



Review

The need for a behavioural analysis of behavioural addictions



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HIGHLIGHTS

- Research into behavioural addictions rarely focuses on behaviour.
- We argue that research on gambling may not generalise to other behavioural addictions because the schedules of reinforcement may not be comparable.
- The review explores the application of gambling to internet gaming disorder and other potential forms of behavioural addiction.
- Our analysis has implications for designing interventions for behavioural addictions.

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ABSTRACT

This review discusses research on behavioural addictions (i.e. associative learning, conditioning), with reference to contemporary models of substance addiction and ongoing controversies in the behavioural addictions literature. The role of behaviour has been well explored in substance addictions and gambling but this focus is often absent in other candidate behavioural addictions. In contrast, the standard approach to behavioural addictions has been to look at individual differences, psychopathologies and biases, often translating from pathological gambling indicators. An associative model presently captures the core elements of behavioural addiction included in the DSM (gambling) and identified for further consideration (internet gaming). Importantly, gambling has a schedule of reinforcement that shows similarities and differences from other addictions. While this is more likely than not applicable to internet gaming, it is less clear whether it is so for a number of candidate behavioural addictions. Adopting an associative perspective, this paper translates from gambling to video gaming, in light of the existing debates on this matter and the nature of the distinction between these behaviours. Finally, a framework for applying an associative model to behavioural addictions is outlined, and its application toward treatment.

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1. Introduction

The latest edition of the Diagnostic and Statistical Manual of Mental Disorders in 2013 (DSM-5) (American Psychiatric Association, 2013) saw the introduction of addictions as a discrete category within the manual, covering both substance and behavioural addictions. The use of the term addiction instead of dependence highlighted a rebalancing from the latter toward compulsive consumption of a substance or behaviour (O'Brien, Volkow, & Li, 2006). For the first time an addictive behaviour, Gambling Disorder, was included in this category, with Internet Gaming Disorder noted as worthy of further consideration. Future revisions may add further behavioural addictions, inclusions that might prove controversial as numerous critiques have queried the nature and appropriateness of an addictions analysis of activities such as frequently flying, tango dancing and fortune telling that have become increasingly common in the literature (Cohen, Higham, & Cavaliere, 2011; Grall-Bronnec, Bulteau, Victorri-Vigneau, Bouju, & Sauvaget, 2015; Higham, Cohen, & Cavaliere, 2014; Targhetta, Nalpas, & Perney, 2013). It has been argued that aspects of this research program may inappropriately categorize aspects of everyday life as addictive (Billieux, Schimmenti, Khazaal, Maurage, & Heeren, 2015; Young, Higham, & Reis, 2014). The literature and popular media have also identified further behaviours such as eating, work, sex, water consumption and exercise (e.g. cycling) as potential behavioural addictions.

This paper explores the associative research on behavioural addictions, and its application to candidate behaviours. It has been previously noted that such a line of analysis is likely to prove most fruitful in expanding our understanding of behavioural addiction (Robbins & Clark, 2015). The first section surveys associative approaches to addiction, looking at their application to behavioural addictions and identifying similarities and distinctions between gambling and other addictions. The second section reviews the use of pathological gambling as a basis for behavioural addictions, focusing on the case of internet gaming disorder. The third section then outlines the areas where behavioural research would be useful in considering the employment of an addictions analysis for excessive activities. Finally, this is then considered in the context of treating behavioural addictions. For behavioural addictions such as problem gambling, Cognitive Behavioural Therapy (CBT) is often the first line of treatment offered to disordered gamblers. Many of the considerations outlined here might be of relevance when designing interventions and treatments for people with difficulties or addictions to other candidate behaviours.

