Innovative Treatment Approaches in Gambling Disorder

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10.1 Introduction

Treating disordered gambling can be challenging. There is ample empirical evidence suggesting a complex and dynamic interaction of genetic, developmental, cognitive, psychosocial, and environmental factors in the development and maintenance of excessive gambling behavior [1, 2]. There is also a growing recognition that gambling disorder (GD) and substance use disorders (SUDs) share clinical, endophenotypical and neurobiological similarities [3, 4], culminating in the inclusion of GD in the substance-related and addictive disorders category of the latest DSM-5 [5]. Furthermore, individuals suffering from GD are not a homogeneous group. Rather, disordered gamblers report distinct motivations for gambling [6], as well as a range of different intra- and interpersonal characteristics in the symptomatological expression of GD [7].

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Designing effective interventions for GD is further challenged by the difficulty in reaching individuals suffering from gambling problems. Less than 10% of disordered gamblers ever seek help and enter treatment [8, 9]. This is partly related to most gamblers having difficulties to acknowledge they have a problem. Among those who do, the most frequently reported reasons for not seeking help include shame, stigma, and difficulties in disclosing personal issues, lack of motivation to stop gambling, desire for self-reliance, lack of awareness of treatment options, concerns about treatment content and quality, or issues with treatment attendance and costs [10, 11].

As local gambling opportunities continue to change and grow, with greater acceptability and accessibility and the progressive legalization of varieties of online gambling services, there is an urgent need for the development of effective prevention initiatives and support programs. Despite the surge of empirical studies on various therapeutic approaches (cf. Chap. 9 by Ginley, Rash, & Petry), the evidence on the differential and long-term effectiveness of these therapeutic approaches is still limited [12]. Thus, it is impossible to define “best practice” treatment standards for addressing disordered gambling at this time.

This chapter presents an overview of recent advances in research on innovative treatment approaches and modalities for gambling problems, ranging from training interventions based on addiction models, neuromodulation techniques, and employment of modern digital technology, to tailored interventions and integration of multiple methods. Altogether, these novel domains of research on gambling interventions share the goal of enhancing therapeutic effects and overcoming barriers and limitations to existing treatment programs by meeting the heterogeneous needs and demands of this particular clinical population.

10.2 Cognitive Training

10.2.1 Dual-Process Models of Addictive Behaviors

Dual-process models describe addiction as the result of an imbalance between two different types of neurocognitive processes: a bottom-up impulsive motivational processing network in which limbic structures such as the ventral striatum and amygdala play a crucial role, and top-down control processes representing inhibition of impulses based on long-term and goal-directed reflective considerations, associated with a network including the dorsolateral prefrontal cortex [13, 14]. However, dual-process models have theoretical problems and have been criticized for being neurologically implausible [15]. As a solution, neurocognitive models have been proposed emphasizing temporal dynamics dependent on the reinforcement of cognitive functions together with iterative reprocessing, in which the features of cognitive-motivational processes shift from impulsive to reflective with more reprocessing [16, 17]. It is important to be aware of these theoretical developments when considering recent advances in cognitive interventions in addiction [18, 19].

One crucial ingredient of interventions in addiction is to help people to develop a long-term perspective, including personal goals that conflict with continuation of the addictive behavior [20, 21]. This is directly compatible with the motivational interviewing approach, a therapeutic technique originally developed by William ("Bill") Miller in the context of addiction treatment and now applied more widely [22]. However, sometimes motivation alone is not enough for a successful quitting attempt. Theoretically, motivation may be present but not sufficient by itself or not readily enough activated to change the outcome of response selection processes, in particular in situations that advantage impulsive responding. In other words, the addicted person may know at some level that discontinuation of the addictive behavior would be better in view of long-term goals, but at the same time addiction-related cues may capture attention, may trigger memory associations and elicit trains of thought related to continuation, and in some cases even trigger action tendencies toward the addictive behavior [18, 23]. In recent years, several varieties of cognitive training have been developed, which may help motivated clients to bias their addiction-related decision-making toward a discontinuation of the addictive behavior. While these training programs have been rather successful as add-on to regular treatment of SUDs, especially when added to inpatient treatment for alcoholism [18, 24, 25], we do not know yet whether this approach works for problematic gambling as well. Further, a mechanism hypothesized to play a role in the disproportional influence of bottom-up, cue-elicited processes is neural sensitization resulting in sensitized responses to cues predicting the addictive behavior [14, 26], based on the work of Robinson and Berridge [27, 28], and we do not know whether this mechanism plays a similar role in gambling. However, there are indications that similar cognitive biases, such as attentional bias, also occur in gamblers (e.g., [29]; for a narrative review, see [30]), strengthening the case for cognitive training in gambling.

Cognitive training paradigms can be classified into two broad types: those aimed at modifying impulses and those aimed at increasing cognitive control in general [18]. The first type of training aims to modify cognitive biases automatically triggered by addiction-related stimuli (i.e., Cognitive Bias Modification paradigms). The training can focus on attentional processes (attentional bias retraining), action tendencies (approach bias retraining), or memory processes (e.g., evaluative conditioning). The second class of training typically involves many sessions of training general cognitive control functions such as working memory and has been applied with some success to addiction [31–33].

10.2.2 Cognitive Bias Modification

Cognitive bias modification (CBM) refers to a class of cognitive training paradigms that target specific automatic attentional, behavioral, or evaluative biases triggered by addiction-related cues. These biases have repeatedly been shown to play an important role in addiction, leading researchers to believe that finding a way to modify these biases could drastically advance the treatment of addiction [18]. Encouraged by results in the domain of anxiety, researchers started developing such methods [34–36]. The resulting training paradigms are typically based on assessment versions of reaction-time tasks used to measure the targeted cognitive bias, with a built-in stimulus-response contingency to manipulate the bias [18, 37].

For example, to manipulate selective attentional processes toward salient cues, researchers adjusted the visual-probe task [34]. In this task, participants have to respond to a probe presented at the location of one of two stimuli displayed next to each other on the computer screen (e.g., an addiction-related picture and a neutral picture). In the assessment version of the task, the probe is presented equally often after both stimuli. The idea is that participants show a faster response when the probe appears at the location on which their attention was already focused [38]. In the training version of the task, the stimulus-probe contingency is manipulated so as to consistently present the probe at the location of the neutral stimulus, thus training participants to consistently shift attention away from addiction-related cues and to attend to neutral cues instead. Similar contingencies are added to other tasks used to train different biases (e.g., approach bias and memory associations) and to stimulate learning of a new stimulus-response association counteracting the previously learned, dysfunctional implicit associations. The underlying idea is that repeated training can reduce or even invert biases and lead to behavioral change [18].

10.2.2.1 Attentional Bias Modification

Motivationally salient cues have the ability to grasp our attention over neutral cues and interfere with the processing of our surrounding environment by “hijacking” our cognitive resources. This attentional preference has been called attentional bias [18]. While mostly studied in the domain of anxiety, where threatening stimuli seem to grab the attention of anxious participants more than neutral or positive cues [39], the role of attentional bias has also been more recently explored in addictive behaviors by using training varieties of two reaction-time tasks: the emotional Stroop task [40] and the visual-probe or dot-probe task [41]. Both tasks measure the attentional interference induced by salient (i.e., addiction-related) cues [42]. Using these two tasks, attentional bias toward addiction-related cues has been found in tobacco [43, 44], alcohol and drugs [45, 46], cannabis [47], heroin [48], cocaine [49], and in the eating domain [50]. Moreover, attentional bias has been found to be related to addiction severity ([51–53]; but for a critical review, see [54]).

A few studies have investigated the role of selective attentional processes in GD as well (for a review, see [30]). Consistent with other addiction disorders, problematic and pathological gamblers show generally faster reaction times toward gambling-related cues, compared to other stimulus categories [55–60]. This attentional preference for gambling-related cues was also found in other behavioral measures of attention [29, 57, 61]. Further, neuroimaging studies on cue reactivity for gambling stimuli found increased activations in fronto-striatal reward circuitry and brain areas related to attentional processing in pathological and problematic gamblers compared to healthy controls [62, 63]. Importantly, some research suggests gamblers’ attentional bias is specific to their preferred gambling activity [64, 65].

