in 'cold' state), i.e., to a seemingly compulsive behavior (in weaker sense; see Heather, 2020).

Despite the many items assessing insensitivity to negative consequences in the questionnaires analyzed in this review, virtually none of them is worded to be sensitive to any of these distinctions. First, none of the items referring to negative consequences is worded in such a way that such consequences are pitched against rewarding outcomes of the activity. And second, no items are sensitive to negative utility specifically at the time of choice.

5.5. Attentional capture and cognitive hijacking

On the one hand, this operationalization comprises items regarding automatic orientation towards cues that have become associated with the problematic activity and the availability of the rewards resulting from it. On the other, it comprises items reflecting preoccupation, and intrusive thoughts. These meanings are exemplified in items like "When I know a delicious food is available, I can't help myself from thinking about having some" (Cappelleri et al., 2009) and "When I haven't been able to connect for some time, I become preoccupied with the thought of connecting" (Armstrong, Phillips, & Saling, 2000).

As mentioned by one of the experts, in terms of delimitation, it can be argued that automatic orientation of attention towards addiction-related cues, as also measured using cue-reactivity and eye-tracking techniques (e.g., Maurage et al., 2021), and intrusive/persistent thoughts depend on separable processes. For instance, in Berridge and Robinson's model, attentional capture arises (along with craving) from incentive sensitization, whereas the intrusiveness of certain thoughts has been linked to elaboration of desire (May et al., 2015), or to the fact that thoughts that involuntarily intrude one's mind are interpreted as threatening, and suppression or avoidance attempts make them progressively more salient and difficult to ignore (Moss et al., 2015; Enkema et al., 2021). In this second sense (when intrusiveness is fueled by perceptions of threat), there seems to be a mechanism in common between uncontrollable thoughts in addictive disorders and in obsessive-compulsive disorder (OCD). This mechanism, however, seems to play a more fundamental role in the case of OCD, where compulsions are primarily performed to seek relief from obsession-related anxiety (Marcks & Woods, 2007).

Relatedly, there is a potential overlap between this category and *overwhelming urge or desire*. For instance, an item such as "I cannot control my thoughts about gambling" seems useless to discriminate between overwhelming craving and cognitive hijacking. More importantly, these two concepts could be even difficult to separate at the

conceptual level. In the incentive sensitization model, motivational and cognitive salience result from the same underlying learning process. Alternatively, the previously mentioned elaborated intrusion theory of desire conceptualizes episodes of craving as high-level cognitive processes – or elaborations – recruiting mental imagery and executive (controlled) mechanisms (Cornil et al., 2018), i.e., uncontrollable thoughts and desires are not neatly dissociable.

Also closely related to cognitive hijacking are the items included in some scales to measure salience (as one of the proposed addiction criteria proposed by the components model; Griffiths, 2005). Salience-related items usually refer to preoccupation, rumination, and interference. Indeed, some of these items have been identified here as sensitive to compulsivity [for example, "Has thinking about food, eating or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?"; Mond et al., 2004]. However, in some recent scales for putative behavioral addictions, items of this sort have been replaced by items referring to the subjective importance of such an activity in the individual's life. For example, in the validation study of the Exercise Addiction Inventory (EAI, Terry et al., 2004), excessive salience is said to occur when exercise dominates the individual's thinking (preoccupations and cognitive distortions), feelings (cravings), and behavior (deterioration of socialized behavior), but the scale itself measures it with a single item, namely "exercise is the most important thing in my life". Quite ostensibly, the reformulation of this item has altered its content, and loosened the criterion for the detection of so-called salience (Brevers et al., 2022).

That said, here we remain agnostic regarding the commonality or separability of the etiological mechanisms underlying attentional capture and intrusive thoughts. Still, we advocate that both sorts of behaviors can be considered compulsive, as far as (a) the two occur independently of one's will and in spite of attempts to control them, and (b) they detract resources from other goal-directed mental activities. Hence, attentional capture and cognitive hijacking items should remain in future compulsivity scales, yet only if carefully worded to incorporate undesired interference and uncontrollability, and not willful planning and fantasizing, or activity-related mind wandering.

5.6. Inflexible rules, stereotyped behaviors, and rituals related to task completion or execution

The last category partially mirrors – particularly when it refers to rituals or superstitions – the definition of compulsion in OCD (i.e., repetitive behaviors that the person feels driven to perform in response to an obsession, *or according to rules that must be applied rigidly, and are aimed at preventing or reducing distress, or preventing some dreaded event or situation*; American Psychiatric Association, 2013, italics added). Items of this type are, for example, "I feel unsatisfied until I have done everything I want to do in a video game." or "There are certain things I do when I am betting (for example, tapping a certain number of times, holding a lucky coin in my hand, crossing my fingers, etc.) which increase the chances that I will win" (King & Delfabbro, 2014; Steenbergh et al., 2002).

The potentially compulsive nature of these behaviors could account for the overlap between OCD and addictive disorders. Actually, compulsivity could be a common transdiagnostic ingredient in addictive disorders and OCD, and differences between the two would emerge from specific non-overlapping acquisition and maintenance factors (e.g., obsession-related anxiety is hypothesized to play a more crucial role in OCD; Figuee et al., 2016; Fontenelle et al., 2012).