1.1. Behavioural research in addiction

The standard account of addiction in the research literature focuses on the role of behavioural conditioning in reinforcing drug consumption and compulsive use (Everitt et al., 2008; Everitt & Robbins, 2005, 2016; Hogarth, Balleine, Corbit, & Killcross, 2013; Koob, 2013; Koob & Volkow, 2009; Ostlund & Balleine, 2008; Wise & Koob, 2014). Different models emphasise various components of associative learning: some consider the relative importance of positive versus negative reinforcement (i.e. the effects of drug consumption versus withdrawal), while others place greater emphasis on the instrumental (operant) or classical elements of conditioning. Some of these models instead consider the how behavioural control changes from being directed by the outcome to antecedent stimuli as addiction progresses. Others still attempt to model in animals the transition from primarily impulsive to compulsive behaviour that appears to be characteristic of drug addictions. Many are complementary but ultimately all identify learning processes as the central locus of addiction.

Associative learning processes have been modelled across the entire spectrum of addiction, from drug consumption to negative reinforcement during withdrawal, compulsive drug seeking and relapse during extinction (i.e. post-treatment). The prevailing accounts of substance use addictions place these at the heart of explaining how individuals

transition from recreational to pathological use of substances (Everitt & Robbins, 2016; Hogarth et al., 2013). A number of these theories emphasise an imbalance in behavioural control toward habitual processes, with dysfunction or failure of control.

1.2. Associative learning in behavioural addictions

While the associative model is the standard account of drug addictions, this is not the case for behavioural addictions. As the following two sections will highlight, an individual difference approach to behavioural addiction tends to be the most common within the research literature. Gambling however does have a significant associative learning research base (Brown, 1987; Dickerson, 1979; Ghezzi, Wilson, & Porter, 2006; Haw, 2008), following Skinner's (1953) analysis of slot machines. Like drug addictions, these have attempted to model different aspects of gambling play. A significant research effort has focused on how contextual stimuli drive preferences in equivalent concurrent slot machines (Nastally, Dixon, & Jackson, 2010; Zlomke & Dixon, 2006). Others have focused on the effect of different types of stimulus, such as near misses (Daly et al., 2014; Ghezzi et al., 2006; Reid, 1986) (van Holst, Chase, & Clark, 2014), big wins (Kassinove & Schare, 2001), losses disguised as wins (Dixon, Harrigan, Sandhu, Collins, & Fugelsang, 2010), or the structural features of gambling games (Griffiths & Auer, 2013) and their effect on behaviour. Many of these studies have looked at different aspects of gambling, such as machine preference (Dymond, McCann, Griffiths, Cox, & Crocker, 2012), rate of gambling (Dixon et al., 2010), post reinforcement pauses (Delfabbro & Winefield, 1999), latencies between gambles (James, O'Malley, & Tunney, in press), fixed interval schedules in betting (Dickerson, 1979), the random ratio schedule of reinforcement (Crossman, Bonem, & Phelps, 1987; Haw, 2008; Hurlburt, Knapp, & Knowles, 1980) and perseverance during extinction (James, O'Malley, & Tunney, 2016). Similar to drug addictions, these have also looked at the role of different types of reinforcement in addictive gambling and changes in behavioural processes (Horsley, Osborne, & Wells, 2012). The concept that different types of reinforcement drive distinct subtypes of gambler is central to models of problem gambling (Błaszczynski & Nower, 2002; Sharpe, 2002). Nonetheless, it has been argued that the predominant approach to gambling research focuses on individual differences between recreational ('normal') and 'problem' gamblers (Cassidy, 2014). The behavioural literature on gambling is still less developed than substance addictions. Animal models of gambling are still in their infancy (Winstanley & Clark, 2016), and new types of reinforcement are still being discovered (Dixon et al., 2010). There is also a lack of betting related analysis in this field, some notable instances excepted (Dickerson, 1979; McCrea & Hirt, 2009).

Although it is often assumed that gambling and other behavioural addictions share common, underlying features, research looking at behavioural and cognitive processes in gambling and substance use addictions suggests this might not be so. Gambling has many similarities to drug addictions (Leeman & Potenza, 2012), but the existing differences may seriously qualify whether indicators of behavioural addiction should directly translated from disordered gambling. The learning processes in gambling have a number of idiosyncrasies that distinguish it not only from drug addictions but also many of the candidate behavioural addictions identified in the literature.

