

Review article

Sustained cognitive and functional effects of pro-cognitive interventions for bipolar disorder: A systematic review of randomised controlled trials

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ABSTRACT

A substantial proportion of individuals with bipolar disorder (BD) experience considerable cognitive deficits. Existing systematic reviews have evaluated the efficacy of pro-cognitive interventions in BD, but have not established whether any cognitive benefits translate into functional improvements, with evidence for sustained functional effects remaining limited. A systematic search was conducted on MEDLINE, EMBASE, PsycINFO and Cochrane Library from inception until 21 May 2026. Eligible studies were randomised controlled trials (RCTs) in BD reporting cognitive or functional outcomes at three or more months following a pro-cognitive intervention, or examining the translation of cognitive benefits into improvements in functional outcomes at any timepoint. Seven unique RCTs plus three secondary analyses of these trials ($n = 615$) met the inclusion criteria. Approximately 13% (7/55) of RCTs identified in the search of pro-cognitive interventions in adult BD assessed cognitive or functional outcomes at least 3 months after treatment end. Of the seven unique RCTs, most evaluated cognitive remediation (CR; $k = 4$). The average follow-up length was 4 months (range: 3–6 months). Three of the four RCTs examining CR reported cognitive benefits at 3 to 6 months, whereas only one CR RCT found consistent functional effects at 3 months. Evidence on the translation of cognitive benefits to functional improvements is scarce and inconsistent. Most trials examining pro-cognitive interventions do not examine whether potential benefits are sustained or whether they translate into improvements in real-world functioning. CR appears to be a promising intervention for achieving durable cognitive gains in BD, although evidence for sustained effects of other interventions is limited.

1. Introduction

Bipolar disorder (BD) is a disabling mental health condition associated with considerable burden for the individual, family and society (GBD 2019 Mental Disorders Collaborators, 2022; Young et al., 2011). A core feature of BD is cognitive impairment, with around 40%–60% of people exhibiting moderate deficits across different domains, including memory, attention, processing speed and executive function (Bourne et al., 2013; Douglas et al., 2018; Tsapekos et al., 2026) also during full or partial remission (Jensen et al., 2016). Consequently, mood episode remission does not necessarily translate into functional

recovery. More importantly, these deficits can impair psychosocial functioning and quality of life (Cotrena et al., 2016; Martínez-Arán et al., 2004; Mora et al., 2013), and are associated with increased risk of episode recurrence (Miskowiak et al., 2022a) and psychiatric hospitalisations (Sankar et al., 2023).

Over the past decade, there has been a shift from treatments solely targeting mood symptom remission to interventions targeting to facilitate functional recovery and improve quality of life. This has led to the emergence of pro-cognitive interventions as potential treatment options in BD. Existing systematic reviews in BD suggest that pro-cognitive interventions can be effective in improving cognitive and psychosocial

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functioning, with cognitive remediation (CR) presenting the most consistent evidence on either primary or multiple exploratory cognition outcomes (Miskowiak et al., 2022b; Samame et al., 2023), whereas the evidence from pharmacological and neuromodulatory trials was overall negative or preliminary (Miskowiak et al., 2022b; Martin et al., 2015; Talaei et al., 2024).

However, it is yet to be examined systematically whether the cognitive effects of pro-cognitive interventions translate into functional improvements. In addition, evidence for long-term effects of pro-cognitive interventions remains limited. This represents an important research gap. Assessing the durability of both cognitive and functional outcomes is essential for determining the clinical utility of these interventions as effective treatment options for recovery. Furthermore, several pro-cognitive approaches, including CR, are based on the premise that improvements in cognition generalise to functional gains, which is thought to represent the primary mechanism underlying recovery-related outcomes (Bowie et al., 2020). Thus, empirical evaluation of this transfer between cognition and functioning is crucial for validating their mechanisms of action and establishing their potential to induce meaningful benefits in real-world outcomes.

Therefore, the present systematic review aimed to investigate the sustained effects (≥ 3 months after treatment end) of pro-cognitive interventions on cognition and functioning, as well as the extent to which cognitive gains translate into functional benefits in BD.

2. Methods

2.1. Protocol

This systematic review was conducted in accordance with established methodological recommendations for systematic reviews (Strawbridge et al., 2025) and is reported in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2015). The protocol was pre-registered on to the international prospective register of systematic reviews (PROSPERO; CRD420251168154).