In this case, delimitation problems arise again from the fact that the stereotyped behaviors that some items in this category describe are not necessarily compulsive. For instance, inflexible rules regarding the attainment of goals or task completion, despite being severely problematic in some cases (e.g., Billieux et al., 2020), seem to have more to do with the valuation of activity goals. For instance, "exercise addiction" scales normally include items referring to inflexibility (e.g., "I follow a

set routine for my exercise sessions”), that is, to training routines that are firmly believed by some sportspeople to contribute to performance, but actually increase overtraining and health risks (Goodwin et al., 2011). Similarly, in scales for video gaming problems, some items refer to inflexibility as persevering, whatever it costs, to attain certain in-game goals (for example, “When I make mistakes, lose progress, or fail in a game, I must reload and try again”; King & Delfabbro, 2014). Perseveration is in some cases also linked to irrational cognitions (e.g., the sunk-cost and gambling fallacies). These fallacies are frequently present in gambling disorder scales, along with superstitions and rituals aimed to attract luck (for example, “I have specific rituals and behaviors that increase my chances of winning”; Raylu & Oei, 2004).

These instances of inflexible, stereotyped or ritualistic behavior, anchored in less-than-rational beliefs, can be certainly dysfunctional, and can be involved in the process by which certain activities become problematic. However, we doubt they can be regarded as compulsive. These behaviors are clearly goal-oriented and based on beliefs that can be considered irrational from an external observer’s point of view, but reflect the individual’s knowledge about the world.

5.7. Limitations

The present review is not free of limitations, with the most important one probably being search scope. To ensure that the number of articles to be screened was manageable, articles had to include a variation of the term compulsive or habitual or craving, and to mention behavioral addiction (including variations or selected putative behavioral addictions), in order to be identified. The possibility exists that this term combination missed articles containing instruments of interest. However, although the list of screened articles and measures could be non-exhaustive – and in view that most scales are developed by recycling items and components from previous scales – it is extremely unlikely that missed scales contained items not classifiable in any of the final compulsivity operationalizations proposed here.

The other important limitation is that results of the systematic review inherit the definition of compulsivity with which we started. Our initial definition of compulsivity is not based on a well-defined construct, but mostly on a previous consensus definition that was enriched with the theory-driven inclusion of closely related concepts. The whole procedure was however transparent enough for readers to assess its strengths and weaknesses, and we still believe this review is a step ahead in understanding compulsivity and its role in the transition from recreational or coping behaviors to addictive disorders.

5.8. Conclusions and recommendations

The present review was aimed at detecting compulsivity in behavioral items from available psychometric instruments used in the field of (putative) behavioral addictions. After funneling the scales through a theory-informed definition of compulsivity, we identified and listed the items that fitted it. Subsequently, the contents of those items were carefully analyzed to identify item categories that could be used as operationalizations. And finally, such categories were scrutinized to assess the degree to which they can be used as better delineated operationalizations of compulsivity in future attempts to measure it.

As a result, this attempt has revealed that behaviors can be categorized as compulsive in non-trivially different ways. Yet, disutility seems to be a common element to all of them. Behaving on autopilot, being unable to resist craving, to stop when intended, to ignore certain stimuli, or to suppress certain thoughts, behaving in a stereotyped way, persevering in following inflexible rules, and neglecting negative consequences, can be considered compulsive when behaviors are disconnected from goals, or their net utility is negative.

Moreover, in a strict sense, for a certain behavior to be intrinsically compulsive, disutility should occur at the moment of choice. Unfortunately, even if compulsivity exists in this strict sense (which is debatable;

see Hogarth & Field, 2020), retrospective self-report methods are probably incapable of capturing it. Still, in our view, psychometric tools remain valuable to detect compulsivity as global (instead of local) disregard of utility. Even in this weaker sense, many of the items considered in this review are too imprecise and over-inclusive. The lack of any explicit reference to inability to help engaging in the activity, to stop it, or to do it in a certain way, despite awareness of net disutility or disregard of goals make them almost useless to detect compulsivity, so our recommendation is to include these elements when wording items for compulsivity scales. This suggestion should have the effect of raising the bar to conceptualize a given behavior as compulsive. In doing so, our prediction is that the presence of compulsivity in behavioral problems, and its role in their aggravation, and even its composition, will largely vary across conditions. In other words, many of the activities currently regarded as compulsive (as, for instance, compulsive exercising or compulsive working) are likely to reveal little real influence or presence of compulsivity.

If corroborated, this prediction should converge with results obtained with scales inspired by transdiagnostic models, i.e., people showing specific compulsive behaviors in one or more domains are expected to also show higher scores in trait compulsivity. Conversely, people experiencing dysregulated or problematic behaviors that, despite being maladaptive, cannot be characterized as compulsive, would not necessarily present high trait compulsivity scores.

For instance, the BATCAP (Albertella et al., 2019) was developed to cover several activities and behaviors (including alcohol use, gambling, eating, Internet use, and contamination, checking, and ordering compulsions), so that “individuals who reported having engaged in any of these behaviors in the past month were asked to complete the corresponding BATCAP” (Albertella et al, 2019; p. 498). In that sense, the aim of the BATCAP aligns with our aim to develop a compulsivity scale that can be applied to different behavioral domains. However, instead of on bottom-up content analysis, the development of this scale was based on a theory-driven selection of items from previous scales, so that, for each potentially problematic behavior, individuals are asked to answer questions about time lost, distress, loss of control, functional impact, anxiety if prevented from doing the behavior, and strongest urge.

