



Cognitive Remediation for Impulsivity in Addictive Disorders: Review of Current Evidence and Future Directions

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Abstract

Purpose of Review Impulsivity is a core feature underpinning addictive disorders linked to difficulties achieving and sustaining treatment goals. Cognitive remediation is a promising adjunct intervention approach to improve impulse control in addictive disorders, although evidence is still preliminary. This review summarizes available evidence and discusses opportunities to enhance the development and delivery of future interventions.

Recent Findings We identified six studies that delivered cognitive remediation and assessed state impulsivity in substance use disorders. There was substantial heterogeneity in the intervention ingredients and delivery approaches. We identified key opportunities to enhance future cognitive remediation studies, including (1) co-designing interventions, (2) incorporating specific impulsivity training strategies, (3) increasing opportunities to practice skills, (4) supporting skill transfer to everyday settings, and (5) demonstrating clinician compassion.

Summary Researchers should work alongside frontline clinicians and clients with addictive disorders to enhance the potential benefit of cognitive remediation interventions prior to high-quality trials.

Keywords Impulsivity · Cognitive remediation · Cognitive training · Substance use disorder · Gambling disorder

Introduction

Addictive disorders (including substance use and gambling disorders) involve loss of control over reward-seeking behaviours and continued engagement in these behaviours despite adverse consequences. Impulsivity processes (which drive the tendency to prematurely act without foresight) [1] are core neurocognitive mechanisms underpinning addictive behaviours [2–4]. State impulsivity can be segregated into rapid response (e.g. motor responses; also termed “disinhibition”) and impulsive choice categories. Disinhibition has been theorized to be driven by difficulties in attentional control, insufficient information gathering, and reduced feedback monitoring/shifting [5, 6], whereas impulsive

choice is considered to be driven by the preference for smaller instant rewards over larger delayed rewards [7]. Impairments in impulse control (i.e. exhibiting greater disinhibition and impulsive choice) have been consistently linked with difficulty achieving treatment-related goals after reducing or abstaining from the addictive behaviour (e.g. premature treatment cessation, re-engaging with the addictive behaviour, and poorer perceived quality of life) [8–13]. Impulsivity processes therefore represent key intervention targets for addictive disorders.

Current mainstream psychosocial treatments for addictive disorders (e.g. cognitive behavioural therapy, 12-step programs, motivational-based programs) have shown limitations in their efficacy and client engagement [14–16]. This may be due, in part, to untreated deficits in impulse control which make it difficult to both effectively process high level concepts and persist with treatment goals when faced with the urge to re-engage in previously rewarding behaviours. Therefore, their efficacy may be enhanced by targeting impulse control during treatment.

Cognitive remediation represents a promising adjunct intervention approach for addiction treatment as it is well-suited to addressing impulsivity and may aid in the achievement of

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treatment-related goals. In the context of addictive disorders, cognitive remediation trains higher order executive processes (i.e. impulse control, flexibility, working memory, and decision-making) [17, 18] through meta-cognitive principles and strategy-based learning in a therapeutic context [19]. Therapist-led sessions typically focus on providing support with strategies, facilitating group discussions, and discussing opportunities to practice and strengthen skills in everyday life to promote far-reaching (i.e. to addiction-relevant goals) and longer-lasting skill transfer [20, 21].

Whilst still a relatively novel treatment approach for addictive disorders, initial evidence supports benefits for impulse control and treatment outcomes in substance use disorder (SUD) populations [22]. In our recent meta-analysis, we found that cognitive remediation was the only intervention category (out of pharmacological enhancers, computerized training and cognitive remediation) to have a significant group effect at improving control over impulsive choice [23]. Previous reviews have also found benefits for decision-making and other executive function processes [24•, 25].

In this review, we first summarize the studies classed as cognitive remediation for SUDs. As there are a limited number of studies available, we have included articles that were published more than five years ago. We then extend prior reviews by discussing treatment development (i.e. design approaches and ingredients) and delivery considerations in an effort to move cognitive remediation forward as an evidence-based adjunct intervention for impulsivity in addictive disorders.