2.2. Eligibility criteria

Eligible for inclusion were randomised controlled trials (RCTs) recruiting adults (aged ≥ 18 years) with BD that included a cognitive or functional outcome assessed at three or more months following a pro-cognitive intervention. This follow-up duration is in line with recommendations from the International Society for Bipolar Disorders (ISBD) Targeting Cognition Task Force (Miskowiak et al., 2017, 2022b). Pro-cognitive interventions were defined as pharmacological, psychological or neuromodulation treatments that included cognition as an outcome (Tsapekos et al., 2025). RCTs that examined the association of cognitive benefits with potential improvements in functional outcomes (i.e., translation or transfer) at any timepoint were also eligible. Comparators included either active or passive control conditions.

2.3. Systematic search

A comprehensive systematic search was conducted on MEDLINE, EMBASE, PsycINFO and Cochrane Library databases from inception to the 21st of May 2026. The following search terms were used: (bipolar disorder OR bipolar OR bipolar depression) AND (trial OR clinical study OR RCT OR randomised controlled trial OR randomized controlled trial) AND (Cognit* OR attention OR memory OR executive func* OR cognitive impair* OR cognitive deficit* OR employment OR recovery OR function*) AND (Procognit* OR pro-cognit* OR remediation OR cognitive rehabilitation OR pharmacotherapy OR medication OR pharmacological OR neuromodulat*). The reference lists of included studies and relevant reviews were hand-searched to identify additional potentially eligible studies.

2.4. Study selection and data extraction

The study selection process was performed independently by MK and one additional reviewer (EH, AT and DT) blinded to each other selections, using the Rayyan open-source review management software (Ouzzani et al., 2016). Initially, the titles and abstracts of all articles were screened, followed by screening of potentially relevant full-texts. Data extraction was conducted independently by MK and one additional reviewer (DT and AT) using a standardised spreadsheet. The following data were extracted: citation, basic sociodemographic and clinical characteristics, follow-up length, treatment and control conditions details (name, number of sessions, duration), cognitive and functional outcomes, and main findings for each outcome. Discrepancies were resolved through discussion with RS, SJ and AHY.

2.5. Outcome measures

The primary outcome measure was cognitive and functional outcomes assessed at three or more months following a pro-cognitive intervention. The secondary outcome was the translation of cognitive benefits to functional improvement.

2.6. Risk of bias assessment

Risk of bias (RoB) was assessed independently by MK and one additional reviewer (AT and DT) using the Cochrane Collaboration's Tool for Assessing Risk of Bias 2.0 (RoB 2 tool; Sterne et al., 2019). Where necessary, we conducted additional searches in trial registries and published protocols to extract relevant methodological details. Discrepancies were resolved through discussion with RS, SJ and AHY.

2.7. Data synthesis

Due to the limited number of studies and heterogenous outcomes, a quantitative synthesis was not considered appropriate. Findings were synthesised narratively, using the synthesis without meta-analysis (SWiM) reporting guidelines (Campbell et al., 2020).

3. Results

The systematic search yielded 4629 records after removing duplicates, with an additional 15 RCTs identified through hand-searches. Full texts of 177 RCTs were screened for inclusion, and 10 articles describing seven RCTs met the eligibility criteria for the present review. Three of these studies (Carracedo-Sanchidrian et al., 2024; Mardani et al., 2023; Tsapekos et al., 2023a) were secondary analyses of included RCTs (see Table 1). In total, studies included 615 unique participants, 266 of whom received a pro-cognitive intervention. Approximately one in eight RCTs (13%; 7/55) in adult BD identified in the search assessed cognitive or functional outcomes three or more months after treatment end. A PRISMA flowchart is presented in Fig. 1.

3.1. Study characteristics

Participants had a weighted mean age of 39 years and were mostly women (62%). The mean follow-up duration after treatment completion was four months, with three months being the minimum cut-off for inclusion (six months: $k = 3$; four months $k = 3$ [one of which was a secondary analysis]; three months: $k = 4$ [two of which were secondary analyses]). Four of the seven RCTs assessed the efficacy of CR programmes, whereas mindfulness-based cognitive therapy and transcranial direct current stimulation (tDCS) combined with mood stabilisers were examined by one RCT each. The effects of functional remediation (FR) were evaluated in one RCT (Bonnín et al., 2016). In terms of comparators, two unique RCTs employed psychoeducation and treatment-as-usual (TAU) (Bonnín et al., 2016; Carracedo-Sanchidrian

Table 1
Characteristics of included studies.