In hindsight, it becomes obvious that the BATCAP could have been included from the beginning in this review, but was missed because none of its validations mention any behavioral addiction (or the term behavioral addiction itself) either in the title or the abstract. Still, it is reassuring that BATCAP items mostly fit the operationalizations described here. Indeed, its six items would have been categorized as sensitive to compulsivity if they had been assessed to begin with, and, altogether, they are closer to our final operationalizations than to the original criteria we used to categorize items as compulsivity-sensitive. This implies that some degree of conceptual convergence can be reached via very different methodologies. Still, the items in this scale are affected by the delimitation problems we have discussed in the previous sections. For instance, items like “On average, how much time was occupied by these behaviors?” or “What was the strength of your strongest urge/craving to perform these behaviors?” are surely sensitive to compulsivity, but they would probably fail to isolate compulsivity defined in a stringent manner. In other words, measures like this could also benefit from the present effort to operationalize compulsive behaviors as precisely as possible.

Relatedly, further research is warranted on the link between compulsivity as a trait and vulnerability to develop compulsive behaviors in specific domains. The availability of a well-defined operationalization to determine if a specific activity (as exercising, working, gaming, or gambling) has become compulsive could help establish associations between the transdiagnostic dimensions tackled by trait compulsivity and the learning processes that underpin vulnerability to behavioral addictions.

A second recommendation for compulsivity operationalization also cuts through all the categories identified. The present review intends to

identify compulsive behaviors. However, many of the reviewed items do not explicitly refer to overt or covert behaviors, but to the mental states (beliefs and desires) that account for such behaviors. So, to count as instances of an operationalization of compulsivity, items should be worded to refer to observable behaviors, or to non-observable ones (thinking, imaging, planning, paying attention, etc.) that can nevertheless be reported by the individual. Regardless of their observable or unobservable nature, their suitability to be conceptualized as compulsive, and to be included in one of the proposed operational categories, is the same. This requires items about beliefs and desires to be reworded as items about the behaviors such beliefs refer to, or such desires mobilize (e.g., “I gamble despite knowing it does more harm than good to me” instead of “I know gambling does more harm than good to me”, or “I cannot avoid gambling when I feel the urge to do so”, instead of “I often feel an irrepresible urge to gamble”).

To determine whether compulsivity is a single construct is beyond the aims of the present study. We have briefly reviewed here (and more extensively in Perales et al., 2020) how different models account for compulsivity by alluding to different learning and psychobiological mechanisms. It could well be that compulsivity is multidimensional, as also suggested by research with trait compulsivity scales, so the logical next step would be to analyze the factorial structure of a pool of items generated from the operational definitions identified here, following the recommendations we have formulated for such items to be maximally sensitive and discriminative. We do not have any strict commitment with the ontological value of these operational definitions. These have mostly arisen, in a bottom-up fashion, from the common themes already present in currently available instruments, but different items corresponding to different operationalizations could be found to load to a common factor. The observed factorial structure could thus be used as an intermediate link between specific behavioral items and explanatory psychobiological, learning, and cognitive mechanisms.

CRedit authorship contribution statement

Ismael Muela: Conceptualization, Methodology, Investigation, Resources, Writing – original draft, Writing – review & editing. **Juan F. Navas:** Writing – original draft, Writing – review & editing. **José M. Ventura-Lucena:** Conceptualization, Methodology, Investigation, Resources. **José C. Perales:** Conceptualization, Methodology, Investigation, Resources, Writing – original draft, 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. José C. Perales serves as Associate Editor at Addictive Behaviors.

Acknowledgements

We would like to thank the Spanish the Spanish National Research Agency (Agencia Estatal de Investigación), Ministry of Science and Innovation (Ministerio de Ciencia e Innovación), for funding the project to which this study belongs. We would like to thank Sergio Fernández-Artamendi (Loyola University, Seville, Spain), and Damien Brevers and Pierre Muraige (Université Catholique de Louvain, Louvain La Neuve, Belgium) for their assistance as external experts for inter-judges agreement assessment, and for identification of delimitation problems. We would also like to thank Sumara Suzzette Prince Davidson for her assistance in translating Spanish items into English for external evaluation.

Funding

The roles of the first, second, and third authors in this publication are

part of a R&D project (proyecto I + D + I), funded by the Spanish Research Agency (Agencia Española de Investigación), Spanish Ministry of Science and Innovation (Ministerio de Ciencia e Innovación) (MCIN/AEI/10.13039/501100011033/), with reference PID2020-116535 GB-I00, and by a predoctoral fellowship (PRE2018-085150) from the Spanish Ministry of Science and Innovation to IM.