Defining Cognitive Remediation

There is considerable heterogeneity in the types of interventions classed as cognitive remediation [24•]. Cognitive remediation uses neuroscience and learning principles to train cognitive strategies in a psychosocial therapeutic context to produce lasting cognitive improvements and functional changes [26]. Cognitive training bears similarities to cognitive remediation in that the goal is to strengthen cognitive processes [27] and it can include intentional instruction (i.e. strategy training) [28]. However, cognitive training for addictive disorders typically uses repetitive practice (process-based training) [28], frequently via computerized software [29, 30]. Furthermore, cognitive training programs are often administered without a psychosocial component to help clients to link trainings to everyday life, limiting their transferability [31, 32]. There is stronger evidence for transferability of cue-based cognitive training interventions, which include disorder-relevant cues (e.g. alcohol cues in cognitive bias modification) [30, 33]. However, evidence of skill transfer in cognitive training programs that specifically target impulsivity (e.g. inhibitory control training) is less apparent [30]. Given the limitations of cognitive training in the impulsivity domain, we will mainly focus on cognitive remediation.

Specifically, we argue that there are two key aspects of cognitive remediation that make it a suitable intervention for impulse control. First, cognitive remediation interventions include strategy training rather than a practice-based approach—the former being superior to restore the functionality of complex top-down executive processes such as impulse control [34]. Second, they include a therapist-led psychosocial component, which is well suited to facilitating environmental skill transfer [20].

Efficacy of Cognitive Remediation for Impulsivity in Addictive Disorders

There were six studies that met our inclusion criteria. Table 1 displays the study design, key outcomes, intervention ingredients, delivery format, and treatment intensity. Most studies were pilot or proof-of-concept designs, with only one randomized controlled trial (RCT) [38]. Findings on the cognitive outcomes are interpreted through the lens of the tripartite model of disinhibition (i.e. attentional control, information gathering, feedback monitoring/shifting) and impulsive choice [5]. Three studies assessed clinical outcomes in addition to impulsivity performance measures [22, 35•, 38, 40] and three studies delivered miscellaneous interventions. We present the GMT studies together and the remaining studies separately. Higher quality methodological studies are presented first.

GMT

GMT is a therapist-led cognitive remediation intervention for executive dysfunction, originally designed for people with brain injuries [40]. GMT trains executive functions through the inclusion of strategy learning, scaffolding of new skills, and experiential learning of common errors. It also teaches clients the application of metacognitive skills to individual goals and real-world situations. The program is delivered in groups and includes in-session (training, activities, discussions) and between-session (written reflection and skills practice) content.

In a recent randomized proof-of-concept trial, we assessed a modified version of GMT (GMT⁺) that was tailored to the needs of people with methamphetamine use disorder against an active matched psychoeducation-control ($n = 36$) [35•]. The study was not designed to assess efficacy; however, GMT⁺ showed large effects at improving performance on an information gathering (Cognitive Impulsivity Suite; CIS) task and an impulsive choice task. We did not find notable benefits on (CIS) attentional control or feedback monitoring/shifting tasks. In addition, GMT⁺ led to a significant and large reduction in methamphetamine dependence severity compared to the control, four weeks after treatment. Valls-Serrano and colleagues [36]