Building upon this knowledge, researchers tried to manipulate and retrain selective attentional processes using adjusted versions of the same tasks used to measure this bias, i.e., attention bias modification (ABM) paradigms. A first group of experimental studies on ABM for alcohol successfully manipulated the attentional bias toward alcohol or neutral cues, with participants trained to avoid alcohol cues reporting less craving for alcohol compared to participants trained to attend to alcohol cues [66, 67]. However, manipulation of alcohol attentional bias did not affect alcohol consumption after the training. In a further study with heavy drinkers trained to avoid alcohol cues, ABM was successful in decreasing alcohol attentional bias [68]. However, this effect did not generalize, as participants did not show reduced attentional bias for untrained alcohol cues. No effects on craving were found either. Following these early preliminary lab studies, in a first clinical study with alcohol-dependent patients, 5 ABM sessions were offered as an add-on intervention atop treatment as usual (3–6 months of CBT [69]). Patients were randomized to either ABM training or sham training. Results indicated that ABM was successful in reducing alcohol attentional bias in the experimental condition, and this effect did generalize to novel alcohol stimuli. As in the previous studies, a reduced attentional bias did not result in less craving. However, participants who received the ABM training were discharged faster and took significantly longer to relapse. Other studies using different training paradigms (i.e., the Alcohol Attention-Control Training Program based on the emotional Stroop task) over multiple sessions found similar results: reduced attentional bias after ABM training, resulting in reduced alcohol consumption and increased motivation to change drinking habits [70], but results are hard to interpret and not conclusive due to the lack of a control group. In a more recent study, this training was combined with a motivational intervention in a full factorial design, with ABM yielding primarily short-term reductions in drinking, while motivational enhancement yielded more long-term changes [71].

The investigation of ABM interventions with smokers has produced rather mixed results, with ABM not always successfully reducing attentional bias toward smoking cues [72, 73]. Smoking-related attentional bias can be manipulated, albeit not always resulting in sustained effects or changes in craving and smoking rate [74, 75]. In contrast, one study in a more natural environment did find effects of ABM on smoking attentional bias and craving in participants not seeking help [76]. However, the reduction in attentional bias and craving did not result in decreased smoking behavior, which is not surprising given the fact that the participants did not want to quit smoking. A longitudinal study including help-seeking smokers varied the number of ABM sessions (0–3) across participants [77]. Results indicated ABM successfully reduced attentional bias, and the sustainability of this effect was dependent on the number of sessions (up to 6 months for participants receiving three ABM sessions). However, reduced attentional bias once again did not result in reduced craving or abstinence. A recent study obtained more promising results: smokers who wanted to quit were invited to participate in an online ABM program, based on the visual-probe task [78]. Participants were selected based on motivation to quit: only those who confirmed an actual quit attempt were included. While the clinical trial did not result in significant effects in the whole group, it did significantly increase 6-month abstinence in the subgroup of heavier smokers.

ABM studies have also been conducted in the field of eating disorders, with similar findings: reversed attentional bias for unhealthy foods with generalization to novel food cues [79]. Moreover, manipulating attentional bias for food-related cues affected craving for and consumption of unhealthy foods [80, 81]. ABM has also been used to promote healthy food choice by increasing attentional bias for healthy food cues, with a related increase in consumption of healthy food [82].

To our knowledge, no study has been published on the effects of ABM in gambling disorder yet. However, a first pilot randomized clinical trial is currently ongoing [83], where an online ABM program including 6 sessions of training is being tested with a sample of problematic and disordered gamblers. The researchers hope to answer the question as to whether ABM is potentially effective in reducing gambling-related attentional bias and gambling problems.

All in all, ABM seems to be effective in altering attentional bias for motivationally salient cues in addictive behaviors. Results on the effectiveness of ABM in reducing craving or actual consumption, however, are mixed. It should be taken into account that most of the research done on ABM in addictive behaviors can be considered experimental, often using just one session of training, whereas in the first, albeit very few, clinical studies with motivated patients receiving multiple ABM sessions on top of treatment as usual, ABM does seem to have clinically significant effects. In the light of the psychopathological and endophenotypical similarities between GD and other addictive behaviors and the evidence on cue-induced selective attentional processes in problem gamblers, ABM holds promise as an innovative (add-on) treatment approach for GD targeting conditioned attentional processes.

10.2.2.2 Approach Bias Modification

As mentioned in Sect. 10.1, through conditioning, addiction-related cues and behaviors acquire incentive salience properties for triggering impulsive, automatic, and involuntary motivational states [27, 28]. As a result, these cues not only grab our attention, but they can also induce a state of behavioral preparedness and approach tendencies toward those cues signaling the upcoming reward, i.e., approach bias. Approach bias has received increasing interest over the last few years, since it appears to play a crucial role in the onset and maintenance of addictive behaviors [18]. Addiction-related cues do gain increasing motivational incentive salience over time, in turn resulting in an increased tendency to reach for or move toward these cues.

Reaction-time assessment tasks of approach bias generally require participants to either approach or avoid certain cues, based on specific stimulus characteristics. The cues themselves are often a mix of neutral (e.g., photos of flowers, animals, landscapes, daily objects or activities, etc.) and addiction-related cues (e.g., photos of slot machines or alcoholic beverages). Depending on the type of task, stimulus features on which the approach or avoid decision has to be made can be either related or unrelated to the contents of the stimulus (i.e., relevant- or irrelevant-feature tasks, see [84–86]). Frequently used tasks to measure approach bias are the relevant-feature manikin and stimulus-response compatibility task [87, 88] and the irrelevant-feature Approach Avoidance Task (AAT [89]). Using these tasks, addiction-related approach bias has been documented in different addictive behaviors, including smoking [90–92], cannabis use [47, 93], drinking [42, 89, 94], and even toward unhealthy foods in overeaters and overweight individuals [95–99]. Moreover, the strength of the approach bias seems to be related to addiction severity and addictive behavior escalation across substances [91–93, 98]. A study in the alcohol domain has also associated the strength of an approach bias to a genetic variation: male carriers of the G allele in the OPRM1 gene showed a stronger approach bias for alcohol and other appetitive cues, compared to noncarriers [89].

A first set of studies has been recently conducted to examine the role of gambling-related approach bias in Canadian and Dutch problem and non-problem gamblers, using an adapted version of the AAT with gambling stimuli tailored to participants' gambling preferences [100, 101]. Results demonstrated the presence of approach bias toward gambling cues among Dutch gamblers with moderate-to-high severity of gambling problems, compared to non-problem gamblers [101], but not for Canadian problem gamblers [100]. Moreover, gambling approach bias predicted frequency and duration of prospective gambling episodes, over and above baseline neutral approach bias and gambling frequency and duration, respectively [101]. Even though not yet replicated, these results are consistent with findings in other addictive behaviors and support the hypothesis that automatic approach tendencies also play a role in problematic gambling behavior.

Similar to ABM, assessment tasks used to measure approach bias have been adapted to retraining paradigms, falling under the category of approach bias modification (ApBM). The first experimental study delivered one session of ApBM with a training version of the AAT, to train participants to either approach or avoid alcohol [94]. At posttest, participants who were trained to approach alcohol cues proved to be faster to approach (i.e., pull the joystick) alcohol cues, while those who were trained to avoid (i.e., push the joystick) alcohol cues showed an increased avoidance bias toward alcohol. These results also generalized to novel cues and to another implicit task using words instead of pictures (i.e., the approach-avoid Implicit Association Test [102, 103], based on [104]). Moreover, heavier drinkers who were successfully trained to avoid alcohol cues drank less alcohol during a subsequent taste test [94].

Consecutive clinical studies on AppBM in alcohol showed similar results (for a recent review and meta-analysis, see [105, 106]). Two large-scale randomized clinical trials have been published [24, 25]. In both studies, ApBM was implemented as an add-on to treatment as usual (primarily CBT therapy). The first of these studies ($n = 214$) found that 4 sessions of ApBM had a long-term positive effect on relapse rate in alcohol-dependent participants 1 year after treatment completion [24], with 13% less relapse in trained patients compared to controls, who were either assigned to a no-training control group or to a sham-training (continued assessment) control group. A second replication study ($n = 509$) with 12 sessions of training found similar results, with 9% lower relapse rate after 1 year in the experimental group. The large sample size allowed for determination that the clinical effect was mediated by the change in alcohol approach bias. Moreover, a moderation effect was also found: participants with a strong alcohol approach bias prior to treatment and of older age benefited most from the ApBM training [25].