References

- Albertella, L., Chamberlain, S. R., Le Pelley, M. E., Greenwood, L. M., Lee, R. S., Den Ouden, L., et al. (2020). Compulsivity is measurable across distinct psychiatric symptom domains and is associated with familial risk and reward-related attentional capture. *CNS Spectrums*, 25(4), 519–526. <https://doi.org/10.1017/S1092852919001330>
- Albertella, L., Le Pelley, M. E., Chamberlain, S. R., Westbrook, F., Fontenelle, L. F., Segrave, R., et al. (2019). Reward-related attentional capture is associated with severity of addictive and obsessive-compulsive behaviors. *Psychology of Addictive Behaviors*, 33(5), 495. <https://doi.org/10.1037/adb0000484>
- Albertella, L., Le Pelley, M. E., Chamberlain, S. R., Westbrook, F., Lee, R. S., Fontenelle, L. F., et al. (2020). Reward-related attentional capture and cognitive inflexibility interact to determine greater severity of compulsivity-related problems. *Journal of Behavior Therapy and Experimental Psychiatry*, 69, Article 101580. <https://doi.org/10.1016/j.jbtep.2020.101580>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Antons, S., & Brand, M. (2021). Diagnostic and classification considerations related to compulsive sexual behavior disorder and problematic pornography use. *Current Addiction Reports*, 8(3), 452–457. <https://doi.org/10.1007/s40429-021-00383-7>
- Armstrong, L., Phillips, J. G., & Saling, L. L. (2000). Potential determinants of heavier Internet usage. *International Journal of Human-Computer Studies*, 53(4), 537–550. <https://doi.org/10.1006/ijhc.2000.0400>
- Balleine, B. W., & Dickinson, A. (1998). Goal-directed instrumental action: Contingency and incentive learning and their cortical substrates. *Neuropharmacology*, 37(4–5), 407–419. [https://doi.org/10.1016/S0028-3908\(98\)00033-1](https://doi.org/10.1016/S0028-3908(98)00033-1)
- Barberis, N., Cannavò, M., Costa, S., & Cuzzocrea, F. (2021). Problematic behaviours and flow experiences during screen-based activities as opposite outcomes of the dual process of passion and basic needs. *Behaviour & Information Technology*, 1–14. <https://doi.org/10.1080/0144929X.2021.1972158>
- Berridge, K. C., & Robinson, T. E. (2016). Liking, wanting, and the incentive-sensitization theory of addiction. *American Psychologist*, 71(8), 670. <https://doi.org/10.1037/amp0000059>
- Billieux, J., Potenza, M. N., Muraige, P., Brevers, D., Brand, M., & King, D. L. (2020). Cognitive factors associated with gaming disorder. *Cognition and Addiction*, 221–230. <https://doi.org/10.1016/B978-0-12-815298-0.00016-2>
- Billieux, J., Schimmenti, A., Khazaal, Y., Muraige, P., & Heeren, A. (2015). Are we overpathologizing everyday life? A tenable blueprint for behavioral addiction research. *Journal of Behavioral Addictions*, 4(3), 119–123. <https://doi.org/10.1556/2006.4.2015.009>
- Bodi, G., Maitenant, C., & Pennequin, V. (2021). The role of maladaptive cognitions in gaming disorder: Differences between online and offline gaming types. *Addictive Behaviors*, 112, Article 106595. <https://doi.org/10.1016/j.addbeh.2020.106595>
- Brand, M., Rumpf, H. J., Demetrovics, Z., King, D. L., Potenza, M. N., & Wegmann, E. (2019). Gaming disorder is a disorder due to addictive behaviors: Evidence from behavioral and neuroscientific studies addressing cue reactivity and craving, executive functions, and decision-making. *Current Addiction Reports*, 6(3), 296–302. <https://doi.org/10.1007/s40429-019-00258-y>
- Brand, M., Wegmann, E., Stark, R., Müller, A., Wölfling, K., Robbins, T. W., et al. (2019). The Interaction of Person-Affect-Cognition-Execution (I-PACE) model for addictive behaviors: Update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. *Neuroscience & Biobehavioral Reviews*, 104, 1–10. <https://doi.org/10.1016/j.neubiorev.2019.06.032>
- Brand, M., Young, K. S., Laier, C., Wölfling, K., & Potenza, M. N. (2016). Integrating psychological and neurobiological considerations regarding the development and maintenance of specific Internet-use disorders: An Interaction of Person-Affect-Cognition-Execution (I-PACE) model. *Neuroscience & Biobehavioral Reviews*, 71, 252–266. <https://doi.org/10.1016/j.neubiorev.2016.08.033>
- Brevers, D., Muraige, P., Kohut, T., Perales, J. C., & Billieux, J. (2022). On the pitfalls of conceptualizing excessive physical exercise as an addictive disorder: Commentary on Dinardi et al. (2021). *Journal of Behavioral Addictions*. 10.1556/2006.2022.00001.
- Cappelleri, J. C., Bushmakin, A. G., Gerber, R. A., Leidy, N. K., Sexton, C. C., Karlsson, J., et al. (2009). Evaluating the Power of Food Scale in obese subjects and a general sample of individuals: Development and measurement properties. *International Journal of Obesity*, 33(8), 913–922. <https://doi.org/10.1038/ijo.2009.107>
- Castro-Calvo, J., King, D. L., Stein, D. J., Brand, M., Carmi, L., Chamberlain, S. R., et al. (2021). Expert appraisal of criteria for assessing gaming disorder: An international Delphi study. *Addiction*, 116(9), 2463–2475. <https://doi.org/10.1111/add.15411>
- Chamberlain, S. R., & Grant, J. E. (2018). Initial validation of a transdiagnostic compulsivity questionnaire: The Cambridge-Chicago Compulsivity Trait Scale. *CNS Spectrums*, 23(5), 340–346. <https://doi.org/10.1017/S1092852918000810>
- Cornil, A., Long, J., Rothen, S., Perales, J. C., de Timary, P., & Billieux, J. (2019). The gambling craving experience questionnaire: Psychometric properties of a new scale

