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Research Progress on Digital Interventions for Anhedonia in Depression over the Past Five Years: From General Efficacy to Precision Targeting

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Abstract. Anhedonia, a fundamental symptom of depression, is strongly associated with poor prognosis and suicide risk. Traditional pharmaceutical and psychotherapies showed limited effectiveness in treating anhedonia. Recent advancements in digital interventions offer new options for depression-related anhedonia. However, systematic comparisons of their efficacy for anhedonia remain lacking. This review included 17 empirical studies published since 2021 that reported anhedonia measurements, examining the effectiveness and possible mechanisms of several digital intervention formats for depression-related anhedonia. Text-message therapies and smartphone apps — largely automated and lacking interpersonal interaction — were generally ineffective; evidence for virtual reality interventions is limited but demonstrates unique potential by directly simulating multimodal sensory stimulation and providing immersive environmental interactions; online psychotherapy including various therapies showed generally positive outcomes, though efficacy varied significantly by format. According to mechanism analysis, active interventions requiring real-time therapist guidance and interaction outperform passive ones, for they create a therapeutic connection, offer consistent social incentives and improve adherence through supporting accountability. Current limitations include short follow-up periods, small sample sizes, reliance on single assessment tools, and insufficient studies. Future research should extend follow-up periods, adopt multimodal assessment methods, enlarge samples, and examine specific anhedonia subtypes to define the applicability of different digital therapies.

Keywords: Anhedonia, depression, digital intervention, online psychotherapy, reward processing

1. Introduction

Anhedonia, "defined as a loss of interest in pleasurable stimuli or a diminished capacity for joy or pleasure," is a common symptom across a variety of mental disorders, including depression, schizophrenia, and substance use disorders [1]. It is strongly associated with poor treatment response and increased suicide risk, yet first-line treatment options remain insufficiently effective. Some conventional antidepressants may even exacerbate anhedonic symptoms, and while evidence-based

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psychotherapies are effective for overall depressive symptoms, they tend to focus on reducing negative emotions and have shown limited efficacy in treating anhedonia [2].

As a complement to traditional service delivery, digital mental health interventions have evolved over more than a decade, with rapid growth in recent years. Current digital modalities span diverse technological platforms: smartphone apps are the most popular and offer the greatest accessibility; virtual reality (VR) holds transformative potential; and self-guided online courses, as well as web-based counselling, provide additional channels for both providers and clients [3].

Although preliminary evidence indicates that various digital interventions are effective for depression overall [3], most of the existing studies evaluate the effectiveness of these therapies in isolation. A systematic comparison of different digital formats—considering dimensions such as delivery modality and level of human interaction—specifically for their effects on anhedonia in depression remains lacking. What's more, former meta-analyses have primarily focused on medication versus psychotherapy comparisons, or general depressive and anxiety, but they didn't treat anhedonia as a primary endpoint. To address this gap, the present scoping review synthesises available evidence on the impact of different digital intervention formats on depression-related anhedonia and compares their relative efficacy.

2. Methods

2.1. Search strategy

This article systematically searched PubMed, Web of Science, APA PsycInfo, and Embase for articles published between January 2021 and August 2026. The search strategy combined the following keywords: ('anhedonia' OR 'pleasure') AND ('digital' OR 'app' OR 'smartphone' OR 'mobile' OR 'Short Message Service (SMS)' OR 'virtual reality' OR 'VR' OR 'telehealth' OR 'telemedicine' OR 'online' OR 'internet' OR 'web-based') AND ('depression' OR 'depressive' OR 'major depressive disorder (MDD)'). In addition, the author manually screened the reference lists of included studies to identify further relevant reports.

Inclusion criteria were: (1) the study population comprised individuals with depression or subsamples with depression; (2) the intervention was a digital mental health intervention delivered via a smartphone app, text message, virtual reality, an online platform, or telehealth; (3) anhedonia was measured or reported; (4) the study designs were randomized controlled trials (RCTs) or observational studies with quantitative outcome data.

2.2. Data extraction and synthesis

Data were extracted by intervention format, recording the first author, year of publication, intervention type, sample size, measures of anhedonia, and key findings. Due to heterogeneity in intervention types and outcome measures, a narrative synthesis approach was adopted, with studies categorized by digital intervention format.

3. Results

3.1. Article overview

Preliminary search results are as follows: 255 articles in PubMed, 237 in Web of Science, 844 in Embase, and 308 in PsycInfo. After restricting the publication timeframe and excluding duplicate publications, the article was screened sequentially by title and abstract; ultimately, 17 studies were

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included. Among these, 4 studies examined smartphone app and text-message interventions, 1 study related to virtual reality interventions, and 12 studies connected to telemedicine and online psychotherapy interventions.

3.2. Smartphone app and text message interventions

Most of the smartphone-based interventions reduced general depression symptoms; however, almost none showed improvement in the specific area of anhedonia. Gamified intervention according to the Facilitating Thought Progression (FTP) theory was employed while Blomberg et al. employed approach-avoidance bias modification training [4, 5]. Their had the similar results: the intervention group improved in general depressive symptoms more than control group, although there is no significant improvement in anhedonia, and these effects continued at long-term follow-up. It may be that the interventions changed the content of thought or patterns of thought, but did not enhance patients' ability to derive pleasure from activities. Notably, Blomberg's study did not find a significant improvement in short-term depressive symptoms, but the long-term effects were better to the control group, therefore, the effect may be delayed [5]. Furthermore, according to the scale, there was no change in approach-avoidance bias, so it is unknown whether the expected modification of cognition occurred.