Table 1 Characteristics and key outcomes of cognitive remediation studies

Authors	Design/addictive disorder/setting/N	Active (A) & comparator (C) interventions	Impulsivity outcome (comparable disinhibition or choice process)	Improved impulsivity Y/N	Clinical benefit	Key intervention ingredients	Delivery format/treatment intensity
Anderson et al. 2023 [35]	Randomized proof-of-concept crossover trial	A: Goal Management Training ⁺ C: Matched Health-Oriented Psychoeducation	Delay discounting (impulsive choice)	Y ^a	Severity of methamphetamine dependence—active group showed significant reduction at 4-week follow-up Treatment retention—no group difference	Includes hands-on in-session activities to demonstrate common cognitive ‘slips’ Teaches strategies to help clients to prevent slips and aid goal achievement Group discussions to link slips and strategies to everyday life Participants are taught progressive strategies to be aware of attention, to pause and reflect on current goals to prevent impulsive errors, to shield their goals from distractors, and to reflect on longer-term goals (incl. episodic future thinking) when making short-term decisions	Delivered in groups by trained psychology doctoral students Includes between-session written skills practice journal 1 × 90-min session per week for 4 weeks 10-min daily journal completion
Valls-Serrano et al. 2016 [36]	Multisite residential treatment N = 36 Randomized proof-of-concept trial	A: Goal Management Training & mindfulness meditation	CIS Bounty Hunter (attentional control) CIS Prospector’s Gamble (feedback monitoring/shift-ing) Reflection impulsivity (information gathering)	N N Y	Craving—no group difference Quality of life—Comparator group showed moderate improvement N/A	Includes hands-on in-session activities to demonstrate common cognitive ‘slips’ Teaches strategies to help clients to prevent slips and aid goal achievement Group discussions to link slips and strategies to everyday life	Delivered in groups by trained clinical psychologist Includes between-session written skills practice workbook activities 1 × 120-min session per week for 8 weeks
	Substance use disorders	C: TAU	Stroop test (attentional control)	N		Teaching participants progressive strategies to Stop to inhibit automatic impulsive behaviour and refocus attention, to keep goals in mind, to break tasks into steps, to self-monitor and check for goal distractors or errors	
	Multisite residential treatment N = 32						

Table 1 (continued)

Authors	Design/addictive disorder/setting/N	Active (A) & comparator (C) interventions	Impulsivity outcome (comparable disinhibition or choice process)	Improved impulsivity Y/N	Clinical benefit	Key intervention ingredients	Delivery format/treatment intensity
Alfonso et al. 2011 [37]	Non-randomized (parallel groups) pilot trial	A: Goal Management Training & mindfulness meditation C: TAU	Stroop test (attentional control)	Y	N/A	Includes hands-on in-session activities to demonstrate common cognitive ‘slips’ Teaches strategies to help clients to prevent slips and aid goal achievement Group discussions to link slips and strategies to everyday life	Delivered in groups by a trained therapist Includes between-session written skills practice workbook activities 2 × 90-min sessions per week for 7 weeks
	Substance use disorders		Iowa Gambling Task (feedback monitoring/shifting)			Teaching participants progressive strategies to Stop to inhibit automatic impulsive behaviour and refocus attention, to keep goals in mind, to break tasks into steps, to self-monitor and check for goal distractors or errors	
	Outpatient treatment						
	<i>N</i> = 34						
Rezapour et al. 2019 [38]	Randomized controlled trial	A: Neuro Cognitive Rehabilitation for Disease of Addiction programme (NECOREDA) C: Group painting (matched in group format and time)	Stroop task (attentional control)	N	Substance use—active group showed significant reductions in opiate use and amphetamine use* Treatment retention—no group differences	Includes paper and pencil training modules with cognitive activities. Psychoeducation on meta-cognitive education, compensatory & lifestyle training Cognitive activities target attention, visuospatial processes, working memory, verbal skills, & executive functions. Difficulty increases over time	Delivered in groups by therapist Includes between-session paper and pencil training activities 2 × 60-min sessions per week for 8 weeks
	Opioid use disorder						
	Single residential treatment centre						
	<i>N</i> = 120						

Table 1 (continued)