- based on the elaborated intrusion theory of desire. *Addictive Behaviors*, 95, 110–117. <https://doi.org/10.1016/j.addbeh.2019.02.023>
- Cornil, A., Lopez-Fernandez, O., Devos, G., de Timary, P., Goudriaan, A. E., & Billieux, J. (2018). Exploring gambling craving through the elaborated intrusion theory of desire: A mixed methods approach. *International Gambling Studies*, 18(1), 1–21. <https://doi.org/10.1080/14459795.2017.1368686>
- Davis, R. A., Flett, G. L., & Besser, A. (2002). Validation of a new scale for measuring problematic Internet use: Implications for pre-employment screening. *Cyberpsychology & Behavior*, 5(4), 331–345. <https://doi.org/10.1089/109493102760275581>
- De Houwer, J., Tanaka, A., Moors, A., & Tibboel, H. (2018). Kicking the habit: Why evidence for habits in humans might be overestimated. *Motivation Science*, 4(1), 50. <https://doi.org/10.1037/mot0000065>
- de Wit, S., Kindt, M., Knot, S. L., Verhoeven, A. A., Robbins, T. W., Gasull-Camos, J., et al. (2018). Shifting the balance between goals and habits: Five failures in experimental habit induction. *Journal of Experimental Psychology: General*, 147(7), 1043. <https://doi.org/10.1037/xge0000402>
- Delfabbro, P., & King, D. (2015). On finding the C in CBT: The challenges of applying gambling-related cognitive approaches to video-gaming. *Journal of Gambling Studies*, 31(1), 315–329. <https://doi.org/10.1007/s10899-013-9416-3>
- Dixon, M. J., Stange, M., Larche, C. J., Graydon, C., Fugelsang, J. A., & Harrigan, K. A. (2018). Dark flow, depression and multiline slot machine play. *Journal of Gambling Studies*, 34(1), 73–84. <https://doi.org/10.1007/s10899-017-9695-1>
- Dolan, R. J., & Dayan, P. (2013). Goals and habits in the brain. *Neuron*, 80(2), 312–325. <https://doi.org/10.1016/j.neuron.2013.09.007>
- Dutra, L., Stathopoulou, G., Basden, S. L., Leyro, T. M., Powers, M. B., & Otto, M. W. (2008). A meta-analytic review of psychosocial interventions for substance use disorders. *American Journal of Psychiatry*, 165(2), 179–187. <https://doi.org/10.1176/appi.ajp.2007.06111851>
- Enkema, M. C., Hallgren, K. A., Bowen, S., Lee, C. M., & Larimer, M. E. (2021). Craving management: Exploring factors that influence momentary craving-related risk of cannabis use among young adults. *Addictive Behaviors*, 115, Article 106750. <https://doi.org/10.1016/j.addbeh.2020.106750>
- Epstein, D. H. (2020). Let's agree to agree: A comment on Hogarth (2020), with a plea for not-so-competing theories of addiction. *Neuropsychopharmacology*, 45(5), 715–716. <https://doi.org/10.1038/s41386-020-0618-y>
- Ersche, K. D., Gillan, C. M., Jones, P. S., Williams, G. B., Ward, L. H., Luitjen, M., et al. (2016). Carrots and sticks fail to change behavior in cocaine addiction. *Science*, 352(6292), 1468–1471. <https://doi.org/10.1126/science.aaf3700>
- Everitt, B. J., & Robbins, T. W. (2022). Drug addiction: Updating actions to habits to compulsions ten years on. In *Evaluating the Brain Disease Model of Addiction* (pp. 50–73). Routledge.
- Ezoe, S., Iida, T., Inoue, K., & Toda, M. (2016). Development of Japanese version of smartphone dependence scale. *Open Journal of Preventive Medicine*, 6(07), 179. <https://doi.org/10.4236/ojpm.2016.67017>
- Fernández-Serrano, M. J., Peralas, J. C., Moreno-López, L., Pérez-García, M., & Verdejo-García, A. (2012). Neuropsychological profiling of impulsivity and compulsivity in cocaine dependent individuals. *Psychopharmacology*, 219, 673–683. <https://doi.org/10.1007/s00213-011-2485-z>
- Fidge, M., Pattij, T., Willuhn, I., Luijckes, J., van den Brink, W., Goudriaan, A., et al. (2016). Compulsivity in obsessive-compulsive disorder and addictions. *European Neuropsychopharmacology*, 26(5), 856–868. <https://doi.org/10.1016/j.euroneuro.2015.12.003>
- Flayelle, M., Canale, N., Vögele, C., Karila, L., Maurage, P., & Billieux, J. (2019). Assessing binge-watching behaviors: Development and validation of the “Watching TV Series Motives” and “Binge-watching Engagement and Symptoms” questionnaires. *Computers in Human Behavior*, 90, 26–36. <https://doi.org/10.1016/j.chb.2018.08.022>