Citation	Participant characteristics						Intervention			Outcomes			
	N	Tx	Age (mean)	Female %	Mood at baseline	Impairment at baseline	Treatment	Control	Duration	FU length	Cognitive	Functional	Transfer
Bonnín et al., 2016	239	77	40.1	57.7%	HAMD ≤ 8 YMRS ≤ 6	No	Functional remediation	Psychoeducation TAU	21 weeks	6 months	Att, EF, PS, VeLM, ViLM, WM	FAST	Yes
Carracedo-Sanchidrian et al., 2024 ^a	84	40	46.8	64.3%	HAMD ≥ 8 and ≤ 19 YMRS < 8	No	Mindfulness-based cognitive therapy	Psychoeducation TAU	8 weeks	4 months	Att, EF, WM	No	No
de Dios et al., 2023 ^a	46	23	34	62.5%	HAMD ≤ 14 YMRS ≤ 14	Subjective (CPFQ > 4 on > 2 domains)	Group-based Cognitive remediation	Standard treatment	12 weeks	13 weeks	No Att, EF, PS, WM, VeLM	FAST	No
Demant et al., 2015					YMRS ≤ 6 PANSS < 75	No	Computerised Cognitive Remediation	Computer control	24 weeks	6 months	Att, EF, PS, VeLM, ViLM, WM, composite	MCAS	Yes
Lewandowski et al., 2017	75	39	29.5	54.2%	Depressed (NR)	No	tDCS + mood stabilisers	Mood stabilisers	10 days	3 months	EF (Go/No Go) EF (Tower of London)	No	No
Mardani et al., 2021 ^b	30	15	31.2	56.7%	HAMD ≤ 7 YMRS ≤ 7 or HAMD/YMRS 8–14	SCIP-D ≤ 74	Action-Based Cognitive Remediation	Conversation group	10 weeks	6 months	Att, EF, PS, VeLM, WM, global cognition	FAST, UPSA-B, WSAS, SDS	Yes
Mardani et al., 2023 ^b	61	32	36.5	73.8%	HAMD ≤ 7	No	Cognitive remediation (CIRCuiTS)	TAU	12 weeks	3 months	Att, EF, PS, WM, VeLM, global cognition	FAST, UPSA	No
Ott et al., 2021	60	29	42	68.3%	YMRS ≤ 7						Global cognition (Att, EF, PS, VeLM)	FAST	Yes
Strawbridge et al., 2021 ^c	80	40	42.2	71.3%									
Tsapekos et al., 2023a													

Abbreviations: Att: Attention; CPFQ: Massachusetts General Hospital Cognitive and Physical Functioning Questionnaire; EF: Executive function; FAST: Functional assessment short test; HAMD: Hamilton depression rating scale; MCAS: Multnomah community ability scale; NR: Not reported; PS: Processing speed; SCIP-D: Screen for Cognitive Impairment in Psychiatry Danish version; SDS: Sheehan disability scale; TAU: Treatment as usual; tDCS: Transcranial direct current stimulation; Tx: Treatment group; UPSA: University of California, San Diego performance-based skills assessment; VeLM: Verbal learning and memory; ViLM: Visual learning and memory; WM: Working memory; WSAS: Work and social adjustment scale; YMRS: Young mania rating scale.

^a Refer to the same trial.

^b Refer to the same trial.

^c Refer to the same trial.