One possible difference is in the respective schedules of reinforcement and the maintenance of drug consumption. Drug consumption is by and large continuously reinforced although the value/magnitude of reinforcement may alter as addiction progresses, either due to changes in the rewarding value of the drug (Robinson, Fischer, Ahuja, Lesser, & Maniates, 2016) or reward processing (Koob & Le Moal, 2001). Additionally drug seeking is modelled on a second order schedule of reinforcement.

It is unclear which component of gambling behaviour translates to this concept, and there are multiple candidates in the literature. The

primary candidate is physiological arousal produced by gambling behaviour that is subsequently associated with gambling cues and stimuli. It has been argued that arousal is one of the primary components in maintaining gambling behaviour (Brown, 1987). The other alternative is near-misses, where a similar component to drug seeking has been proposed (Ghezzi et al., 2006). It has been alternatively proposed that near-misses get their predictive value from winning outcomes i.e. near-misses on a slot machine must occur prior to a win (Daly et al., 2014), largely in the same manner as arousal. Additionally the two interact; studies have shown greater levels of autonomic arousal in recreational gamblers to losses disguised as wins (Dixon et al., 2010), and greater reactivity to near-misses in problem gamblers (Dymond et al., 2014; van Holst et al., 2014).

Whereas in drug consumption associations are maintained by conditioned reinforcers, in gambling it is more complex. First, gambling's schedule of reinforcement (independent of cues) is thought to be associated with increased elicitation of behaviour (Crossman et al., 1987; Haw, 2008; Hurlburt et al., 1980; Madden, Ewan, & Lagorio, 2007). Second, there may be two components to the role of conditioned stimuli and conditioned reinforcement in gambling. The first is the standard environmental cues that might trigger gambling associations in the same manner as drug behaviour. The second, which has been extensively studied in slot machine paradigms, is the role of conditioned reinforcement during gambling consumption in the absence of wins.

Other considerations focus on the role of extinction, where the contingencies between response and outcome are abolished, or a shifting of responses in the face of a reversal of contingencies. Studies of gambling addiction suggest that deficits in this domain are more common and consistent than substance addictions (Leeman & Potenza, 2012). With gambling, the interesting question is whether this is due to exposure to gambling's schedule of reinforcement that, as explored above, drives perseverance through multiple aspects of conditioned reinforcement. Although the different components of compulsivity are less understood than impulsivity, it may be the case that both gambling and drug addictions transition from impulsive to compulsive behaviour, but behaviourally express the latter in different ways. If this is the case, these differences may be specific to gambling and not translate to other behaviours.

In contrast, there is evidence that numerous disorders on an impulsive-compulsive spectrum, including behavioural addictions, show similar deficits in impulsive choice and action as other addictions including gambling (Robbins & Clark, 2015). Studies have looked at the application of behavioural economic approaches to impulsive choice drawn from operant conditioning research (Bickel & Marsch, 2001), or the application of the delay discounting paradigm in understanding behavioural addictions (Reed, Becirevic, Atchley, Kaplan, & Liese, 2016). A greater literature exists in the field of obesity, where parallels with eating/food addiction have been drawn with delay discounting performance in other addictions (Amlung, Petker, Jackson, Balodis, & MacKillop, 2016a; Amlung, Vedelago, Acker, Balodis, & MacKillop, 2016b; MacKillop et al., 2011). Other studies have found in binge eaters that there is no difference in impulsive action compared with controls (Voon et al., 2014).

Other associative research has looked at different models of addiction in the context of eating. There have been several strands to this research. The first looks at the type of addiction model to apply to disordered eating behaviours; whether a substance or behaviour based addiction model is the most appropriate (De Jong, Vanderschuren, & Adan, 2016; Hebebrand et al., 2014). This research has studied the question of whether the locus of addictive behaviour is in the food (i.e. the nutritional constituents of processed or sugary food) or in eating behaviour. The second is the application of associative models of addiction to eating behaviours and disorders (Berridge, 2009; Robinson et al., 2016; Smith & Robbins, 2013). Third is the comparison with other addictions such as tobacco, as an example of an addiction where evidence for many of the prototypical markers of addiction are

attenuated, but belie key similarities and public health outcomes (Schulte, Joyner, Potenza, Grilo, & Gearhardt, 2015). These are considered alongside the role of reinforcement and behaviour in the similarities with other addictions.