- Flint, A. J., Gearhardt, A. N., Corbin, W. R., Brownell, K. D., Field, A. E., & Rimm, E. B. (2014). Food-addiction scale measurement in 2 cohorts of middle-aged and older women. *The American Journal of Clinical Nutrition*, 99(3), 578–586. <https://doi.org/10.3945/ajcn.113.068965>
- Fontenelle, L. F., Oostermeijer, S., Harrison, B. J., Pantelis, C., & Yücel, M. (2011). Obsessive-compulsive disorder, impulse control disorders and drug addiction. *Drugs*, 71(7), 827–840. <https://doi.org/10.2165/11591790-000000000-00000>
- Franken, I. H. (2003). Drug craving and addiction: Integrating psychological and neuropsychopharmacological approaches. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 27(4), 563–579. [https://doi.org/10.1016/S0278-5846\(03\)00081-2](https://doi.org/10.1016/S0278-5846(03)00081-2)
- Goodwin, H., Haycraft, E., & Meyer, C. (2014). Psychological risk factors for compulsive exercise: A longitudinal investigation of adolescent boys and girls. *Personality and Individual Differences*, 68, 83–86. <https://doi.org/10.1016/j.paid.2014.03.048>
- Goodwin, H., Haycraft, E., Taranis, L., & Meyer, C. (2011). Psychometric evaluation of the compulsive exercise test (CET) in an adolescent population: Links with eating psychopathology. *European Eating Disorders Review*, 19(3), 269–279. <https://doi.org/10.1002/erv.1109>
- Gormally, J. I. M., Black, S., Daston, S., & Rardin, D. (1982). The assessment of binge eating severity among obese persons. *Addictive Behaviors*, 7(1), 47–55. [https://doi.org/10.1016/0306-4603\(82\)90024-7](https://doi.org/10.1016/0306-4603(82)90024-7)
- Griffiths, M. (2005). A ‘components’ model of addiction within a biopsychosocial framework. *Journal of Substance Use*, 10(4), 191–197. <https://doi.org/10.1080/14659890500114359>
- Gutiérrez, J. L., & Morales, A. U. (2019). Craving en usuarios de Whatsapp en teléfonos smartphones: Desarrollo de un instrumento para su evaluación en población chilena. *Revista Argentina de Clínica Psicológica*, 28(4), 399–408.
- Hausenblas, H. A., & Downs, D. S. (2002). How much is too much? The development and validation of the exercise dependence scale. *Psychology and Health*, 17(4), 387–404. <https://doi.org/10.1080/0887044022000004894>
- Heather, N. (2020). The concept of akrasia as the foundation for a dual systems theory of addiction. *Behavioural Brain Research*, 390, Article 112666. <https://doi.org/10.1016/j.bbr.2020.112666>
- Heyes, C., & Dickinson, A. (1990). The intentionality of animal action. *Mind & Language*, 5(1), 87–103.
- Hogarth, L. (2020). Addiction is driven by excessive goal-directed drug choice under negative affect: Translational critique of habit and compulsion theory. *Neuropsychopharmacology*, 45(5), 720–735. <https://doi.org/10.1038/s41386-020-0600-8>
- Hogarth, L., & Field, M. (2020). Relative expected value of drugs versus competing rewards underpins vulnerability to and recovery from addiction. *Behavioural Brain Research*, 394, Article 112815. <https://doi.org/10.1016/j.bbr.2020.112815>
- Hogarth, L., Lam-Cassettari, C., Pacitti, H., Currah, T., Mahlberg, J., Hartley, L., et al. (2019). Intact goal-directed control in treatment-seeking drug users indexed by outcome-devaluation and Pavlovian to instrumental transfer: Critique of habit theory. *European Journal of Neuroscience*, 50(3), 2513–2525. <https://doi.org/10.1111/ejn.13961>
- Hook, R. W., Grant, J. E., Ioannidis, K., Tiego, J., Yücel, M., Wilkinson, P., et al. (2021). Trans-diagnostic measurement of impulsivity and compulsivity: A review of self-report tools. *Neuroscience & Biobehavioral Reviews*, 120, 455–469. <https://doi.org/10.1016/j.neubiorev.2020.10.007>
- Hormes, J. M. (2017). The clinical significance of craving across the addictive behaviors: A review. *Current Addiction Reports*, 4, 132–141. <https://doi.org/10.1007/s40429-017-0138-y>