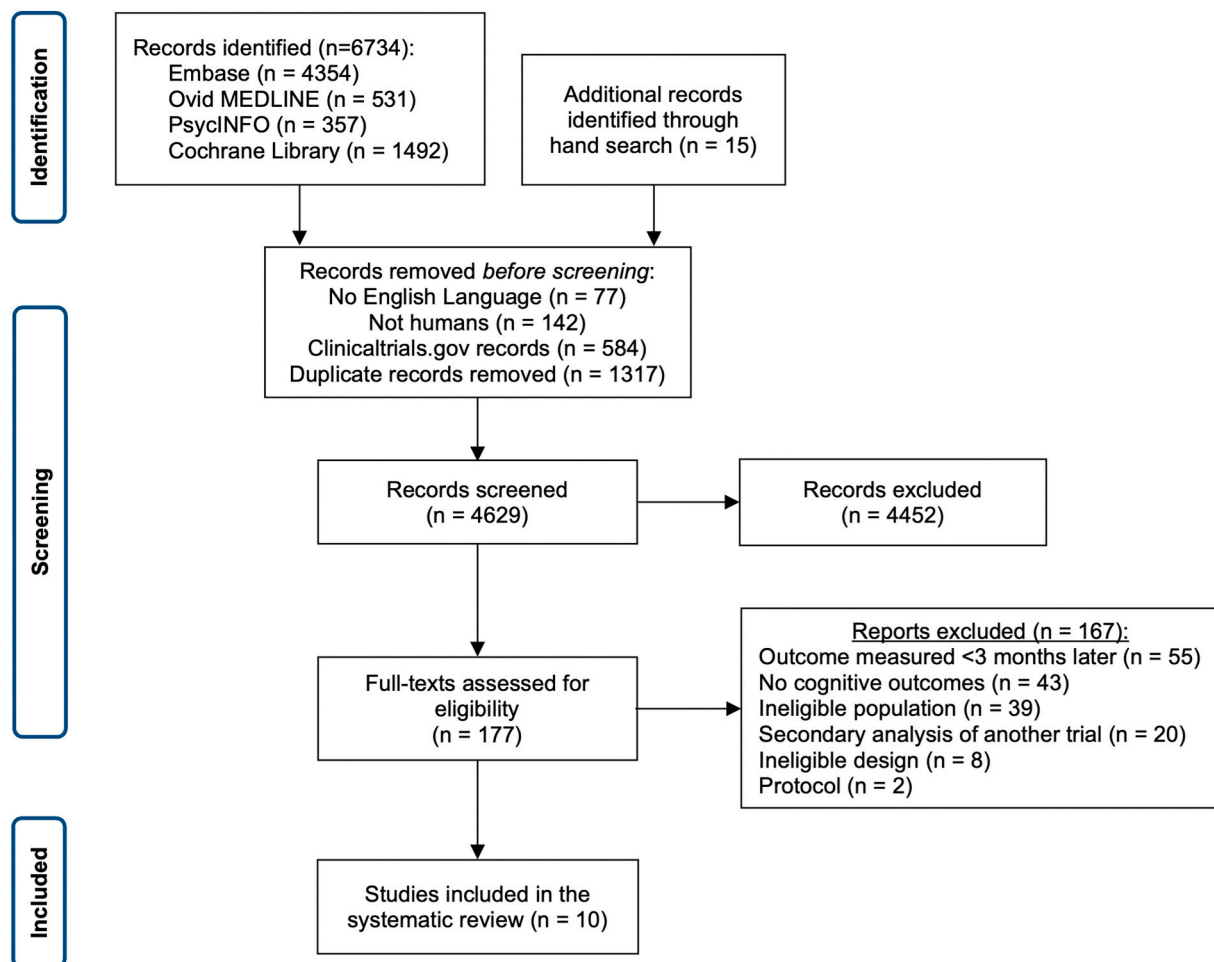


Fig. 1. PRISMA flowchart.

et al., 2024), and two used TAU/standard treatment (Demant et al., 2015; Strawbridge et al., 2021). The remaining RCTs applied an active control group comprising either computer games (Lewandowski et al., 2017), or conversation sessions (Ott et al., 2021). In one study, mood stabilisers were administered to both the tDCS and control groups (Mardani et al., 2021). The detailed study characteristics are presented in Table 1.

3.2. Risk of bias assessment

RoB evaluations are presented in Fig. 2. Four of the seven unique RCTs were evaluated as having some concerns (57.1%), two studies were rated as low RoB, whereas one rated as high risk. Generally, CR or FR trials were rated as having higher methodological quality and included larger sample sizes. The main methodological concerns were biases arising from the randomisation process ($k = 2$) and due to missing outcome data ($k = 3$).

3.3. Sustained cognitive outcomes

Findings of pro-cognitive interventions on cognitive functioning are presented in Table 2.

3.3.1. Cognitive and functional remediation

All unique RCTs included at least one cognitive outcome. CR was most consistently associated with longer-term improvements in cognitive functioning, with three unique RCTs (Demant et al., 2015; Lewandowski et al., 2017; Strawbridge et al., 2021; $n = 181$) reporting a

significant effect of therapy on at least one cognitive domain at three or six months, whereas one trial did not find a significant benefit at six month follow-up (Ott et al., 2021; $n = 61$). Furthermore, both RCTs that reported a significant therapy-related effect on a composite cognitive score at the three-month (Strawbridge et al., 2021) and the six-month follow-up (Lewandowski et al., 2017) evaluated CR interventions.

We identified substantial heterogeneity in cognitive outcomes between studies. Two studies found significant effects of CR on processing speed (Lewandowski et al., 2017; Strawbridge et al., 2021) and verbal fluency at three or six months (Demant et al., 2015; Strawbridge et al., 2021). The effects of CR on working memory, executive function and attention were inconsistent, with only one out of the four CR trials finding consistent improvements in these domains following therapy (Strawbridge et al., 2021). Bonnín et al. (2016) found a significant benefit of FR on verbal memory only.