1.3. Research approaches to behavioural addiction

The typical approach to behavioural addictions often takes three steps (Billieux et al., 2015). The first step to applying a behavioural addiction analysis begins with observations or anecdotes around the behaviour in question. Often in the same exercise, this then forms the justification for developing an assessment instrument for an addiction to that behaviour. This is typically developed by adapting the criteria from the DSM-IV conceptualisation of pathological gambling or drug dependence (American Psychiatric Association, 2000), general criteria for addiction, or by translating across from other behavioural addictions scales (e.g. internet, video gaming). This is conducted alongside, or spurs subsequent research collecting additional psychometric data measuring a number of constructs related to addictions, primarily in the domains of risk taking and impulsivity. It has been argued that this is part of a confirmatory, atheoretical approach that lacks specificity (Billieux et al., 2015). The end result of this has been a series of candidate addictions where there appear to be a substantial number of addicts but rarely a clear reason for why the behaviour they engage in is addictive. In many cases these have the superficial markers of addiction, often showing associations with constructs more common among disordered gamblers or substance users. We argue that an associative approach is a useful heuristic model for capturing the current consensus on behavioural addictions, at least for behaviours that researchers may compare against gambling. Although these criticisms have been well stated in the literature, it is the contention of this review that a consensus about which behaviours meet the definition of a psychiatric illness and require public health intervention is unlikely to emerge without taking into account the role of behaviour.

The previous sections highlighted how the individual or trait determinants of addictive behaviour take precedence over behavioural research. Much of the work that considers reinforcement and conditioning in behavioural addictions does so in the form of vicarious reinforcement (Bandura, Ross, & Ross, 1963) or discusses operant conditioning in a very general sense, rather than identifying how specific aspects of a behaviour are reinforced, maintain or become habitual. The majority of attempts to apply learning based approaches have been in gambling and food/eating addictions. Many commentaries or research papers do mention there is a role for conditioning in the behaviours in question. However, as in behavioural addictions as a whole, there is a lack of specificity in this regard. There is little consideration of the reinforcers that drive perseverative behaviour. Like gambling, many of these behaviours will be conducted repeatedly in a short space of time. Even then, surveys of the gambling literature have noted that there is an overwhelming preponderance to focus on individual pathology and disorder (Cassidy, 2014; Reith, 2013). This has meant that the causal understanding of problem gambling has often focused on why problem gamblers behave in a disordered fashion rather than why gambling is addictive. One of the concerns enunciated by Young et al. (2014) was the over application of the addiction model to behaviours where its relevance is at best tenuous (in this case frequent flying). It is highlighted how an addictions narrative can be highly powerful, but there were compelling reasons why it should not be applied. This reiterates the criticisms of a behavioural addictions approach from the social sciences that the predominant account of addiction is one that seeks to 'other-ize' inappropriate forms of consumption. This seats the locus of consequences and causality in the disordered consumer rather than the industries that propagate these behaviours. However, as noted by Reith (2013), a number of these critiques are less relevant to a behavioural approach to gambling and addictions, which focus on the role of the product in controlling behaviour.

While there have been multiple commentaries on behavioural addictions over the past 2–3 years (Billieux et al., 2015; Griffiths et al., 2016; Petry et al., 2016; Starcevic & Aboujaoude, 2016), the role of associative learning in behavioural addictions has not been explored in detail. It has been noted that the decision to include gambling in the DSM-5 as an addiction was made based on the convergence between substance addictions and pathological gambling across a range of different domains (Potenza, 2015). A behavioural approach is likely to be prominent among these, and is therefore helpful in considering the criteria under which a pathological, behavioural addictions model is appropriate for certain behaviours. The contention we put forth is that an associative learning based conceptualisation of behavioural addictions is the most parsimonious model of the current state of behavioural addictions in the DSM, notwithstanding the trenchant criticisms the DSM also faces. The following section explores Internet Gaming Disorder in further detail, identifying behavioural similarities and how an increasing convergence between video gaming and gambling provides further evidence these originate from a similar model.