A reduced relapse rate in the experimental group was also found when 4 sessions of ApBM or sham training were offered to inpatients during the early week of detoxification phase before treatment as usual [107]. It is interesting to note that an optimal dosage of AppBM is not yet known. In a re-analysis of Eberl et al.'s data [25], the same authors investigated the dose-response relationship of ApBM intervention and found 6 ApBM sessions to be the mean optimum dosage but also indicated that a proportion of participants showed further improvement after 9 and 12 sessions [108].

The implementation of ApBM for smoking behavior provided promising initial results, with participants receiving one session of online ApBM showing reduced levels of smoking after 4 weeks [109] and after 3 months [110]. However, these results should be considered preliminary. Other results of ApBM in smoking are somewhat mixed and appear to be dependent on the setting and the motivation of participants (e.g., [111]) and the amount of behavior change in studies is still very limited [106]. A few studies have started exploring the efficacy of ApBM in other addictive behaviors, such as unhealthy food intake [112–114]. However, when the approach bias toward unhealthy foods was not successfully modified, ApBM did not have any behavioral effect [115], consistent with the mediation effect demonstrated in the alcohol domain. A preliminary study in a different form of behavioral addiction, namely, online gaming, reported that a single session of ApBM resulted in a reduced approach bias to gaming cues, subjective urges, intention to play, and game-seeking behavior [116].

To our knowledge, there is as yet no published study on ApBM in GD. First attempts are however under way encouraged by the discovery of an approach bias in problem gamblers [101]. An online ApBM program is currently being tested with Belgian and Dutch problem and disordered gamblers (the randomized clinical trial has a parallel-group design testing both ABM and ApBM interventions [83]). Personalized motivational feedback has been added to the training program to increase training adherence and prevent dropout. The same research group also launched a second web-based study combining online ApBM with internet-based CBT program with chat-based guidance from a trained therapist [117]. Participants receive nine CBT sessions through online chat with the therapist and, concurrently, nine sessions of AppBM. The same Canadian-Dutch group that found an approach bias in problem gamblers [101] also launched a subsequent study investigating whether problem gambling symptoms can be reduced trough an online program combining 4 sessions of ApBM with dynamic personalized motivational feedback, the latter added to increase adherence (Stewart, S.H., personal communication, March 2017).

The evidence suggesting a role of approach bias in addictive behaviors is accumulating and already quite extensive, with first results pointing to similar automatic associative processes in disordered gambling. The use of ApBM paradigms to decrease or reverse approach bias toward addiction-related appetitive cues has provided promising results and is also currently tested in the gambling population. ApBM has the potential to become an innovative add-on treatment program, when used in addition to regular treatment or as low threshold and not too intensive training program for motivated participants. Future research is warranted to further investigate the clinical effectiveness of AppBM, hopefully leading to a better understanding of its working mechanisms and operational optimization.

10.2.2.3 Evaluative Conditioning

The last CBM paradigm is evaluative conditioning (EC), which is based on the assumption that behavior is influenced by implicit attitudes or associations [118]. These implicit attitudes are formed through experience and are activated whenever coming in contact with (addiction-related) environmental cues that have been associated with a strong emotional valence and anticipatory expectation of reward.

Indeed, there is some evidence for implicit evaluative associations to predict unique variance in additive behaviors [119]. For example, implicit positive attitudes have been found to predict escalation of alcohol consumption [120], to correlate with nicotine dependence and predict relapse in smoking [121], and to predict food choice [122]. In gambling, implicit positive attitudes seem to be associated with greater gambling involvement and more gambling-related problems and uniquely predict gambling behavior above and beyond explicit outcome expectancies [123–126] and to be a hallmark of problem gamblers [127].

EC has been designed to target these dysfunctional attitudes, based on the assumption that, similarly to how these attitudes are developed, repeatedly pairing addiction cues with emotional or valenced cues results in dominant evaluative associations. EC can work both ways by creating new positive or negative valence associations and has previously been used in, among others, the areas of advertising, racial prejudice, and anxiety and phobias [118, 128, 129].

More recently, researchers have begun assessing the effectiveness of EC in addictive behaviors. In alcohol, EC resulted in stronger implicit and explicit negative attitudes toward alcohol, less craving for alcohol, and less alcohol consumption directly after and 1 week following the intervention [130, 131]. Interestingly, one study found EC was only effective in changing implicit alcohol attitudes when general negative images were used and not when photos of frowning faces were used [130]. This implies implicit alcohol attitudes are perhaps more strongly influenced by experiencing affective states than by social feedback.

In the eating domain, EC increased implicit negative attitudes toward unhealthy foods [132–135] while leaving explicit attitudes and cognitions intact [132, 136]. In a number of studies, EC also resulted in reduced unhealthy food intake [132], possibly through a mediating role of implicit attitudes [134]. However, in other studies, EC did not produce any behavioral result [133, 135]. Interestingly, the effectiveness of EC in changing implicit attitudes also appears to be greatest in those with prior stronger implicit attitudes and those with low emotional control [132, 134, 135], partially similarly to the moderation effects observed in AppBM for alcohol [25]. It should be noted that a lot of research done on EC in the food domain demoted unhealthy food choices while simultaneously promoting healthy food choices. Hence, behavioral effects of EC (choosing to eat a healthy snack vs. an unhealthy snack in a subsequent taste test) should be interpreted with caution since it is unclear whether these effects are due to devaluation or promotional effects, or perhaps even both.

These first proof-of-principle studies in alcohol and food intake have pinpointed the positive effects of EC in reducing the strength of positive memory associations with addictive cues. The deployment of EC as a therapeutic approach is still in the experimental phase, and more studies are necessary to further prove its validity as an effective training program. To our knowledge, no studies have yet explored the effects of an EC program in GD.

10.2.3 General Cognitive Training

General cognitive control training aims at improving the ability to self-control. We can better visualize the role of self-control by using the metaphor of a rider riding a horse and trying to steer it in an intended direction. The horse represents our impulses and urges striving for immediate gratification and the rider our intentional plans of action and ideas of where to go. In spite of the clear goal of reaching the destination, the rider needs to be able to tame and guide the horse, preventing it from taking over whenever something interesting and appetitive appears along the path. General cognitive training helps in improving the rider's strength to tame the horse and guide it in the intended direction [137].

This class of training targets executive functions often used to exert self-control and guide behavior, such as working memory and response inhibition. However, sometimes a training may have different effects than one might expect; for example, selective inhibition training has often been classified as a variety of cognitive control training, but in fact, a specific response to a cue can also be trained (e.g., a no-go response to an addiction-related cue), which makes the addiction-related associations more negative (e.g., [138, 139]) but does not increase general inhibition capacity [138].

10.2.3.1 Working Memory Training

Working memory training (WMT) is used to improve working memory capacity (WMC), which refers to the ability of transiently holding, processing, and manipulating information. WMC is a core executive function and a crucial factor in cognitive processes such as monitoring, planning, problem-solving and decision-making, and performing complex cognitive tasks such as learning, reasoning, and comprehension [140]. As such, WMC appears to be heavily involved in top-down control and guidance of behavioral processes.

WMC deficits are seen in a number of unhealthy and addictive behaviors. In smokers, for example, WMC has been found to be impaired after a period of abstinence [141], and impaired WMC during abstinence was a predictor of relapse [142, 143]. In alcohol, WMC interacts with impulsivity and cognitive biases in predicting alcohol consumption, in line with the role of WMC in top-down processes (see review by Wiers et al. [144]). WMC deficits indeed predict alcohol use in those with strong cognitive biases or high impulsivity [145–147]. Moreover, a longitudinal study on early alcohol use in adolescence showed that WMC deficits preceded impulsivity, which in turn predicted alcohol use [148]. This same interaction has been reported in predicting drug use [149]. Results in cannabis use and unhealthy food intake show similar patterns [150, 151].

In problem gambling, the role of WMC seems to be more complex. In a number of studies, problem gamblers did not differ from healthy controls on measures of WMC [152–154] while one study did find WMC deficits in problem gamblers [155]. It is also unclear whether or not WMC can predict gambling or gambling relapse after treatment.