Authors	Design/addictive disorder/setting/N	Active (A) & comparator (C) interventions	Impulsivity outcome (comparable disinhibition or choice process)	Improved impulsivity Y/N	Clinical benefit	Key intervention ingredients	Delivery format/treatment intensity
Allan et al. 2022 [39]	Non-randomized pilot trial	A: Neuropsychological and Educational Approach to cognitive Remediation (NEAR) C: TAU	Wisconsin Card Sorting Test (feedback monitoring/shifting)	Y ^c	N/A	Includes computerized tasks that are completed individually in group setting. Tasks are personalized to participants' cognitive profile, goals, and learning style Group discussions about cognition and strategy application in everyday life, and personalized coaching from the clinicians	Delivered in groups by therapists 3 × 60-min sessions per week for 18 sessions
	Substance use disorder					Training targets attention, processing speed, short-term memory, working memory, and executive functions. Difficulty adapts according to user responses	
	Multisite residential treatment N = 65						
Marceau et al. 2017 [22]	Controlled sequential groups design (non-randomized)	A: Mixed cognitive remediation and computerized training program C: TAU	Stroop task (attentional control)	Y	Quality of life—active group showed significant improvements at the end of treatment Craving—no group difference	Includes computerized tasks that are completed individually in group setting Therapists also facilitate strategy training and group discussions Strategies included goal management training, time pressure management, self-alert training, executive dysfunction multifaceted treatment, mental contrasting, and implementation intentions Modules focussed on brain functioning, attention, executive functions, learning and memory, self-awareness, inhibition, visual and verbal working memory, decision-making, problem-solving, and emotion regulation	Delivered in groups by therapists 3 × 120 minute-sessions per week for 4 weeks
	Substance use disorders						
	Single residential treatment site N = 33						

Note. TAU, treatment as usual; CIS, Cognitive Impulsivity Suite

^aLarge group × time interaction effect size, not significant

^bLarge group × time interaction effect size, not significant

^cMedium group × time interaction effect size, not significant

*Reduced amphetamine use was seen in participants with a history of methamphetamine use

administered the original GMT program plus mindfulness meditation. Individuals enrolled in inpatient therapeutic communities ($n = 32$) were randomly assigned to receive cognitive remediation or treatment-as-usual (TAU). GMT significantly improved performance on an information gathering (reflection impulsivity) task, but not on an attentional control (Stroop) task. Alfonso and colleagues [37] also delivered GMT and mindfulness meditation to individuals receiving outpatient care for polysubstance use ($n = 34$). GMT was compared against TAU, with non-random assignment. GMT participants showed significantly improved performance on an attentional control (Stroop) task and the Iowa Gambling Task, a decision-making task that requires learning to choose options with less immediate and longer-term reward outcomes (tapping into the feedback monitoring/shifting mechanism). Treatment outcomes were not assessed in the original GMT studies [36, 37].

Other Cognitive Remediation Approaches

Three studies administered different cognitive remediation approaches. Two of the study interventions were based on existing cognitive remediation approaches designed for neurological and psychiatric populations [22, 39] and one study developed a tailored approach for SUDs [38].

Rezapour and colleagues [38] developed a paper-and-pencil cognitive remediation program and conducted an RCT in people with opioid use disorder in residential treatment ($n = 120$). Cognitive remediation did not show a significant benefit on an attentional control (Stroop) task relative to a comparison painting group. However, the trained group showed significantly lower opiate use after 3 months. Furthermore, trained clients with a history of methamphetamine use showed lower rates of stimulant use at 3 and 6 months post-intervention. In a recent non-randomized pilot trial, Allan et al. [39] drew from the Neuropsychological Educational Approach to cognitive Remediation (NEAR) model and applied a selection of personalized computerized cognitive training activities to individuals with SUDs across two residential treatment centres. Therapists facilitated discussions about the use of strategies in everyday life. Cognitive remediation, compared to TAU, had a moderate effect at improving performance on the Wisconsin Card Sorting Test, a disinhibition task capturing difficulties in shifting ($n = 65$). Clinical outcomes were not assessed. Marceau and colleagues [22] administered a combination of cognitive remediation and computerized cognitive training, compared to TAU, in 33 individuals with SUDs enrolled in residential treatment. The cognitive remediation intervention was compiled from numerous evidence-based programs for acquired brain injury (including GMT). The authors used a sequential groups design and found significant improvements in performance on an attentional control (Stroop) task as well as quality of life in the trained group.