2. Behavioural addictions in the DSM – the case of internet gaming disorder

2.1. Addictions in the DSM

The conceptualisation of addiction in the DSM has changed over time, emerging from personality disorders before becoming a discrete type of disorder in the 1980's. In the first DSM (American Psychiatric Association, 1952), addictions (alcohol and drugs) were considered as a secondary diagnosis under the category of 'sociopathic personality disorder' alongside a range of other antisocial and deviant behaviours. In the DSM-II (American Psychiatric Association, 1968), both became primary diagnoses in the category of personality and non-psychotic disorders, the non-personality, non-psychotic disorders being addictions and sexual deviance. The present conceptualisation as a distinct category emerged with the DSM-III (American Psychiatric Association, 1987). This separated addictions from personality disorders, with addictions being assessed on Axis I under Psychoactive Substance-Induced Organic Mental Disorders whereas personality disorders were assessed on Axis II of the DSM's multiaxial system. The DSM-IV (American Psychiatric Association, 2000) retained this demarcation under 'Substance Related Disorders', identifying these as disorders of dependence. Pathological Gambling was introduced in the DSM-III as part of Disorders of Impulse Control Not Otherwise Specified, included alongside other disorders such as kleptomania, pyromania, intermittent and isolated explosive disorders. This approach has been maintained in the ICD-11 (Grant & Chamberlain, 2016). Gambling Disorder was included as the first behavioural addiction in the DSM-5 (American Psychiatric Association, 2013), which also included Internet Gaming Disorder as potentially suitable for future inclusion, given further research. In addition to addiction's transitory history, models of addiction focus on a shift from impulsivity to compulsivity, highlighting how facets of the transition toward addictive behaviour touch on a range of other psychopathologies.

2.2. Internet gaming disorder – the next behavioural addiction?

Internet Gaming Disorder as it is considered in the DSM-5 refers to a restricted set of behaviours focusing around online video game usage. One of the controversies concerning whether this is included as a disorder in future revisions is whether it should include other forms of content consumed over the internet, as an internet use disorder or internet addiction (Kuss, Griffiths, & Pontes, 2016). Many secondary aspects of online and mobile video gaming, particularly when free, have a similar behavioural profile to gambling. For many games, items are distributed on a Variable-Ratio (VR) or Random-Ratio (RR) schedule designed to elicit copious behaviour, often utilising gambling or pseudo-gambling mechanisms in a 'freemium' model to monetise their

platform. These mechanisms are used to nudge in-game spending in lieu of an up-front payment. Video gaming is an example where translating from problem gambling to a behavioural addiction is a reasonable first step. The typical profile of internet games (at least traditionally) has been different from other video games. Online games have traditionally been more 'grind' heavy, where random processes dominate the mechanisms for item drops within the game.

While previous commentaries consider the role of game played, from a behavioural perspective both miss an important behavioural consideration: Griffiths et al. (2016) for instance raise the possibility that the type (i.e. goal-directed versus competitive) or genre of game as being worth consideration under separate addictions, whereas Petry et al. (2016) suggest that such a demarcation is unhelpful and unlikely to endear psychiatrists. The possibility that certain video games are designed toward maximising perseverance is not surprising, as developers have always attempted to maximise playtime. Ultimately however a behavioural perspective suggests that some games will be addictive and some will not, not that internet games or a specific genre are addictive as a whole.