Considering the role of WMC in addictive behaviors, training programs aiming to increase WMC could be a promising and efficient addition to regular therapy

[140]. A meta-analysis indicated that improving WMC is in fact possible through WMT [156], and WMT seems especially effective in those with low WMC [157–159], although one critical meta-analysis expressed concerns regarding these results [160]. WMT paradigms generally consist of several visuospatial or sequence recall tasks in which participants are required to mentally store and recall increasingly complex information [32, 33, 161].

WMT interventions have been experimentally tested in individuals who heavily consume, or have problems with, a variety of substances. In alcohol, WMT was effective in improving WMC and reducing drinking at 1-month follow-up [33], with the strongest effects in participants with strong automatic impulses or associations. One study assessing the effects of WMT in stimulant addiction reported that WMT did not produce any effect on a number of cognitive measures, including a measure of WMC, but WMT did improve performance on a delay discounting task [32]. In a follow-up study, the authors proposed delay discounting to be closely related to WMC [162]. The effects of WMT have also been studied in unhealthy eating [163]. In obese adolescent inpatients, WMT resulted in enhanced WMC but did not improve weight loss at discharge. However, those who received WMT better maintained their weight loss 8 weeks after discharge. At 12 weeks after discharge, the advantage of the WMT subsided [163]. In a study with adult overweight individuals, WMT effectively reduced eating-related thoughts, overeating in response to negative emotions, and food intake among participants with strong dietary restraint goals, but no changes in BMI, craving or hunger in the laboratory were observed [164]. To the best of our knowledge, no studies exist assessing the effects of WMT interventions for disordered gambling.

Considering the role of WMC in decision-making processes and in regulating behavior and the preliminary results of WMT in other addictive behaviors, WMT would seem a promising addition to existing therapy for gambling problems. However, results so far are mixed, and some authors are concerned with the generalized effectiveness of WMT [160]. Future research is therefore needed to further investigate the role of different WMC components in addictive behaviors and particularly in disordered gambling, due to the absence of exogenous neurotoxin intake, which possibly leads to different patterns of neuropathology in disordered gambling vs. substance addiction. Broadening the understanding of the role of WMC in behavioral addictions would then also result in more refined training programs efficiently manipulating it.

10.2.3.2 Selective Inhibition Training

Research shows that, similarly to SUDs, inhibitory control plays a crucial role in the formation and continuation of GD [165, 166]. Indeed, problem gamblers tend to score lower on measures of general inhibitory control [63, 152, 167–172]. The notion that deficits in inhibitory control play an important role in addictive behaviors led to the idea that training and improving general inhibition could reduce addictive behavior. However, results of general inhibition training on addictive behavior are mixed and effects limited (e.g., [173–175]; for a review, see [176]).

Interestingly, some theories have taken a different approach in explaining the relation between inhibitory control and addictive behavior. These theories state that inhibitory control should be considered a fluctuating state dependent on internal and external momentary states and conditions, including the influence of environmental cues [177, 178]. In support of this idea, studies in addictive and eating behaviors have shown that states of impaired inhibitory control can be induced by addiction- and food-related cues [179–182]. This state, in turn, has been shown to prospectively predict addictive behavior [180].

Further support for the role of selective inhibition in addictice behaviors, as opposed to general inhibition, comes from studies trying to train inhibitory control in addiction using adapted tasks used to measure response inhibition or impulsivity, such as the go/no-go task [183] or the stop-signal task [184]. While quite similar in task structure and purpose (i.e., assessing response impulsivity), it has been argued these tasks measure two distinct processes: a more associative and bottom-up form of cognitive inhibition (go/no-go task) and a more controlled and top-down form of motor inhibition (stop-signal task; for a moredetailed explanation of differences between the processes underlying the two tasks, see [185]). Inhibition training in addictive behavior is, in general, more effective when using the go/no-go task [176, 186], as automatic inhibition leads to devaluation of no-go cues [187], whereas there is no evidence that controlled inhibition devalues stop-signals. These results and the differential effects of using addiction-specific cues as targets [178], led to a reconceptualization of inhibition training, separating (top-down) general inhibition training and (bottom-up) selective inhibition training (SIT) [188].

Most research into SIT has been conducted in the eating domain, wherein researchers were interested in reducing the intake of unhealthy foods. The majority of the studies are proof-of-principle lab studies comprising a single session of an adapted go/no-go training paradigm. Results indicate that SIT is effective in increasing inhibition for food cues [189, 190] and, more importantly, is effective in reducing the intake of unhealthy foods post-training [189–193]. Interestingly, the effects of SIT were especially strong for participants who were hungry or regularly ate unhealthy foods [193] and for participants who had a high BMI or were chronic dieters [190]. Effects on craving are mixed, with some studies indicating reduced craving after SIT [189], while others do not [192]. One study using training with the adapted stop-signal training found the same pattern of decreased unhealthy food intake after SIT training, albeit only for participants who scored high on general impulsivity prior to training [194].

A small number of studies have looked at the effects of multiple SIT sessions on unhealthy eating behavior. Studies using the go/no-go training task found SIT resulted in greater weight loss and a reduction in intake and liking of unhealthy foods directly after treatment [175, 195]. The effect of SIT on weight loss was still present after 6 months [195] and was strongest in participants with a high BMI prior to treatment [175]. However, no behavioral effects were observed. One study using a stop-signal training task found SIT resulted in increased inhibitory control directly after treatment, but not at a 1-week follow-up [174]. Furthermore, effects of SIT on weight loss were mixed, and no behavioral effects were found.

Few studies have looked at the effects of SIT on (heavy) drinking. One study using a one-session go/no-go SIT found heavy drinkers developed negative attitudes toward alcohol and reduced their alcohol consumption in the week following training [139]. A second study in heavy drinkers found one session of stop-signal SIT reduced craving and alcohol consumption directly after training but not in the week following training [173].

In the field of behavioral addiction, there is a paucity of research on SIT. Only one study in sex addiction presented one session of go/no-go SIT training with sexually appealing cues. SIT resulted in cues being rated as less appealing and a reduced sex approach bias directly after training [196]. To our knowledge, no studies have been reported on the effectiveness of SIT in GD, nor are we aware of any such studies presently being conducted or proposed.

Two recent meta-analyses summarized the effectiveness of SIT, concluding it does produce a contingent effect on addictive behavior but that evidence of long-term effectiveness is still mixed [174, 188]. SIT effectiveness does not appear to depend on the number of training trials and training programs using the go/no-go paradigm as the training task showed more positive effects than studies using the stop-signal task. Furthermore, participants who are motivated to change their behavior seem to benefit the most from SIT.

To conclude, the revised conceptualization of SIT working mechanisms encourages the endorsement of SIT as a potential candidate for future research on innovative treatments for GD, since GD is characterized by fluctuations of selective cue-induced states of impaired inhibitory control, rather than general response inhibition problems [159]. SIT works by increasing selective inhibitory control and is especially effective in motivated participants with low selective inhibitory control for addiction-specific cues [175, 190, 191], consistent with findings in CBM for alcohol approach bias [25].

10.3 Brain Stimulation

In the past decade, there has been a surge of interest in the use of neuromodulating interventions in the treatment of a broad range of both neurological and psychiatric disorders, such as depression, anxiety, and addiction [197–199]. The concept of neuromodulation refers to the temporal (noninvasive) modulation of brain neurophysiology within specific regions and circuitries, aimed at changing related emotional and behavioral patterns. Two main neuro-technologies have been commonly used to externally modulate cortical excitability: repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS).

rTMS generates repeated pulses of high-intensity magnetic field by passing a brief electric current through an inductive coil placed on the scalp. This magnetic field induces an electrical current in the brain tissue beneath the coil, resulting in alterations of neural excitability (i.e., neuron depolarization). In addition to its cortical action and as a function of the placement of the coil, rTMS may act remotely on deeper brain structures via brain circuits and interhemispheric connections [200, 201]. tDCS is another method capable of modulating cortical excitability. It consists of delivering a low-intensity electric field (1–2 mA) through the brain between two external electrodes placed on the scalp and inducing a subthreshold modulation of neuronal membrane potentials.

rTMS and tDCS can have both enhancing and inhibiting effects. Anodal tDCS over the dorsolateral prefrontal cortex (DLPFC) increases excitability, while cathodic tDCS reduces it. Likewise, high-frequency rTMS exerts an enhancing effect, while low-frequency rTMS has an inhibitory effect. Increasing (prefrontal) cortical excitability is hypothesized to enhance cognitive functioning. Specifically, noninvasive brain stimulation over the prefrontal cortex region is increasingly shown to (transiently) modify impulsivity and its different components, such as decision-making and delay discounting [202, 203]. Of importance, impulsivity is strongly linked with the pathogenesis (initiation and continuation) of GD [204, 205] and as such might represent an important target for therapeutic interventions. Within this context, neurostimulating interventions such as rTMS and tDCS applied to the DLPFC may indirectly modulate dopaminergic pathways and consequently have an impact on the symptoms of addiction, i.e., improving cognitive control and reducing craving [197].