Three CR trials reported that statistically significant differences emerged between the treatment and control groups in at least one cognitive domain at follow-up, although there was no effect at treatment end (Demant et al., 2015; Lewandowski et al., 2017; Strawbridge et al., 2021). Two studies reported delayed positive effects of FR and CR respectively, on verbal fluency and verbal memory (Bonnín et al., 2016; Strawbridge et al., 2021), as well as processing speed at three or six months after treatment end (Lewandowski et al., 2017; Strawbridge et al., 2021). Findings are presented in Table 2.

3.3.2. Other pro-cognitive interventions

One study reported that mindfulness-based cognitive therapy improved attention compared to TAU, an effect that emerged at the four-

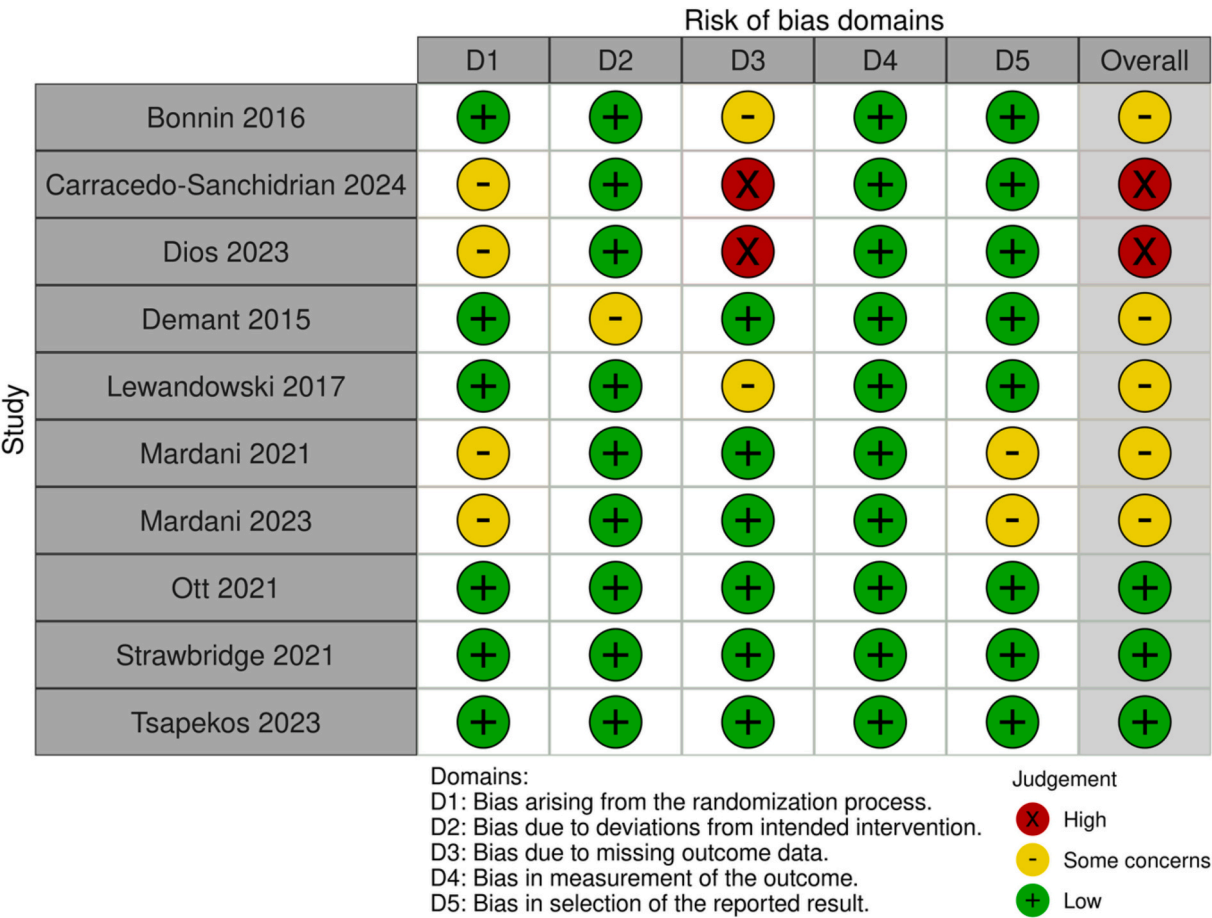


Fig. 2. Risk of bias evaluations.

month follow-up (Carracedo-Sanchidrian et al., 2024). The RCT assessing tDCS plus mood stabilisers did not find a significant effect on executive function at the three-month follow-up (Mardani et al., 2021, 2023).