2.3. Does internet gaming follow a gambling model?

A fundamental consideration that has yet to be answered is whether the addictive nature of internet games is the same or distinct from gambling – is it due to a schedule of reinforcement that encourages extended play in the face of a frequently frustrated outcome? From a behavioural perspective, it follows that this is the case. Moreover, it suggests that internet gaming in of itself is not addictive, but that certain games are based on how they are designed. This echoes a similar distinction between gambling games that have a relatively negligible risk of harm (e.g. lotteries) versus those that are linked with an increase prevalence of problem gambling (e.g. electronic gaming machines or fixed odds betting terminals) based on their structural features (Griffiths & Auer, 2013). The DSM's tentative demarcation based on monetary loss is heuristically useful as it captures a number of the contextual differences that are observed between gambling and gaming. However, there is increasing evidence that this demarcation is becoming obsolete.

Innovations in the gaming market have increasingly involved the adoption of gambling-like processes into games. The literature has previously explored both simulated gambling (e.g. Griffiths, King, & Delfabbro, 2012) and social casino games (e.g. Gainsbury, Hing, Delfabbro, & King, 2014). These kinds of simulated play allow the opportunity for some form of free engagement with a gambling mechanism, usually as a means of item distribution. These, like simulated or social games, typically allow this engagement often to occur using a form of secondary currency earned in-game. Extra plays can then be sought, typically by the player purchasing extra secondary currency using real money. The amount an individual can spend on a play typically ranges from between \$1 and \$3. The appearance of these mechanisms may not be drawn from games of chance, but it is worth noting that many of these games also explicitly use gambling themes, such as scratchcards or reels to present the outcomes to the player. Although the DSM distinguishes between internet gaming and gambling on these grounds, freemium games are nudging spending behaviour for some players that increasingly make this distinction fuzzy. As mobile gaming continues to grow these mechanisms are likely to become more prevalent, but there is little data on how they affect players. Although only a minority of players spend money on social gambling apps (Parke, Wardle, Rigbye, & Parke, 2012), it is unclear whether a similar pattern exists for simulated gambling in video games, and whether these players overlap. It is also unclear if these subsequently transition to real-money gambling, or if there is a gradient between these activities.

There is cross-pollination between these activities; recent events have highlighted how potentially illicit betting takes place in e-sports,

and how in-game collectibles ('skins') have been used as currency for betting and gambling, including among adolescents. These are behaviourally interesting as it involves users gambling using a currency that can only be obtained via random outcomes (or trading). The illicit nature of these is due in part to legal restrictions in the USA over online betting, and a potential population of bettors gambling under the age of 18. A number of the most prominent websites in this area have recently been restricted by game distribution platforms for this reason. Some have sought gambling licenses to continue operations. A similar media focus has been raised over the convergence of video gaming and gambling in the form of betting on spectator video games (e-sports) in an analogous manner to professional sports.

The other thing to consider is that distinct from many behavioural addictions is that the manner that a game, gambling or video, is designed is intrinsically related to its harmful and potentially addictive properties. Griffiths and Auer (2013), in critiquing the research on problem gambling prevalence in game type, noted how structural characteristics of a game have dramatic effects on behaviour, using the example of how the difference between lotteries and keno is primarily in the latency between plays. This has been highlighted both in the behavioural (James et al., *in press*) and social sciences literatures (Schüll, 2012) to explore how slot machines are designed to be addictive. Whereas in drug addictions many of the cues and conditioned reinforcers are incidental in the environment with the salient exceptions of licensed drinking and smoking (e.g. shisha or hookah bars) establishments, in gambling and internet games these are directly under the control of the person designing them.

2.4. Caveats

A behavioural analysis is unlikely to capture all of the features sufficient for a potential behavioural addiction, and there are important contextual differences between gambling and internet gaming. The games on which problem gamblers tend to most over-represented (machine gaming, online gambling) are generally solitary and isolating whereas the instances where random ratio schedules are most employed in internet gaming tend to be social and collaborative affairs (i.e. in Massively Multiplayer Online Role Playing Games). Moreover reinforcement schedules are not the only thing that makes gambling addictive, and there are individual and wider social determinants that must be kept in mind. Even RR heavy online games typically offer a wider array of options to the player than a typical game of chance. Similarly some forms of gambling (i.e. betting) do not fall as straightforwardly onto an RR schedule (Dickerson, 1979) but do appear to be addictive. While there is behavioural research in these domains it is less well explored than in slot machines.