Within clinical samples, tDSC and rTMS have shown clinically relevant effects specifically on reducing craving for alcohol, cocaine, and nicotine [197, 206]. However, their temporal effect indicates the need of repetitive treatment. In contrast to SUDs, hardly any studies have currently been done on GD, although from a viewpoint of etiology/pathogenesis, the similarity with SUDs might suggest that these interventions could be of use in patients suffering from GD and/or other behavioral addictions. With regard to rTMS, a recent small study showed that high-frequency rTMS of the medial prefrontal cortex (PFC) and continuous theta burst stimulation (cTBS) of the right dorsolateral PFC, can reliably reduce motivational and physiological reinforcement effects of slot machine gambling in men diagnosed with GD [207]. These positive findings contrast an earlier, even smaller study showing no effect of deep TMS on gambling behavior [208].

Taken together, based upon the hypothesized neurophysiological working mechanisms associated with noninvasive neuromodulation techniques and the findings from clinical studies in SUDs, neuromodulation interventions can be expected to be effective within the treatment of GD. As such, they represent a novel line of interventions. However, at this point in time, studies are few and findings preliminary. In addition to the clinical effectiveness, many questions remain to be explored. These include, among others, exploring the exact components of gambling behavior (and cognitions) that are affected, the location of the coils, depth and intensity of the stimulation, and the ideal repetition time. Indeed, although neurostimulation has been suggested to initiate a process of neuroplasticity [209], and as such a more sustainable change, questions remain about how long a stimulation period is necessary and indeed whether the initial effects will hold up. Finally, there is a need for future studies exploring whether neuromodulation as an add-on to cognitive treatment can enhance the treatment effect. First studies, albeit in heavy alcohol drinking populations, point in that direction [210, 211]. Whether this holds for the treatment of GD remains to be explored.

10.4 Digital Interventions

Overcoming barriers to treatment is one of the primary challenges for healthcare providers when designing, evaluating, and delivering evidence-based care in an accessible and cost-efficient fashion. Broadening the outreach and offering low-threshold programs, tailored to the demands for privacy and self-reliance, and ensuring sensitivity to the socioeconomic conditions of problem gamblers [10, 11] could potentially decrease treatment-seeking stigma and stimulate behavior change on a larger scale. In order to achieve such goals, research in innovative interventions for GD has recently began exploring new mediums of administering treatment. One such a medium sparking researchers' interest is also increasingly being used by gamblers to engage in their activities: the Internet and, more generally, digital technology [212–214].

In the past decade, digital technologies have increasingly become pervasive in all aspects of our daily lives. Mobile and wireless technologies, including laptops, smartphones, tablets, and embedded cameras, promote real-time connectivity in every moment of our lives and provide instant access to a monstrous amount of information, news, documents, and services available nonstop. For health and healthcare, the Internet infrastructure provides a compelling profusion of possibilities to develop and integrate digital health products, services, apps, and platforms, into care protocols complying with the advances in technology, new findings about the determinants of health and illness, and changing modalities of healthcare and recipients' needs.

10.4.1 What Is E-health?

The World Health Organization defines *E-health* as the use of information and communication technologies for health purposes, in which health resources and healthcare are being communicated and transferred by electronic means, facilitating healthcare management and promotion, the confidential communication between caregivers and clients, and a wide outreach of health services to a large scale. Digital health interventions also fall under the field of E-health and refer to "interventions that employ digital technology to promote and maintain health, through primary or secondary prevention and management of health problems" ([215], p. 814). They include web-based programs accessible via smartphone, laptop, and tablet devices but can also employ automated healthcare and communication systems, mobile "apps" (m-health), virtual reality and serious games, and mobile, wearable, and environmental sensors that can provide intelligent monitoring and feedback as and when needed (e.g., ecological momentary assessment and interventions [216]).

It is important to note here that "digital interventions" generally refers to the implementation of therapeutic principles in a digital environment rather than an entirely novel type of interventions [217–219]. In doing so, digital interventions expand the reach of traditional interventions, building upon existing therapeutic principles and harnessing the potential of increasingly sophisticated new technologies, whether it is through serious games, web-based craving diaries, or cognitive training applications. Digital health interventions are typically automated, interactive, and personalized, employing user input or sensor data to tailor feedback or treatment pathways without the need for direct health professional input, although they may still include elements of tele-healthcare (i.e., remote interaction with or monitoring by health professionals). Digital interventions can then facilitate healthy behaviors and lifestyles by supporting the individual in the "real world," outside the highly protected clinical setting, to promote change in behaviors associated with specific contexts in the individual's daily life. Compared to standard face-to-face treatment, digital interventions give users the opportunity to empower self-reliance and self-management skills in a setting that is immediately and intrinsically linked to their health problem and guarantee convenience, 24/7 accessibility, and availability. These features are particularly relevant for hard-to-reach populations and users who seek help but are not inclined to use traditional services, such as at-risk or problem gamblers. Furthermore, as problem recognition and desire for anonymity also appear to be an important barrier to prevention and treatment access, Internet-based screening and support tools for problem gamblers are one way of increasing accessibility due to the confidentiality and nonjudgmental quality of digital interventions [220].

A number of recent systematic reviews have demonstrated the beneficial effects of digital interventions stand-alone or in combination with standard treatment, including Internet-based programs [221–224], mobile applications [225–227], serious games [228–230], and virtual reality environments [231, 232], to promote healthy behaviors and lifestyle (e.g., smoking cessation, healthy eating, physical activity, or alcohol consumption); improve treatment adherence, self-management, and outcomes in people with long-term health conditions (e.g., depression, anxiety, diabetes, asthma, or chronic pain); and provide remote access to effective treatments (e.g., digitally delivered CBT or motivational interviewing for different mental and somatic disorders).

10.4.2 Web-Based and Smartphone Interventions

A general Google search on "how to stop gambling online" gives about 2,930,000 results (November 2016), listing a myriad of websites providing help tools ranging from educational information such as books, brochures, checklists, and functional guidelines, self-assessment instruments, forums for gamblers, and modular self-directed programs to online counseling and chats with therapists. However, until recently only a few studies systematically examined the potential effects of digital interventions for GD, thus providing scientific evidence for their value as an effective and solid treatment option. Most of them created self-directed, web-based interventions based on motivational interviewing and CBT protocols described in existing self-help books [233, 234].

Carlbring and Smit [235] examined the efficacy of a therapist-assisted, 8-week Internet-based CBT program with minimal therapist contact via e-mail and weekly telephone calls of less than 15 min, relative to a wait-list control condition in a sample of 66 pathological gamblers. Participants randomized to the online intervention reported significant improvements in gambling problems, anxiety, depression, and quality of life, compared to the wait-list group at the posttreatment assessment. Treatment effects were sustained in follow-ups at 6, 18, and 36 months, but no medium- and long-term between-group comparison at follow-up was possible given that participants in the waiting list received treatment before the follow-up data collection [236].

Similarly, Castren et al. [237] delivered an online 8-week CBT program for gamblers in Finland, comprising 8 modules containing psychoeducational, motivational, and cognitive-behavioral exercises, relapse prevention information and exercises, homework assignments, and a maximum of 30 min of weekly telephone support provided by 4 trained therapists. The participants could also join online discussion groups. Significant decreases in gambling expenditure, gambling-related problems and erroneous thoughts, and impaired control over gambling from baseline to post-treatment were observed. Gambling urges also decreased after the intervention and sustained after 6 months.