Summary of Cognitive Remediation Findings

Group findings for the six studies are described for impulsive choice, and the three cognitive mechanisms within the tripartite framework of disinhibition.

Impulsive Choice

Only one study assessed impulsive choice, with positive effects on the delay discounting task [35•] revealing a shift in preferences from smaller immediate rewards to larger delayed rewards. As cognitive remediation can aid functional goal achievement (i.e. favouring long-term goals rather than immediately gratifying experiences), impulsive choice is an important outcome to include in future trials.

Disinhibition Mechanisms

Two studies delivering GMT-related interventions found positive effects on information gathering task performance [35•, 36] reflecting an increased tendency to collect and consider the accuracy of information prior to responding. Program effects on attentional control and feedback monitoring/shifting were mixed. Two studies reported benefits on tasks of attentional control [22, 37] reflecting an improved ability to engage and sustain cognitive resources to control automatic impulsive responses. However, three studies did not find notable improvements [35•, 36, 38]. Two studies reported benefits on tasks capturing feedback monitoring/shifting [37, 39] indicating improvements in the ability to monitor outcomes of past decisions and adapt their behaviour in response. However, one study did not find task improvements [35•].

Collectively, these results indicate promise for selected impulsivity processes and clinical outcomes, although there is an opportunity to improve the consistency of effects. There was considerable variance in the selected programs and their training ingredients and delivery approach (format, level of therapist involvement, number and duration of sessions), suggesting the need for greater clarity and consensus around these components.

Opportunities to Enhance Cognitive Remediations for Addictive Disorders

We perceive a number of key opportunities to progress cognitive remediation for addictive disorders and to enhance their potential benefits. In this section, we discuss specific insights and recommendations around content development and intervention delivery.

Developing Cognitive Remediation Content

Current applications of cognitive remediation for addictive disorders are heterogenous in terms of how they were developed and their treatment ingredients (e.g. training strategies). We focus on potential avenues to enhance the development of new interventions and the inclusion of specific training strategies that may benefit impulsivity processes.

Tailoring and Co-developing Cognitive Remediation Interventions for Addictive Disorders

Early trials of cognitive remediation for SUDs applied pre-existing programs designed for neurological populations [36, 37]. There has since been a trend for researchers to develop specialized cognitive remediation interventions, which cater to the specific deficits (relevant to treatment outcomes; see [41]) and needs in SUDs [42, 43]. This is beneficial to enhance the relevance of discussions and the appropriateness of cognitive difficulty levels during training. For example, acquired brain injury is associated with more severe cognitive impairments than SUDs or gambling disorders [44, 45] and the level of difficulty and real-world examples of these deficits should be tailored accordingly.

Although these researcher-developed tailored programs are an important advancement, it is becoming increasingly evident that input from end-users is also necessary to promote more meaningful benefits for clients and providers [46, 47••]. Engaging frontline clinicians and people with lived experiences in intervention co-production can improve their relevance and acceptability and reduce the translational gap between research and practice [48••, 49, 50]. This may enhance client engagement with intervention concepts and promote benefits across key outcomes (including impulsivity and client treatment goals), and better suit the needs of clinical services (e.g. feasibility around the number of sessions, program length, level of therapist-support required). There has been a recent increase in this type of collaborative research for interventions for people with SUDs (e.g. [51, 52]). We used a person-centred approach when developing GMT⁺ and collaborated with clients and frontline clinicians during the intervention design, production, and final review phases [53]. This process of including end-users in all relevant stages of research [54] resulted in considerable modifications to the cognitive tasks, strategies, clinician language, and real-world examples, and was key to the acceptability and benefit of the end-product. For cognitive remediation to enhance the effectiveness of broader addiction treatments, it must be driven by client and practitioner goals. Harnessing lived experience and clinician perspectives should therefore be considered a priority research area for the meaningful progression of cognitive remediation interventions for addictive disorders.