The DSM-5's evidence base for Internet Gaming Disorder is primarily based on disordered gaming in Asia, where some of the games that might be characterised as especially addictive (i.e. *Starcraft* in South Korea) don't have these schedules of reinforcement. It is of considerable interest that some of these games are strategic and highly goal-directed. As many accounts of addiction model a transition from goal-directed to stimulus-directed behaviour, understanding the potential addiction to a goal-directed game might be informative in understanding addictive behaviour more generally.

Additionally, the accounts mentioned in this paper are primarily derived from positive reinforcement. There is a voluble literature on the role of negative reinforcement in substance addictions, and models of problem gambling identify a subgroup of gamblers for whom gambling is driven by escape (Błaszczynski & Nowe, 2002; Jacobs, 1986). Additionally, it is well known that some personality traits exert an influence on behaviour. Impulsivity for example effects components of response perseverance as identified by Leeman and Potenza (2012) and others (Breen & Zuckerman, 1999).

3. A framework for understanding behavioural addictions

The aim of this is to consider when it is appropriate to apply an addictions perspective to a behaviour that is harmful across the population when consumed in excess. Gambling and video gaming might be reinforced quite differently to substance addictions, and it is unlikely to be replicated across all of the potentially harmful behaviours. Most accounts of addiction and studies of behaviour note that these behaviours are positively reinforcing, making reference to operant conditioning and habit. References to operant conditioning in particular are common in the literature, but do not tend to expand too far on the reinforcing elements within a behaviour (Andreassen, 2015; Grall-Bronnec et al., 2015; Shepherd & Vacaru, 2016; Wallace, 1999; Wu, Cheung, Ku, & Hung, 2013), therefore a greater specificity is required.

A number of factors are likely to affect the relationship between acquisition, reinforcement and extinction of addictive behaviours. Although we refer to the critiques of correlating risk taking constructs with behavioural addictions, there is utility in examining how these constructs act in interactions between human behaviour and these addictive products. Moreover in the case of new technologies, some of these might moderate the relationship between addiction and behaviour; this case has been made for mobile gambling (James et al., *in press*). For other excessive behaviours, content downloaded onto phones might form an additional source of reinforcement or a cue (i.e. push notifications) that maintain or prompt behaviour. It is also important to consider where positive reinforcement is coming from; is it primarily from the activity itself (which is where most analyses of behavioural addictions stop), or is it more from generalised contextual cues, as an arousal based explanation of problem gambling predicts. It is also important to consider what cues and contextual stimuli are driving behaviour, particularly for technology-based addictions where these are under greater control of the designer.

The most important challenge is to model how a candidate behavioural addiction is maintained. The research thus far has focused on identifying indicators of addiction without considering how the potential addicts have reached that point. Aside from the concerns that these states appear transient (Konkoly Thege, Woodin, Hodgins, & Williams, 2015), what differentiates these from gambling and substance addictions is that the maintenance of these behaviours prior to habitual or compulsive seeking have been modelled extensively. Many behavioural addictions papers have noted that a potentially addictive behaviour is reinforced, but have not explored which components of that behaviour are reinforcing.

Perspectives on behavioral addiction rarely consider the manner in which the reinforcement is delivered, for example, if the behaviour is partially reinforced (such as gaming or gambling), what is the schedule of reinforcement? Reinforcement might be also delivered by the physiological consequents of the behaviour, such as arousal from gambling that subsequently generalises, or from the act of eating or the effects of sugar/fat/salt. Many of the activities classified as addictive are a composite of a number of behaviours. Take the use of Twitter for example, especially pertinent as social media use has been hypothesized to be a putative addiction (Wu et al., 2013). Which component or components drive persistent use? It might be the act of being followed by other people, posting and sharing information (and the uncertain, intermittent feedback and reinforcement from this), or the repeated, habitual checking given the live nature of the website. The analysis of gambling behaviour is notably more granular than other behavioural addictions.