Fully online supporting materials have also been designed to increase accessibility to healthcare, such as the brief personalized feedback screener for problem gamblers Check Your Gambling (www.checkyourgambling.net [238]). The feedback included a summary of gambling severity, gambling-related cognitive distortions, and a list of techniques to lower the risk associated with gambling, personalized to the participant's responses to an extensive screening survey. The screening tool was further tested compared to a wait-list control with Ontario-based gamblers with moderate to severe gambling problems, with or without the addition of normative feedback [220]. The study reported mixed results: none of the two interventions affected gambling expenditure, with all conditions reporting reduced amount of money spent from baseline to the 12-month follow-up, but the personalized feedback intervention without norms reported a lower number of days gambled, compared to the normative personalized feedback and the wait-list control. The authors concluded that despite the modest positive results, a personalized feedback intervention may have a limited, short-term impact on the severity of problem gambling. Further, it shows potential for a wider outreach of the gambling population and for motivating gamblers to seek further help online or in person [220]. Noteworthy, in the first 15 months the website was active, 1321 tests were recorded, and 78% of respondents were screened as severe problem gamblers, indicating that the online screener reached the population it had been designed for.

More recently, Luquiens et al. [239] conducted a large-scale randomized clinical trial with 1122 non-help-seeking online problem gamblers, in particular poker players, testing three web-based psychotherapy modalities compared to a wait-list control condition: (1) personalized normalized feedback on gambling status by e-mail, (2) a downloadable self-help book adapted from the six-step CBT program by Ladouceur and Lachance [234] with no guidance, and (3) the same CBT program e-mailed weekly by a trained psychologist with personalized guidance. The program lasted 6 weeks, and the main outcome measure was a change in problem gambling severity. At the end of treatment, no significant differences were found between any of the groups. Importantly, high dropout rates were observed, particularly in the group receiving the CBT intervention with guidance. The authors concluded that web-based treatment in nontreatment-seeking populations may have poor acceptability if it requires a large investment of time and participants have no motivation to change their behavior.

Another recent randomized clinical trial tested an online intervention for disordered gambling with a sample of high school students in Italy [240]. Twelve classes were randomized to either an online personalized feedback control group or an intervention group that participated in a 3-week online training in addition to the same feedback. The extended web intervention included question-and-answer games and quizzes, which educated students about gambling activities and concepts such as luck and probability, as well as gambling-related characteristics, such as prevalence of problem gambling and cognitive distortions. At the 2-month follow-up, the intervention group reported significantly fewer gambling problems compared to the control group. However, only participants who were frequent gamblers at baseline showed a significant decrease in proxy measures of gambling severity such as gambling frequency, expenditure, and attitudes.

Currently, there are multiple ongoing randomized clinical trials testing the effectiveness of a variety of treatment programs for gambling problems delivered via the web [83, 117, 241, 242]. Hodgins et al. [242] are evaluating the effectiveness of a fully online version (*Self-change Tools*) of the self-directed CBT program developed by Hodgins [233], incorporating workbook materials, relapse prevention, and motivational interviewing elements, in comparison with the online screener Check Your Gambling developed by Cunningham et al. ([241]; both tools are available at www.problemgambling.ca). The same research group is also testing the same online self-directed CBT program versus an extended version additionally including an intervention for anxiety and depression, with a sample of problematic gamblers with and without co-occurring mental health problems, disclosing interest in online self-help materials [241].

Motivational interviewing interventions for gambling problems have also started being adapted to the web [243]. A text-based, online self-directed motivational enhancement intervention (iMET) has been implemented based on a previous study on brief motivational interventions for problem gamblers [244], with the goal of building commitment to change. Participants received a final report with a review of their gambling behavior and concerns, gambling severity, motivation and confidence to change, values, decisional matrix, and goals. A randomized clinical trial is currently testing the iMET versus the online screener Check Your Gambling. Although the study is still ongoing, preliminary results for the first 40 participants randomized to the two conditions show, similar to the RCT by Cunningham et al. [220], that both groups reported decreases in gambling involvement over the 3-month follow-up and increases in motivation to change, irrespective of received intervention. However, there is a first indication that iMET may positively affect gambling severity, as shown by a marginally greater reduction in problem gambling severity compared to the group completing the Check Your Gambling online screener [243].

Computerized CBM interventions, previously presented in this chapter, are also suitable to be administered online, thus showing potential of being a low-cost, low-threshold addition to conventional treatments. However, it should be noted that in general, CBM has shown to be less effective in online interventions than in a clinical setting, presumably because in an online intervention, it is harder to effectively change the cognitive bias (which requires focused attention [245]). This pattern can also be observed in CBM for addiction [246]. Currently, there is one ongoing study testing the effectiveness of a stand-alone online CBM program targeting selective attention and automatic approach tendencies toward gambling cues in a sample of Dutch and Belgian problematic and pathological gamblers [83]. The program consists of 6 sessions of training, combined with brief automated personalized feedback on gambling motives and reasons to quit or reduce gambling at baseline and at the start of each training session, similarly to Swan and Hodgins et al.'s studies [243, 244]. Another online study by the same research group is launching soon, combining an online CBT program specific for gambling problems with 9 chat sessions with a therapist and 9 sessions of ApBM in parallel [117].

Despite advancements in the implementation and deployment of online interventions for gambling problems, it should be noted that there is still a paucity of published literature about the use of smartphone applications to deliver gambling interventions. It is noteworthy to mention, though, that ongoing research and technological development are focusing on exploiting the benefits of mobile technology to provide gamblers with tools to monitor and support their goals of behavioral change. For example, the Problem Gambling Institute of Ontario developed and published a free online app to help cutting down or quitting gambling, *Mobile Monitor Your Gambling & Urges* (MYGU; http://www.problemgambling.ca/gambling-help/mygu-getmobile/). MYGU promotes self-awareness of gambling behaviors, i.e., it gathers information about gambling behaviors, such as money expenditure, and reports back to the gambler the date and time of craving episodes and their triggers, alternative activities they perform instead of gambling, wins and losses when they gambled, and feelings and consequences if they gambled or did not gamble. The app also complements counseling sessions and provides information to therapists. Another smartphone application has been recently developed and preliminarily evaluated by researchers at the University of Auckland [247]. *SPGETTI* (*Smartphone-Based Problem Gambling Evaluation and Technology Testing Initiative*) was designed to support people with a gambling problem who are seeing counselors and accessing services to receive "just in time" and "at the right place" support, specifically to prevent relapse and remain abstinent from harmful gambling on electronic gambling machines.

There is an emerging body of literature demonstrating the promising efficacy of online cognitive-behavioral and motivational interventions. However, despite the existence of various treatment paradigms, there are only a few methodologically sound, empirical studies comparing the differential, long-term efficacy of these therapeutic approaches. Further studies and development efforts, particularly in the field of m-Health, are currently exploring new venues of treatment programs and modalities, in terms of their effectiveness comparability, clinical feasibility, and utility.

10.4.3 Virtual Reality Interventions

Virtual reality (VR) technology allows the user to navigate and to interact in real time with a virtual three-dimensional environment. VR has mainly been used to deliver cue exposure therapy by using a head-mounted display (HMD or helmet), which is a pair of goggles allowing the presentation of images in stereoscopy, combined with audio stimuli and a motion tracker that follows the user's head — and sometimes also eye — movements. VR offers great control over different types of stimuli and the rhythm of their presentation and provides the opportunity to conduct exposure as well as relapse prevention in various locations (e.g., a bar or casino) that could provoke different reactions in the same person. The fact that VR is interactive and very similar to real-life situations also adds to the acceptability and ecological validity of therapy, thereby lowering the threshold for seeking treatment.

A pilot clinical trial comparing the use of standard imaginal exposure with immersions in a VR bar was conducted with 28 pathological gamblers participating in a 28-day residential CBT program [248]. The first and the last session of the CBT program were modified to include VR. Results revealed that the first VR immersion uncovered significantly more high-risk situations and more dysfunctional thoughts than the standard imaginal exposure exercise. In the second session, devoted to relapse prevention, immersion in the virtual bar was associated with stronger changes in urges to gamble compared with the imaginal exposure condition. Furthermore, changes in urges to gamble induced during the relapse prevention session significantly predicted patient improvements. No ethical issue or adverse events were reported following the use of VR (e.g., inducing too intense craving or cybersickness).