- Huang, H. L., Chen, Y. Y., & Sun, S. C. (2022). Conceptualizing the internet compulsive-buying tendency: What we know and need to know in the context of the COVID-19 Pandemic. *Sustainability*, 14(3), 1549. <https://doi.org/10.3390/su14031549>
- Hursh, S. R., & Roma, P. G. (2016). Behavioral economics and the analysis of consumption and choice. *Managerial and Decision Economics*, 37(4–5), 224–238. <https://doi.org/10.1002/mde.2724>
- James, W. (1890). *The Principles of Psychology, in two volumes*. New York: Henry Holt and Company.
- Kardefelt-Winther, D. (2015). Commentary on: Are we overpathologizing everyday life? A tenable blueprint for behavioral addiction research: Problems with atheoretical and confirmatory research approaches in the study of behavioral addictions. *Journal of Behavioral Addictions*, 4(3), 126–129. <https://doi.org/10.1556/2006.4.2015.019>
- King, D. L., & Delfabbro, P. H. (2014). The cognitive psychology of Internet gaming disorder. *Clinical Psychology Review*, 34(4), 298–308. <https://doi.org/10.1016/j.cpr.2014.03.006>
- King, D. L., & Delfabbro, P. H. (2016). The cognitive psychopathology of Internet gaming disorder in adolescence. *Journal of Abnormal Child Psychology*, 44(8), 1635–1645. <https://doi.org/10.1007/s10802-016-0135-y>
- King, D. L., Kaptis, D., Delfabbro, P. H., & Gradirar, M. (2016). Craving for Internet games? Withdrawal symptoms from an 84-h abstinence from massively multiplayer online gaming. *Computers in Human Behavior*, 62, 488–494. <https://doi.org/10.1016/j.chb.2016.04.020>
- Kor, A., Zilcha-Mano, S., Fogel, Y. A., Mikulincer, M., Reid, R. C., & Potenza, M. N. (2014). Psychometric development of the problematic pornography use scale. *Addictive Behaviors*, 39(5), 861–868. <https://doi.org/10.1016/j.addbeh.2014.01.027>
- Kraus, S. W., Gola, M., Grubbs, J. B., Kowalewska, E., Hoff, R. A., Lew-Starowicz, M., et al. (2020). Validation of a brief pornography screen across multiple samples. *Journal of Behavioral Addictions*, 9(2), 259–271. <https://doi.org/10.1556/2006.2020.00038>
- Kyrios, M., Trotzke, P., Lawrence, L., Fassnacht, D. B., Ali, K., Laskowski, N. M., et al. (2018). Behavioral neuroscience of buying-shopping disorder: A review. *Current Behavioral Neuroscience Reports*, 5(4), 263–270. <https://doi.org/10.1007/s40473-018-0165-6>
- LaFlamme, E. M., Ahmed, F., Forcelli, P. A., & Malkova, L. (2022). Macaques fail to develop habit responses during extended training on a reinforcer devaluation task. *Behavioral Neuroscience*, 136(2), 159–171. <https://doi.org/10.1037/bne0000503>
- Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 33(1), 159–174. <https://doi.org/10.2307/2529310>
- Limbrick-Oldfield, E. H., Mick, I., Cocks, R. E., McGonigle, J., Sharman, S. P., Goldstone, A. P., et al. (2017). Neural substrates of cue reactivity and craving in gambling disorder. *Translational Psychiatry*, 7(1), e992–e. <https://doi.org/10.1038/tp.2016.256>
- Luijckes, J., Lorenzetti, V., de Haan, S., Youssef, G. J., Murawski, C., Sjoerds, Z., et al. (2019). Defining compulsive behavior. *Neuropsychology Review*, 29(1), 4–13. <https://doi.org/10.1007/s11065-019-09404-9>
- Lüscher, C., Robbins, T. W., & Everitt, B. J. (2020). The transition to compulsion in addiction. *Nature Reviews Neuroscience*, 21(5), 247–263. <https://doi.org/10.1038/s41583-020-0289-z>
- Manchiraju, S., Sadachar, A., & Ridgway, J. L. (2017). The compulsive online shopping scale (COSS): Development and validation using panel data. *International Journal of Mental Health and Addiction*, 15(1), 209–223. <https://doi.org/10.1007/s11469-016-9662-6>
- Marcks, B. A., & Woods, D. W. (2007). Role of thought-related beliefs and coping strategies in the escalation of intrusive thoughts: An analog to obsessive-compulsive disorder. *Behaviour Research and Therapy*, 45(11), 2640–2651. <https://doi.org/10.1016/j.brat.2007.06.012>
- Maurage, P., Bollen, Z., Masson, N., & D'Hondt, F. (2021). Eye tracking studies exploring cognitive and affective processes among alcohol drinkers: A systematic review and