Research studying candidate behavioural addictions might begin by considering whether there is a behavioural basis to translate from gambling (and potentially internet gaming) to the behaviour in question. Starting from the associative research in addictions might generate a wider array of potential approaches than currently exist in the literature. For many activities highlighted in the literature a direct application of disordered gambling is unlikely to be appropriate. Instead there is scope to translate from a range of other addictions, and the theories

and paradigms of eliciting behaviour that are associated with them. Earlier on we explored how the starting point for eating addiction came from substance addictions, with an interest comparison with nicotine addiction and is now starting to move toward a behavioural addiction model in some areas. These kinds of approach may prove more fruitful than developing an instrument and measuring the prevalence of addiction-like indicators of recreational activities.

Another consideration is the drivers of persistent behaviour within the activity. Most candidate behavioural addictions (e.g. gambling, social media, cycling) involve a large number of reinforcements within a session. There may also be need for greater clarity concerning the changes in reinforcement that might occur as a behavioural addiction progresses. In gambling for example, near-misses appear to acquire an increased salience (or other outcomes lose theirs) as the severity of the gambling disorder increases (Dymond et al., 2014). The key caveat here is that this requires a way of identifying individuals who experience some sort of change in their interaction with an addictive behaviour. This may be an instrument (and thus form the latter part of a program of research), or a clinical sample.

We suggest that behavioural addictions research ought to begin from a different starting point, and with different initial questions to ask. The present approach of identifying these addictions appears to miss important groundwork before attempting to measure an addiction within a validation sample or the general population. It is worth making parallels with gambling here again: Prior to the classification of Pathological Gambling in the DSM-III in 1980 (American Psychiatric Association, 1987), there had been over two decades of intermittent research on the effects gambling had on behaviour. Post-classification, it was another seven years before the first major screen (the SOGS, Lesieur & Blume, 1987) was developed for clinical screening and a further few years before gambling prevalence surveys became commonplace. While we hesitate to suggest such latency is appropriate, many explorations of behavioural addiction appear to skip a crucial step in this regard.

4. Concluding remarks

The behavioural addictions literature has focused on identifying people with behavioural addictions but has frequently failed to consider why certain behaviours might be addictive. One of the criticisms of gambling research has been an over-emphasis on individual dysfunction as the locus of gambling problems as well as preponderance upon the latter stages of addictive gambling. At present the behavioural addictions literature has translated markers from gambling and substance use disorders to identify people with a behavioural addiction. It remains unclear whether the participants identifying as displaying indicators of an addiction are doing so as the polymorphous and multi-faceted expression of a general addiction syndrome or psychopathology, or whether it is peculiar to a specific behaviour. In other words, while the literature successfully identifies 'addicts', whether this has any relation to an addictive behaviour or not, it has not explored addictiveness. The aim of this is to highlight how an associative approach can be used to look at the behaviour itself, and consider how these may ultimately drive pathological behaviour at least partially independent of individual psychopathology.

What emerges from the behavioural addictions literature at present is that there are a substantial number of people who appear to experience levels of distress (in many cases severe) from certain kinds of behaviour or consumption. Irrespective of whether a behaviour is addictive or not, more specific, behaviourally targeted research can still be beneficial to these people. Practically if the unit of addiction (or harm, or distress) can be behaviourally identified, this can be used to inform the targeting of cognitive and behavioural therapies to make them more efficacious. These are typically used at present as a treatment for people presenting with a behavioural addiction. At present CBT is one of the first lines of treatment for problem and disordered gamblers

(Bowden-Jones & George, 2015). Some tenets of CBT (e.g. challenging irrational thinking) might be perceived as controversial in their extension to addictive consumption behaviours, but there are behavioural therapies (i.e. targeting processes such as extinction) that might be equally beneficial.

The search for candidate behavioural addictions is unlikely to be futile. Although disordered gambling is currently the prototypical behavioural addiction by default, developments in this field may eventually show that a constellation of other behaviours are more typical of a behavioural addiction. More likely than not is that disordered gambling will be the first behavioural addiction that comes to mind for most, but it is quite possible that it will be idiosyncratic among other behavioural addictions once those being to emerge.

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