Program Ingredients

Many existing interventions (originally targeting other populations) cater to a broad range of cognitive difficulties. In the following subsections, we discuss the inclusion of strategies that can help to (1) promote future-focussed decision-making and (2) improve control over habitual impulsive behaviours in addictive disorders, which may positively influence treatment outcomes [8, 10, 11].

Training a Future Focussed Mindset People with addictive disorders typically exhibit shortened time-horizons (e.g. preferencing immediate gratification) and decreased sensitivity to future-oriented goals [55]. Cognitive remediation interventions for addictive disorders may therefore benefit from the inclusion of specific cognitive strategies that favour the achievement of future (treatment-related) goals rather than immediately rewarding (but not goal-aligned) behaviours. Furthermore, when connecting training strategies to everyday experiences, looking to future positive goals to guide decisions may be more adaptive for people with addictive disorders. Past or current experiences can be challenging (e.g. painful memories, uncomfortable therapeutic work) and may motivate behaviour that is not goal-aligned.

Episodic future thinking (EFT) and implementation intentions [56, 57] are two cognitive strategies that may be well suited to extending the temporal window and promoting future-oriented perspectives. EFT involves imagining positive future events or goals that the person would like to achieve with vivid details. EFT has improved impulsive choice (decreasing the value placed on instant rewards and enhancing the value placed on advantageous future rewards, i.e. improving impulsive choice) in people with SUDs [58–62] and gambling disorder [63]. It has also been linked with improved clinical outcomes compared to episodic recent thinking (imagining recent actual events), including a reduction in substance use [64]. The inclusion of EFT as a strategy within a broader cognitive remediation program appears to be favourable for clients with addictive disorders [53], and preliminary results for the overall program showed a benefit for both impulsive choice and severity of methamphetamine dependence [35•]. Although further research is required, initial evidence appears positive for the inclusion of EFT strategies in cognitive remediation.

Implementation intentions involves identifying goal-directed actions to put in place when an “if-then” situation arises (e.g. *if* a positive opportunity or a goal-thwarting obstacle arises, I will *then* enact a planned goal-directed response) [65]. It is another future-focussed strategy with similarities to EFT that has been used within a broader cognitive remediation program for SUDs [22]. Although impulsive choice was not assessed in this study, the authors found improvements in self-reported self-control, compared

to TAU. A recent meta-analysis has supported the benefit of implementation intentions for reducing alcohol consumption in community samples [66], although it has been suggested that sustained effects may be enhanced when combined within broader intervention approaches [67]. Additionally, using pre-planned coping strategies when in risky situations (conceptually similar to implementation intentions) has been associated with lower—compared to higher—risk gambling behaviours [68]. Similar to EFT, implementation intentions strategies may help to build impulse control in the present moment so that clients can persevere in working towards salient future goals, shielding them from overly rewarding or aversive short-term distractions [69].

Helping Clients to Apply the Brakes The inclusion of strategies that promote control over disinhibition (e.g. helping clients to regularly self-monitor and “apply the brakes”) is key to disrupting habitual behaviour that can thwart goal acquisition. Although some existing programs have included strategies that specifically target disinhibition [22, 36, 37, 53], these strategies appear to be less prominent in other programs [38, 39].