- perspectives. *Neuropsychology Review*, 31(1), 167–201. <https://doi.org/10.1007/s11065-020-09458-0>
- May, J., Kavanagh, D. J., & Andrade, J. (2015). The elaborated intrusion theory of desire: A 10-year retrospective and implications for addiction treatments. *Addictive Behaviors*, 44, 29–34. <https://doi.org/10.1016/j.addbeh.2014.09.016>
- Mestre-Bach, G., Steward, T., Jiménez-Murcia, S., & Fernández-Aranda, F. (2017). Differences and similarities between compulsive buying and other addictive behaviors. *Current Addiction Reports*, 4(3), 228–236. <https://doi.org/10.1007/s40429-017-0153-z>
- Meule, A. (2020). Twenty years of the food cravings questionnaires: A comprehensive review. *Current Addiction Reports*, 7(1), 30–43. <https://doi.org/10.1007/s40429-020-00294-z>
- Meule, A., Hermann, T., & Kübler, A. (2014). A short version of the Food Cravings Questionnaire—Trait: The FCQ-T-reduced. *Frontiers in Psychology*, 5, 190. <https://doi.org/10.3389/fpsyg.2014.00190>
- Mond, J. M., Hay, P. J., Rodgers, B., Owen, C., & Beumont, P. J. V. (2004). Validity of the Eating Disorder Examination Questionnaire (EDE-Q) in screening for eating disorders in community samples. *Behaviour Research and Therapy*, 42(5), 551–567. [https://doi.org/10.1016/S0005-7967\(03\)00161-X](https://doi.org/10.1016/S0005-7967(03)00161-X)
- Moss, A. C., Erskine, J. A., Albery, I. P., Allen, J. R., & Georgiou, G. J. (2015). To suppress, or not to suppress? That is repression: Controlling intrusive thoughts in addictive behaviour. *Addictive Behaviors*, 44, 65–70. <https://doi.org/10.1016/j.addbeh.2015.01.029>
- Müller, A., Trotzke, P., Mitchell, J. E., de Zwaan, M., & Brand, M. (2015). The pathological buying screener: Development and psychometric properties of a new screening instrument for the assessment of pathological buying symptoms. *PLoS One*, 10(10), e0141094.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372. <https://doi.org/10.1136/bmj.n71>
- Pavia, L., Cavani, P., Di Blasi, M., & Giordano, C. (2016). Smartphone Addiction Inventory (SPAI): Psychometric properties and confirmatory factor analysis. *Computers in Human Behavior*, 63, 170–178. <https://doi.org/10.1016/j.chb.2016.05.039>
- Perales, J. C., King, D. L., Navas, J. F., Schimmenti, A., Sescousse, G., Starcevic, V., et al. (2020). Learning to lose control: A process-based account of behavioral addiction. *Neuroscience & Biobehavioral Reviews*, 108, 771–780. <https://doi.org/10.1016/j.neubiorev.2019.12.025>
- Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 Internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior*, 45, 137–143. <https://doi.org/10.1016/j.chb.2014.12.006>
- Rachlin, H. (2000). *The science of self-control*. Harvard University Press.
- Raylu, N., & Oei, T. P. (2004). The Gambling Related Cognitions Scale (GRCS): Development, confirmatory factor validation and psychometric properties. *Addiction*, 99(6), 757–769. <https://doi.org/10.1111/j.1360-0443.2004.00753.x>
- Rehbein, F., Psych, G., Kleimann, M., Mediasci, G., & Möble, T. (2010). Prevalence and risk factors of video game dependency in adolescence: Results of a German nationwide survey. *Cyberpsychology, Behavior, and Social Networking*, 13(3), 269–277. <https://doi.org/10.1089/cyber.2009.0227>
- Robbins, T. W., & Clark, L. (2015). Behavioral addictions. *Current Opinion in Neurobiology*, 30, 66–72. <https://doi.org/10.1016/j.conb.2014.09.005>
- Robbins, T. W., & Costa, R. M. (2017). Habits. *Current Biology*, 27(22), R1200–R1206. <https://doi.org/10.1016/j.cub.2017.09.060>
- Rook, D. W., & Fisher, R. J. (1995). Normative influences on impulsive buying behavior. *Journal of Consumer Research*, 22(3), 305–313. <https://doi.org/10.1086/209452>
- Rousseau, F. L., Vallerand, R. J., Ratelle, C. F., Mageau, G. A., & Provencher, P. J. (2002). Passion and gambling: On the validation of the Gambling Passion Scale (GPS). *Journal of Gambling Studies*, 18(1), 45–66. <https://doi.org/10.1023/A:1014532229487>
- Ruiz-Juan, F. (2013). Validation of the Training Addiction Scale (EAE) in master athletes. *Adicciones*, 25(4), 309–320.
- Ruttan, R. L., & Nordgren, L. F. (2015). Perceptions of desire: A hot-cold empathy gap perspective. In W. Hofmann, & L. F. Nordgren (Eds.), *The psychology of desire* (pp. 225–243). The Guilford Press.
- Savci, M., & Griffiths, M. D. (2019). The development of the Turkish craving for internet gaming scale (CIGS): A validation study. *International Journal of Mental Health and Addiction*, 1–18. <https://doi.org/10.1007/s11469-019-00114-0>
- Schiestl, E. T., & Gearhardt, A. N. (2018). Preliminary validation of the Yale Food Addiction Scale for Children 2.0: A dimensional approach to scoring. *European Eating Disorders Review*, 26(6), 605–617. <https://doi.org/10.1002/erv.2648>
- Sharma, B., Lee, S. S., & Johnson, B. K. (2022). The Dark at the End of the Tunnel: Doomscrolling on Social Media Newsfeeds. *Technology, Mind, and Behavior*, 3(1). <https://doi.org/10.1037/tmb0000059>
- Singer, B. F., Fadanelli, M., Kawa, A. B., & Robinson, T. E. (2018). Are cocaine-seeking “habits” necessary for the development of addiction-like behavior in rats? *Journal of Neuroscience*, 38(1), 60–73. <https://doi.org/10.1523/JNEUROSCI.2458-17.2017>
- Stark, R., Klucken, T., Potenza, M. N., Brand, M., & Strahler, J. (2018). A current understanding of the behavioral neuroscience of compulsive sexual behavior disorder and problematic pornography use. *Current Behavioral Neuroscience Reports*, 5(4), 218–231. <https://doi.org/10.1007/s40473-018-0162-9>
- Steenbergh, T. A., Meyers, A. W., May, R. K., & Whelan, J. P. (2002). Development and validation of the Gamblers’ Beliefs Questionnaire. *Psychology of Addictive Behaviors*, 16(2), 143. <https://doi.org/10.1037/0893-164X.16.2.143>
- Stohs, M. E., Schneekloth, T. D., Geske, J. R., Biernacka, J. M., & Karpyak, V. M. (2019). Alcohol craving predicts relapse after residential addiction treatment. *Alcohol and Alcoholism*, 54(2), 167–172. <https://doi.org/10.1093/alcalc/agy093>
- Terry, A., Szabo, A., & Griffiths, M. (2004). The exercise addiction inventory: A new brief screening tool. *Addiction Research & Theory*, 12(5), 489–499. <https://doi.org/10.1080/16066350310001637363>
- Van Timmeren, T., Daams, J. G., Van Holst, R. J., & Goudriaan, A. E. (2018). Compulsivity-related neurocognitive performance deficits in gambling disorder: A systematic review and meta-analysis. *Neuroscience & Biobehavioral Reviews*, 84, 204–217. <https://doi.org/10.1016/j.neubiorev.2017.11.022>
- Yilmaz, E., Griffiths, M. D., & Kan, A. (2017). Development and validation of videogame addiction scale for children (VASC). *International Journal of Mental Health and Addiction*, 15(4), 869–882. <https://doi.org/10.1007/s11469-017-9766-7>
- Yücel, M., Oldenhof, E., Ahmed, S. H., Belin, D., Billieux, J., Bowden-Jones, H., et al. (2019). A transdiagnostic dimensional approach towards a neuropsychological assessment for addiction: An international Delphi consensus study. *Addiction*, 114(6), 1095–1109. <https://doi.org/10.1111/add.1442>