3.4. Sustained functional outcomes

Only one of the seven unique RCTs did not assess a functional outcome (Mardani et al., 2021, 2023). The Functional Assessment Short Test (FAST; Rosa et al., 2007) was the most commonly used functional measure (k = 5, out of seven RCTs). Only one of the included studies found a statistically significant improvement in the total FAST score between the CR and control group at the three-month follow-up (Strawbridge et al., 2021; n = 60). Another study found a significant effect of FR on the autonomy subscale, whereas the effect on the total FAST score at six months disappeared after controlling for subthreshold depressive symptoms (Bonnín et al., 2016). Findings of pro-cognitive interventions on functioning are presented in Table 2.

3.5. Translation of cognitive benefits

The translation of cognitive benefits to functioning was assessed only by four out of ten RCTs (40%), all of which evaluated FR or CR (see Table 2). Of these, three RCTs reported a significant association (Bonnín et al., 2016; Lewandowski et al., 2017; Tsapekos et al., 2023a), although this was specific to the CR (Tsapekos et al., 2023a) or FR group (Bonnín et al., 2016) only in two RCTs. Moreover, only Tsapekos et al. (2023a) explored the association between cognitive change following CR (pre-post treatment) and psychosocial function at follow-up (changes from post-treatment to follow-up), whereas Lewandowski et al. (2017)

examined changes between baseline and post-treatment only.

4. Discussion

The present systematic review explored the sustained cognitive outcomes (≥3 months) following pro-cognitive interventions for BD, as well as the translation of treatment-related cognitive benefits into functional outcomes. We identified 10 studies meeting the eligibility criteria, three of which were secondary analyses of already included RCTs. Based on our systematic search and study selection, approximately one in eight RCTs examining a pro-cognitive intervention in adult BD (7/55; 13%) assessed cognitive or functional outcomes three or more months after treatment end. Of those seven unique trials, five assessed the effects of CR or FR, one examined tDCS, and one mindfulness-based cognitive therapy. Although evidence is still limited, CR appears to be a promising intervention for achieving durable cognitive gains in BD. Four out of the seven included RCTs evaluated the translation of cognitive benefits to functional improvements, with only two reporting a significant transfer effect specific to the therapy group (CR and FR). Our findings highlight a significant evidence gap on sustained cognitive effects and their putative translation to functional improvements, due to insufficient examination of these outcomes in cognition trials.

Almost 10 years ago, ISBD Targeting Cognition Task Force highlighted the importance of allowing a follow-up period of three to six months after treatment end when assessing cognitive functioning in cognition trials (Miskowiak et al., 2017). Despite that, our systematic search confirmed that the majority of efficacy RCTs targeting cognition in BD (>85%) only assessed outcomes less than three months following the completion of a pro-cognitive intervention.

Table 2

Sustained cognitive and functional outcomes at 3 to 6 months following pro-cognitive interventions in bipolar disorder.

Citation	Cognitive outcomes			Functional outcomes			Transfer of cognitive gains to functioning	
	Significant	Non-significant	Significant at follow-up only	Significant	Non-significant	Significant at follow-up only	Type of analysis	Significant
Bonnín et al., 2016	VeLM	Att, EF, PS, ViLM, WM, Composite score	VeLM	Autonomy domain (FAST)	Other FAST domains (after controlling for mood)	Autonomy domain (FAST)	Correlation (change between baseline and follow-up)	Yes, $r = -0.32$, $p = 0.04$ (therapy group)
Carracedo-Sanchidrian et al., 2024 ^a	Att (colour reading speed, number of errors)	EF, WM	Att	Not assessed	Not assessed	Not assessed	Not assessed	N/A
de Dios et al., 2023 ^a	Not assessed	Not assessed	Not assessed	None	FAST	N/A	Not assessed	N/A
Demant et al., 2015	Verbal fluency (letter S)	Att, EF (except verbal fluency), PS, WM, VeLM	Verbal fluency (letter S)	None	FAST	N/A	Not assessed	N/A
Lewandowski et al., 2017	Composite Score ($d = 0.83$), PS ($d = 0.65$)	Att, EF, VeLM, ViLM, WM	PS	None	MCAS	N/A	Regression (change between baseline and post)	Yes (no moderation)
Mardani et al., 2021 ^b	No	EF	N/A	Not assessed	Not assessed	N/A	Not assessed	N/A
Mardani et al., 2023 ^b	No	EF	N/A	Not assessed	Not assessed	N/A	Not assessed	N/A
Ott et al., 2021	None	Att, EF, PS, VeLM, WM, global	N/A	None	FAST, UPSA-B, WSAS, SDS	N/A	Regression (prospective)	No
Strawbridge et al., 2021 ^c	Att/PS ($d = 0.35$), EF (hotel: $d = -0.93$; FAS: $d = 0.52$), WM ($d = 0.7$), VeLM (recall only; $d = 0.45$), global cognition ($d = 0.68$)	VeLM (VPA I, recognition)	Att, EF (VF only), PS, VeLM (recall only), global cognition	FAST ($d = -0.49$)	UPSA	N/A	Not assessed	N/A
Tsapekos et al., 2023a ^c	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Regression (prospective)	Yes (moderation)