The strategies included in the above studies were derived from GMT and involved teaching participants to regularly remind themselves to “Stop” in the original program and “Pause” in the modified GMT⁺. The “Stop”/“Pause” concept has instinctive appeal because it represents a simple and accessible strategy that individuals can employ from moment-to-moment to interrupt habitual behaviours. However, the added and crucial benefit of this strategy is the connection to the subsequent goal-aligned step (e.g. pausing, taking a breath and bringing focus back to the current goal). This has advantages that are relevant to promoting emotion regulation, which people with SUDs can have difficulties with [70], as well as adherence to broader addiction treatment goals. It highlights the advantage of applying cognitive remediation as an adjunctive intervention where clients can utilize meta-cognitive strategies to aid the achievement of co-existing treatment goals (e.g. stopping and then reappraising unhelpful thoughts in cognitive behavioural therapy).

Intervention Development Summary

The collaborative design and development of cognitive remediation represent a gold-standard approach to intervention development [50]. Future studies may produce more meaningful end-results if clients are engaged from the beginning and their goals and cognitive and social needs are incorporated as fundamental to the program. Regarding cognitive needs, there are

opportunities to tailor the focus of inhibition strategies for people with addictive disorders (e.g. promoting a future-focussed mindset and aiding fast inhibition to protect goals). However, future research that systematically maps out the relationship between the active cognitive remediation ingredients (e.g. singular strategies or groups of strategies) and key outcomes (i.e. impulsivity processes and treatment outcomes) is required to clarify the driving mechanisms.

Delivery Considerations

The delivery of cognitive remediation interventions is critical to their effectiveness [71, 72]. In this section, we discuss three key delivery considerations for the treatment of addictive disorders, including the intensity of treatment exposure and skills practice, supporting clients with skill transfer, and the importance of demonstrating compassion around cognitive difficulties.

Increasing Treatment Exposure and Opportunities for Practice

Exerting fast and effective impulse control likely requires substantial practice to transfer effects from in-session/in-training to other tasks and activities. Improvements on attentional control tasks were seen in studies that applied multiple (two or three) sessions of cognitive remediation per week with a total of 12–14 sessions and 21–24 training hours [22, 37]. The other two studies implemented one weekly session, with a total of four to eight sessions and 6–16 training hours [35, 36]. Meta-analytic research and expert consensus have suggested that greater treatment exposure (including total training hours and number of sessions per week) is necessary for more meaningful treatment gains [71, 72]. Furthermore, greater treatment exposure may aid general treatment outcomes for addictive disorders treatments [73].

Treatment exposure may include additional formats to the training sessions. Programs may also include “bridging” sessions that are delivered by therapists to discuss how cognitive task strategies may be applied to everyday application [21]. Alternatively, a between-session “skills practice” component may be included to facilitate regular reflection and activation of concepts and skills [38, 53]. When between-session task engagement is high, completion rates have been linked to symptom reduction across psychiatric presentations [74] revealing their potential to help ingrain key skills and concepts. Finally, integration of concepts into other points-of-care (e.g. group cognitive behavioural therapy or individual counselling) will likely help to make these skills more rehearsed and readily accessible when needed.

Supporting Clients to Transfer Skills to Everyday Situations

A key benefit of cognitive remediation programs is their ability to promote functional gains (i.e. improvements in everyday decisions, self-care, relationships, employment) [20]. Cognitive remediation interventions should therefore, at a minimum, include discussions of real-world relevance and opportunities for clients to implement learnt strategies in everyday situations. However, people with addictive disorders can face complex psychosocial circumstances [75] and will likely benefit from a greater level of therapist support to personalize the strategies to their individual needs and promote reliable skill transfer. For example, bridging sessions, which were previously introduced, may typically be offered at a group level. Yet, this point of contact may be further enhanced by providing brief individual support to assess comprehension of strategies and plans for implementation. Furthermore, interventions that include between-session skills practice components should review progress and provide individual support. In the GMT⁺ proof-of-concept trial, between-session completion rates were lower than anticipated [35]. As this was an inpatient setting, we reason that an additional group support session to workshop barriers and further personalize day-to-day strategy application may have improved engagement with this component. Programs offering individual cognitive remediation could review homework progress and skill application at the beginning of sessions.