Another study explored the effects of a one-session VR cue exposure paradigm for disordered gamblers [249]. Ten participants moved throughout a virtual bar with 5 video lottery terminals for 5 times. Although the desire to gamble significantly increased when participants transitioned from the practice environment to the gambling environment, this study was unable to confirm the process of extinction because it consisted of only a single 20-min session. A more recent experimental study included 5 sessions of VR exposure and relaxation training with a small sample of 12 recreational gamblers [250]. All virtual environments with casino-related cues triggered subjective gambling urges, albeit with no associated psychophysiological arousal response. Urges to gamble decreased after repeated exposure to two main VR cues, playing a casino game and discussing gambling with a colleague, while psychophysiological arousal measures did not significantly change across sessions.

The investigation of VR for gambling problems is still in its infancy. However, despite the preliminary nature of the first experimental studies, alongside the lack of control conditions and long-term follow-up assessments, the use of VR seems to be a viable and promising medium to safely deliver exposure interventions for addictive behaviors without all the inconveniences of in vivo exposure techniques.

10.4.4 Serious Games for Behavioral Change

The term gamification is widely used to indicate the application of gaming elements in nongame contexts to influence behavior, improve motivation, and enhance engagement, such as adding progress bars to a website to show how much of your profile you have filled in, adding points, badges, leaderboards, peer pressure, quests or missions, social interactions, and more to things that normally would not have them. Serious games take this concept one step further: they contain gameplay elements commonly found in video games and, most importantly, are designed for a specific purpose besides mere entertainment.

Currently, there is only one published pilot study looking at the effects of using a serious game as a therapeutic intervention for gambling disorder [251]. The authors explored the feasibility and effectiveness of a serious game specifically designed to treat impulse control disorders like gambling disorder. The overall goal of the serious game, *PlayMancer*, was to train emotion regulation and impulsivity control by improving problem-solving and planning skills, as well as control over general impulsive behaviors and relaxation skills via three mini-games of increasing difficulty. The serious game was incorporated as a complementary therapy tool into a CBT program in a male sample of 16 treatment-seeking participants with severe gambling disorder. The intervention consisted of 16 weekly group CBT sessions and, concurrently, 10 additional 20-min weekly sessions of the serious game. After the intervention, significant changes were observed in severity of gambling problems, several measures of impulsivity, state anxiety, and general psychological distress. Furthermore, dropout and relapse rates during treatment were similar to those described in the CBT literature.

While this is the first semi-experimental study to describe the results of an intervention for gambling problems based on a serious game, the application of gamification and serious games for health and behavior change has become more and more widespread [229]. The exploitation of gamification techniques and the development of serious games as a low-threshold intervention, or as a complement to or enhancer of conventional treatments, could prove to be an interesting and innovative tool to promote users' motivation and engagement in behavior change, and a viable training tool, especially when designed to target concrete problems or specific skills, such as monitoring gambling expenditure or improving risky decision-making and impulse control.

10.5 Innovative Approaches on Existing Treatment

10.5.1 Tailoring

Personalized medicine has been gaining a stronger interest and endorsement in all areas of healthcare, including addiction [252]. Inter- and intraindividual heterogeneity in the gambling population and different clinical profiles of GD strongly confronts researchers and clinical practitioners with the necessity of shifting treatment approaches and methods from a "one-size-fits-all" to a more tailored variety. This implies a targeted focus on the patient's individual, cultural, and environmental characteristics and a better selection of treatment strategies to increase positive outcomes and reduce misdiagnoses and costs.

For example, personalized treatment programs for GD have been recently explored that use available research information on problem gambler subtypes to develop and test novel "matched treatments." These treatments utilize intervention techniques that target each subtype's unique treatment needs [253]. This work is informed by the successes of such matched treatments when applied in other areas of addiction treatment. For example, Conrod and colleagues [254, 255] have developed novel personality-matched interventions for SUD treatment and prevention, which involve unique interventions for individuals at risk for SUDs as a function of their personality features and associated risky motives for use. In this approach, the interventions provided to a sensation seeker (i.e., one who prefers novelty and intense stimulation) are quite different from those provided to a hopeless (i.e., depression-prone, negative thinking) individual, for example. Relative to a variety of controls, in a series of randomized controlled trials, these personality-matched treatments have been shown to reduce substance misuse among those with existing SUDs and to reduce substance use and delay uptake of substance use in youth when used in a school-based prevention context (e.g., [254, 255]).

This type of approach has recently been adapted for use in the problem gambling treatment context. Studies have repeatedly shown that there are valid subtypes of gamblers that differ in characteristics such as psychiatric comorbidity and their primary motivations for gambling (e.g., [6, 256]). In particular, at least two distinct subtypes have been identified: a subtype that gambles primarily for coping motives or to "escape" (i.e., gambling to reduce or avoid negative affective states) and another distinct subtype that gambles primarily for enhancement motives or for "action" (i.e., gambling to achieve pleasurable states or for stimulation) ([6, 257]; see review by Milosevic and Ledgerwood [7]). Reasoning that interventions for problem gamblers could be made more meaningful, efficient, and efficacious by developing interventions that are unique to each of these gambler subtypes, Stewart and colleagues developed the Brief Escape and Action Treatments for problem gambling (i.e., the BEAT Gambling program [258]). Drawing upon a cognitive-behavioral framework, the objective of BEAT Gambling was to expand on traditional CBT for problem gamblers [259] by including intervention components that specifically target psychological factors (e.g., maladaptive beliefs) related to the gambling exhibited by each gambler subtype (action vs. escape). This 6-session motivation-matched treatment was designed to target the distinct beliefs and behavioral patterns that impede control of gambling behavior that are characteristic of each subtype of problem gambler. Problem gamblers of each subtype are taught to identify and challenge their unique thinking errors and to engage in distinct behavioral strategies as means of overcoming their problem gambling. For example, escape gamblers are trained in more adaptive means of relieving distress, whereas action gamblers are trained in less risky means of achieving excitement and stimulation.

Stewart and colleagues recently published a case series that was designed as a preliminary assessment of the effectiveness of this novel, motivation-matched treatment for problem gambling [260]. On the basis of their primary underlying motivations for gambling (as assessed with the Gambling Motives Questionnaire [261]), 6 problem gamblers received either a 6-session escape-motivated (n = 2) or a 6-session action-motivated (n = 4) treatment from the manualized BEAT gambling intervention. Assessments were conducted at baseline, immediate posttreatment, and at 3- and 6-month follow-ups. Primary outcome measures included gambling involvement (i.e., gambling frequency, and time and money spent gambling), problem gambling severity, and gambling-related disability. The secondary outcome measures included gambling abstinence self-efficacy, craving to gamble, high-risk gambling situations, and gambling expectancies. Overall, these pilot participants showed significant improvements from pre- to posttreatment on most of these measures, with relatively less immediate posttreatment gains seen on measures that assessed excessive gambling in specific high-risk situations (i.e., positive situations for action gamblers, negative situations for escape gamblers) and gambling-related disability. However, treatment gains were observed for most participants on these latter measures by the follow-ups [260]. The next step was to conduct a randomized controlled trial to compare the efficacy of the motivation-matched treatment with treatment as usual. Preliminary results regarding short-term outcomes show that, relative to treatment as usual in the community, the BEAT gambling treatment showed statistically superior outcomes on several outcome variables: reduction in gambling frequency, improvement in readiness to change, reduction in gambling craving, and improvements in severity of gambling problems. The matched treatment also showed superior retention relative to treatment as usual suggesting that the BEAT gambling treatment may be more engaging to problem gambling clients (possibly due to these interventions being very relevant to their unique treatment needs), resulting in an increased willingness to remain in treatment (see [262]). The results from this case series and preliminary outcomes from the RCT certainly suggest promise for this novel treatment approach.

The large variety of gambling games and the differences in the legalization and normative regulation of gambling practices among countries bring to the table another level of heterogeneity at the macro level: culture (please also see Chap. 13). Distinctive types of gambling activities, games, design, and locations play a role in shaping gambling behavior and preferences: for example, gambling games and practices in the Netherlands are different than those in Canada, resulting in Dutch and Canadian gamblers becoming highly familiar with the gambling instances available and common in their environment. This element is of particular importance for training programs aimed at reducing maladaptive reward-related associative processes toward gambling, such as CBM interventions.