Att: Attention; EF: Executive function; FAST: Functional assessment short test; MCAS: Multnomah community ability scale; N/A: Not applicable; PS: Processing speed; SDS: Sheehan disability scale; TAU: Treatment as usual; tDCS: Transcranial direct current stimulation; UPSA: University of California, San Diego performance-based skills assessment; VeLM: Verbal learning and memory; VF: Verbal fluency; ViLM: Visual learning and memory; VPA: Verbal paired associates; WM: Working memory; WSAS: Work and social adjustment scale.

^a Refer to the same study.

^b Refer to the same study.

^c Refer to the same study.

Our findings on the sustained effects of pro-cognitive interventions align with those from a recent systematic review by the ISBD Targeting Cognition Task Force, according to which, CR was most consistently associated with cognitive benefits (Miskowiak et al., 2022b). An important limitation is that existing CR trials are using different treatment paradigms (e.g., in terms of delivery method, therapy duration and number of sessions) and thus findings may not be directly comparable. In our review, the effects of mindfulness-based cognitive therapy and tDCS on cognition and functioning were assessed by only one study each, which limits the potential to draw any reliable conclusions on their long-term efficacy.

Findings on the functional effects of CR were mixed, with only one study reporting a significant improvement in general psychosocial functioning after three months (Strawbridge et al., 2021). This is consistent with two meta-analyses on the efficacy of CR, which found no significant effects on functional outcomes (Goldberg et al., 2023; Samame et al., 2023). One possible explanation is that longer follow-up periods are required to capture the full extent of CR effects, particularly the translation of cognitive gains into functional improvements, which may occur with a temporal delay (McGurk et al., 2015; Miskowiak et al., 2017). Consistent with this, three CR trials in the present review reported significant cognitive and functional improvements emerging only three to six months after treatment (Demant et al., 2015; Lewandowski et al., 2017; Strawbridge et al., 2021). However, none of the included RCTs extended follow-up beyond six months post-treatment.

Overall, there was limited evidence that cognitive benefits following CR or FR translate into functional improvement. Only one of the four RCTs examining this transfer reported a significant prospective association, where post-treatment cognitive performance predicted functional outcomes at follow-up, and this effect was specific to the CR group (Tsapekos et al., 2023a). Two additional studies reported significant concurrent associations between changes in cognition and functioning (Bonnín et al., 2016; Lewandowski et al., 2017), although this relationship was specific to the intervention group in only one case (Bonnín et al., 2016). This lack of consistent findings for the transfer of cognitive gains to functioning is an important empirical gap in the literature, as various CR paradigms hypothesise that cognitive gains result in improved functional outcomes (Bowie et al., 2020).

Interestingly, the only study that reported significant functional effects of CR also found that post-treatment performance in global cognition mediated the effect of CR on functioning at follow-up. Nevertheless, cognitive gains accounted only for 35% of the improvement in psychosocial functioning (Tsapekos et al., 2023a). This suggests that factors beyond cognitive changes may underlie the functional integration of pro-cognitive interventions, including changes in social cognition (Ospina et al., 2018) and metacognition (Davies and Greenwood, 2020).

Table 3
Methodological recommendations for trials examining sustained effects and translation of cognitive gains in bipolar disorder.

Timing of follow-up assessments
• Include a follow-up assessment at ≥3 months after treatment completion for the examination of functional outcomes, in line with the International Society for Bipolar Disorders Targeting Cognition Task Force • If feasible, add a long-term follow-up (≥12 months) to assess ‘hard’ functional outcomes (e.g., employment status, educational attainment), which are less susceptible to short-term change.
Examining transfer between cognition and functioning
• Ensure temporal sequencing between cognitive and functional outcomes (i.e., examining whether post-treatment cognitive changes predict subsequent changes in functioning at a later follow-up time-point). • Use a staged outcome framework: cognition → functional capacity (e.g., UPSA) → psychosocial functioning (e.g., FAST) → real-life outcomes (e.g., employment). • Apply longitudinal and mechanistic statistical models (e.g., mediation analysis). • Ensure studies are adequately powered for these mechanistic analyses.