Sensitivity to Increased Awareness of Deficits

Cognitive remediation programs are designed to target cognitive weaknesses and as such have the potential to be perceived as confronting for clients. Programs may intentionally foster impulsive errors (promoting “slips”) in the safe context of therapeutic sessions to reveal common cognitive weaknesses and promote experiential learning [40, 53]. Alternatively, programs may highlight typical cognitive impairments via psychoeducation content [39, 42]. Although each program type also provides the opportunity for clients to experience progress (e.g. via regular strategy practice to prevent slips or an “errorless learning” approach) [39, 40, 42], enhanced meta-awareness of cognitive difficulties may trigger self-criticism and negative self-perceptions. For example, in one study that administered a psychoeducation intervention, increased insight into cognitive deficits led to significant declines in self-reported abilities in attention, inhibitory control, and decision-making abilities in people with SUDs [76]. Furthermore, clients with methamphetamine use disorder did not self-report improvements in cognition following cognitive remediation, despite demonstrating improved

performance on cognitive tasks of impulsivity [35•]. Qualitative feedback from clients has also confirmed the potential for heightened sensitivity when engaging in cognitive remediation programs. Specifically, clients indicated that they focussed on perceived failures when experiencing (intended) cognitive errors [53] and provided feedback that these programs could “hit a nerve for some people” [39]. As negative affect and self-criticism are related to poorer treatment engagement and outcomes [77, 78], normalising impulse-driven errors and encouraging self-compassion will be important considerations when developing and delivering cognitive remediation for addictive disorders.

Delivery Considerations Summary

Some impulsivity processes may require more intensive training or greater practice with concepts in between sessions to produce meaningful improvements (e.g. attentional control). However, there remains a need for comparative ‘dosing’ trials to determine the minimum hours of treatment engagement that produces meaningful program effects [71]. Clinician involvement is paramount to enhance client comprehension and confidence to practice skills, and to minimize the potential impacts of self-criticism. This lends further support to the importance of engaging in intervention co-production with clients with lived experiences and clinicians and may be an important focus point of future intervention development studies.

Conclusions

Cognitive remediation represents a novel category of neuroscience-based psychosocial intervention that has potential to enhance impulse control processes in addictive disorders. Despite expert consensus that these interventions may aid both cognitive functioning and the achievement of broader treatment-related goals [48••], there are only a limited number of studies in people with SUDs and no studies in people with gambling disorders. Furthermore, there are very few well-powered RCTs, with only one study identified that met the inclusion criteria in the current review. However, there have been recent efforts to address this, including a systematic review that has highlighted the need for further high-quality trials [24] and a recent Delphi study that aimed to identify the most promising cognitive remediation approaches to further develop and progress in fully powered studies [48••].

This review outlines potential avenues to enhance the content development and delivery of new or revised

cognitive remediation interventions, with a focus on addressing impulsivity in addictive disorders. Firstly, intervention development should include a collaborative approach to harness the perspectives and goals of consumers and frontline clinicians from the inception, to achieve more meaningful program benefits [46]. Program ingredients (e.g. cognitive strategies) should also target disrupted aspects of impulsivity. We suggest supporting clients to develop a future-focussed mindset and exert fast impulse control to refocus on their goals. Second, we suggest delivery opportunities to enhance the transfer of skills to everyday settings, including the provision of more intensive program exposure and integration with other points of addiction treatment care. Additionally, the inclusion of therapist-led psychosocial sessions is an integral part of cognitive remediation treatments and can help to promote functional gains by personalising skills practice opportunities and addressing challenges compassionately. We believe the advancement of tailored interventions and subsequent well-powered studies in this field will continue to drive cognitive remediation forward as an evidence-based intervention category to restore impulse control and improve treatment outcomes in addictive disorders.

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Compliance with Ethical Standards

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Human and Animal Rights and Informed Consent All reported studies/experiments with human or animal subjects performed by the authors have been previously published and complied with all applicable ethical standards (including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines).

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