As mentioned earlier, the first set of studies examining gambling-related approach bias attempted to validate a new gambling AAT task by evaluating its correlates cross-culturally in the Netherlands and Canada [100, 101]. Results for Dutch gamblers revealed the hypothesized gambling approach bias only among problem gamblers [101], compared to non-problem gamblers. Unexpectedly, Canadian gamblers appeared to show an avoidance bias, rather than an approach bias, toward the gambling stimuli, and approach bias showed a significant negative (rather than positive) correlation with gambling severity [100].

A potential explanation for what may at first look like an important cross-cultural difference is that these discrepancies may be due to the pictures used for the Canadian version of the gambling AAT. The Canadian researchers were not granted access to local casinos and play halls to create relevant stimuli for their gambling AAT and thus opted to use the original Dutch gambling stimuli or to process using Photoshop any Dutch stimuli that were deemed to be not cross-culturally appropriate. The observed differences may be the result of an effect akin to "the uncanny valley effect," in which subtle imperfections in the visual familiarity of a specific object, in this case the gambling stimuli, result in an aversion toward that specific object or stimuli [263]. Perhaps the Dutch gambling stimuli were close but not close enough to what Canadian gamblers typically see when they gamble, and this close but not perfect appearance put Canadian gamblers in a situation similar to the "uncanny valley" originally evidenced in the domain of humanoid robotics design [264], generating an associated aversion toward the gambling stimuli. Presumably, these subtle discrepancies would be most evident to the problem gamblers with a greater history of gambling exposure, leading to a stronger "uncanny valley" and associated aversion bias to Dutch and photoshopped gambling stimuli among the Canadian problem gamblers [100]. To confirm such a culture-based effect, the study is currently being repeated with new, localized pictures for the Canadian gambling AAT that are more culturally appropriate to the Canadian gambling context.

Salmon et al. [100] is not the first study to observe aversion to addiction-relevant stimuli when adapting a computerized implicit association task across cultures. Specifically, Larsen et al. [264] examined approach bias differences between Dutch and American teenagers toward smoking stimuli. The study used smoking and control stimuli that were validated among American but not Dutch teenagers. Dutch teens exhibited an avoidance bias toward smoking and control stimuli while American teens did not. While this could represent a cross-cultural difference, it is possible that this difference may have resulted from an "uncanny valley" effect – an aversion toward the stimuli, which were familiar but not quite right to the Dutch adolescents.

Given emerging work on the utility of implicit association-type tasks in the gambling research area (e.g., [123, 125]), these early results highlight the importance of using culturally appropriate stimuli in implicit cognition studies. An appropriate selection of stimuli representing common gambling activities in the local participants' context would also allow for a more refined matching of relevant stimuli to the individual gambling preferences.

10.5.2 Mindfulness

In the last decade, a new group of treatment approaches has emerged, combining CBT techniques with Buddhist principles. This group of interventions is part of a body of newly developed methods which is commonly referred to as the "third wave" of cognitive-behavioral interventions [265]. While traditional CBT focuses on controlling and modifying cognitions, third-wave approaches focus on mechanisms of awareness and acceptance of and re-distancing from cognitions [266]. Moreover, these approaches offer a new perspective on different psychopathologies, such as addiction, and add new techniques based on meditation and Buddhist philosophy [267]. Within the group of third-wave approaches, mindfulness-based interventions (MBI) take a prominent place.

Mindfulness has been defined as "the process of observing body and mind intentionally, of letting […] experiences unfold from moment to moment and accepting them as they are" [268]. It is both a trait and a process, a form of meditation [269]. MBI encompass a spectrum of interventions, including mindfulness-based relapse prevention, mindfulness-based cognitive therapy, dialectical behavior therapy, and acceptance and commitment therapy [270]. Since a review of these individual interventions is beyond the scope of this chapter, we will refer to them collectively.

MBI have been employed in the treatment of, among others, mood and anxiety disorders and seem especially effective as an adjunct to regular treatment and in patients who respond poorly to previous treatments [271]. MBI have also been used in substance and behavioral addictions, showing some promising preliminary results such as reduced substance use and increased positive psychosocial outcomes [266, 272, 273]. Inspired by these results, interest has grown in the applicability of MBI in the treatment of problem gambling. This interest is further fueled by the high relapse rates and large numbers of treatment nonresponders in the disordered gambling population [269]. In further support of the potential of MBI in problem gambling, trait mindfulness has been found to be inversely related to problem gambling, gambling severity, gambling cue reactivity and urge, and psychological distress [274–277]. Interestingly, there is some evidence that this relation might be mediated by impulsivity [274], rumination, emotion dysregulation, and thought suppression [275].

A number of case studies have provided initial, preliminary insights into the effectiveness of MBI in the treatment of gambling problems [270, 278, 279]. These studies used MBI combined with CBT in patients who did not respond to previous usual treatment. Results indicate that MBI could increase trait mindfulness, reduce craving, and decrease anxious and depressive symptomatology, decrease problem gambling severity, help gamblers reach abstinence, and improve re-distancing from obtrusive thoughts [270, 278, 279]. These results were maintained up to 3 months after treatment [278], but only when patients continued practicing mindfulness after treatment ended [270]. However, due to the nonexperimental nature of case studies, these results should be interpreted with caution.

A few initial clinical studies have explored systematically the effects of MBI in disordered gambling [280–283]. These studies have generally included a small number of inpatients not responding to previous treatments and employed different types of MBI, most commonly dialectical behavioral therapy or mindfulness-based cognitive therapy. Despite not evaluating effects on gambling severity, one study found that MBI improved trait mindfulness in the short term [283]. Another study confirmed MBI to increase trait mindfulness in problem gamblers and found that 83% of participants were abstinent or had reduced gambling after treatment [281]. However, both studies did not include a control group and had moderately high dropout rates. When employing a group-controlled experimental design, MBI was shown to reduce severity of gambling, gambling urges, and psychiatric symptoms directly after treatment and with sustained effects after 3 months [282]. This study also found that those participants who continued to practice mindfulness after treatment had better clinical outcomes. The latter results are in line with findings from an earlier study, in which MBI in problem gamblers resulted in reduced psychopathological symptoms 14 weeks after treatment, compared to treatment as usual [280]. Some of the methodological limitations of these studies, mainly due to small sample size and the lack of proper control comparisons, still prevent us from drawing any firm conclusion, and results should thus be interpreted with caution.

Altogether, MBI have shown several beneficial advantages when used as an alternative or adjunct treatment of gambling problems, especially with patients who respond poorly to usual treatment. This claim is supported by the inverse relation between trait mindfulness and gambling severity as well as preliminary findings on the effectiveness of MBI in the treatment of gambling disorder. Interestingly, the inverse relationship between trait mindfulness and, for example, impulsivity, can help explain the underlying working mechanisms of MBI within the framework of dual-process theories [274]. What sets MBI apart from standard treatment programs such as CBT is the focus on changing the individuals' relation to their cognition instead of changing the cognition itself [284]. Considering the role of rumination, obtrusive irrational beliefs, and cognitive distortions in the development and maintenance of disordered gambling [279], MBI may offer a new way of dealing with these beliefs and cognitions. Finally, MBI can effectively be administered online, meeting the need for more accessible, low-threshold, and cost-efficient treatment programs [285].

10.6 Conclusion

In this chapter, we explored a number of innovative approaches for the treatment of GD. Although the resulting assemblage is arguably quite diverse, there is a common denominator: they expand upon existing interventions by trying to fill in current voids and by extending the reach of existing treatments. They achieve this by exploring new media and techniques, providing new routes for caregivers to reach patients and vice versa, building upon new psychological and neurobiological insights, thereby increasing intervention effectiveness and suitability, and by translating scientific knowledge into practical solutions at the individual level. More importantly, they force us to reconsider the very way we understand and treat GD. In light of this, it may come as no surprise that none of the interventions discussed in this chapter should be considered alone as the answer to GD. They should rather be perceived as different but complementary modules sharing a common ambition. For clinical practice, this means that the true innovation in the treatment of GD would be an integrative approach, building upon existing knowledge, harnessing the power of new techniques and technologies, and tailoring interventions to meet individual needs.

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