FAST: Functional assessment short test; UPSA: University of California, San Diego performance-based skills assessment.

5. Limitations

This systematic review presents some limitations. Firstly, it included a relatively small number of studies ($k = 10$), three of which were secondary analyses of already included RCTs. One of the included RCTs (Strawbridge et al., 2021; Tsapekos et al., 2023a) was conducted by three of the co-authors. Due to limited number of studies, as well as heterogeneity in treatment paradigms, outcome measures and follow-up length, it was not possible to conduct a meta-analysis. Important clinical variables (e.g., residual mood symptoms, medications, illness characteristics) were inconsistently controlled across RCTs, which may have contributed to variability in findings. Most RCTs included euthymic individuals, which may limit the generalisability of findings. RCTs including a transdiagnostic sample without reporting findings in the BD subgroup were excluded. In addition, most studies examined the efficacy of CR or FR therapy, whereas there was a paucity of research on other pro-cognitive interventions, such as tDCS. Consequently, we were not able to draw conclusions on the sustained effects of other pro-cognitive interventions apart from CR. Nevertheless, the above mostly constitute limitations of the existing literature, rather than the present systematic review.

6. Future perspectives

According to recent evidence, virtual reality (VR) may be an effective tool for improving transfer of CR-related cognitive gains to real-world functioning in people with mood or psychosis spectrum disorders (Jespersen et al., 2026). It is therefore possible that emphasising and directly practicing the application of cognitive skills in real-world-like settings can enhance the functional effects of pro-cognitive interventions. In line with this, the only CR trial that found a durable effect on psychosocial functioning domains (Strawbridge et al., 2021) used the computerised software CIRCuiTS (Wykes and Reeder, 2006), which also offers tools for the transfer of cognitive skills to daily life activities (Tsapekos et al., 2023b).

Establishing whether cognitive improvements are sustained and translate into real-world functioning is key to demonstrating the clinical efficacy and cost-effectiveness of pro-cognitive interventions. Short-term improvements (≤ 3 months) on cognitive measures are of limited clinical value if they do not endure beyond the intervention period or fail to generalise to functional domains such as occupational functioning, independent living, quality of life, and overall psychosocial engagement- outcomes of relevance to patients and carers. Although methodological recommendations have long emphasised these priorities (Miskowiak et al., 2017), their uptake remains limited nearly a decade later. Future research should therefore prioritise both extended follow-up periods and the identification of mechanisms linking cognitive and

functional outcomes. Table 3 summarises methodological recommendations for assessing this translation in cognition trials, extending prior ISBD guidance (Miskowiak et al., 2017; Tsapekos et al., 2025).

7. Conclusions

Our findings highlight a persistent scarcity of evidence for sustained cognitive effects of pro-cognitive interventions and their translation into functional outcomes in BD, despite functional recovery being their primary aim. This gap underscores the need for cognition trials to incorporate longer follow-up periods, as functional gains may emerge with delay.

CRediT authorship contribution statement

Michail Kalfas: Writing – review & editing, Writing – original draft, Project administration, Methodology, Data curation, Conceptualization. **Anna Tröger:** Writing – review & editing. **Elliot Hampsey:** Writing – review & editing. **Rebecca Strawbridge:** Writing – review & editing, Supervision, Methodology. **Kamilla W. Miskowiak:** Writing – review & editing. **Sameer Jauhar:** Writing – review & editing, Supervision, Methodology. **Allan H. Young:** Writing – review & editing, Methodology, Funding acquisition. **Dimosthenis Tsapekos:** Writing – review & editing, Supervision, Methodology, Conceptualization.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Michail Kalfas reports financial support was provided by Imperial College London and a relationship with Neurocentrx that includes: consulting or advisory. Rebecca Strawbridge reports a relationship with Janssen that includes: speaking and lecture fees. Kamilla W Miskowiak reports honoraria from Lundbeck, Novonesis and Gedeon Richter in the past three years. Sameer Jauhar reports speaker fees from Boehringer Ingelheim, the Dubai Masterclass conference, Janssen, Lundbeck, and Recordati; serving as a nonpaid member of the UK National Institute for Health and Care Excellence (NICE) Health Technology Appraisal committee; serving as a committee member and on the funding panel for the Wellcome Trust; and advisory board fees from Boehringer Ingelheim and LB Pharmaceuticals outside the submitted work. Allan H Young reports

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None.

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