The conclusions of the above study may be due to the fact that it only changed the content or patterns of thought; however, a randomized controlled trial of a fully automated, text-message-based behavioral activation (BA) therapy also reached similar conclusions [6], and thus the that the lack of significant intervention effects may not be solely related to the theoretical system of the treatment. In this RCT, 126 adults with moderate-to-severe depression were randomly assigned to a BA group, a healthy activity group, or a passive control group. Again, there was a general improvement in depressive symptoms, but anhedonia did not change significantly. Notably, non-digital behavioral activation (BA) therapy has also been shown to be effective in alleviating anhedonia [7].

However, one study has reported a positive outcome. Reference [8] conducted a mixed-care intervention (Switch) study targeting motivational deficits by combining in-person group Switch interventions with ecological momentary interventions (EMI). Among 8 participants with schizophrenia spectrum disorders and major depressive disorder, only the 4 patients who completed the intervention showed significant improvement on the anhedonia subscale of the Brief Negative Symptoms Scale (BNSS), while those non-completers worsened. However, this study has several limitations. First, it was a small-scale exploratory experiment with a very small sample ($n = 8$). Second, a standardised anhedonia scale was not used to assess changes in the patient. Finally, the digital intervention served only to supplement the in-person therapy and could not be used to evaluate the independent effect of the digital part.

3.3. Virtual reality interventions

Virtual reality (VR), is an immersive digital technology with great potential. It may promote the synthesis of monoamine neurotransmitters and regulate the function of the glutamate/gamma-aminobutyric acid system, but it can also increase dendritic spine remodeling and long-term potentiation (LTP). Recently, some studies shown that VR may also activate the mesolimbic dopamine system and alter the hypothalamic-pituitary-adrenal (HPA) axis. Additionally,VR combied with exercise may help to stimulate hippocampal neurogenesis and improve functional connectivity between the prefrontal cortex and the limbic system [9].

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VR is commonly used in exposure therapy for anxiety disorders and has also been applied to study in post-traumatic stress disorder (PTSD) and obsessive-compulsive disorder (OCD); participants are exposed to specific environments to reduce stress responses [10]. However, to treat anhedonia, the focus of enhancing positive emotional experiences and reward anticipation is more important; thus, the relevant evidence is not easily transferable to anhedonia in depression.

Only one exploratory study has examined the impact of VR on anhedonia in depression to date [2]. VR-based reward training with imaginative narratives was given to six patients with depression in this study. Self-reported anhedonia decreased significantly from baseline to the 1-month follow-up, however, there were no significant changes in scores for the Temporal Experience of Pleasure Scale (TEPS) or Behavioral Activation Scale (BAS). VR can provides multimodal sensory stimulation and immersive environmental interactions via head-mounted displays [9]. Reference [2] hypothesized that these unique characteristics of VR may increase pleasurable responses through direct simulation of positive experiences; however, this mechanism has not been verified by mediation analysis.

3.4. Telemedicine and online psychotherapy interventions

Telemedicine and online psychotherapy are the most widely used forms of digital interventions, encompassing various types such as internet-based Cognitive Behavioral Therapy (iCBT), video conferencing psychotherapy, and computer-based cognitive training. Their effectiveness for anhedonia varies considerably.

3.4.1. Online cognitive behavioral therapy (iCBT)

Two iCBT studies have supported the general effectiveness for depression; however, direct evidence on anhedoniais lacking. Reference [11] investigated whether iCBT could reduce anhedonia by improving the function of reward circuits. The intervention increased the activation of the nucleus accumbens (Nacc) and the subgenual anterior cingulate cortex (sgACC), which are related to reward processing and emotional regulation, respectively in response to reward cues, these neural changes mediated the reduction in anhedonia, and thus iCBT may alleviate anhedonia by restoring the reward circuitry. However, the improvements in neural function did not necessarily lead to corresponding behavioral changes compared to the control group as shown by scores of Snaith-Hamilton Pleasure Scale (SHAPS). Reference [12] explored the priming effects of exercise at different intensities on iCBT before Cognitive Behavioral Therapy (CBT). Based on the results, 30 minutes of moderate-intensity exercise before each CBT session led to improvements with large effect sizes in both state anhedonia, therapeutic alliance, and behavioral activation.

3.4.2. Behavioral activation (BA) and mindfulness meditation

Unlike the text-based BA mentioned earlier, the online BA psychological interventions have shown better outcomes. Reference [13] provided a 4-week online BA intervention to 34 participants with mild to moderate depression. Reference [14] combined BA with cognitive training by integrating computerized approach-avoidance training with brief computerized BA, thereby intervening simultaneously on two fronts: increasing positive overt behavior and altering implicit cognitive biases. In both studies, participants' depression and anhedonia decreased significantly, with the effects on anhedonia persisting at the one- and three-month follow-up. Notably, in the study by Ruzickova et al., participants' negative cognitive bias toward facial expressions improved—a finding

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never previously observed in pure behavioral therapy [13]. This suggests that online BA may, to some extent, alleviate negative cognitive biases toward faces.

In an RCT, Potsch and Rief compared the effects of online BA, mindfulness and gratitude training, a combination of both, and a waitlist control group on reward sensitivity and depressive symptoms [15]. The results showed that all intervention groups significantly reduced anhedonia, but only the BA and mindfulness groups significantly improved reward sensitivity. The researchers reported the long-term stability of their interventions at the four-month follow-up [16].

Turning to mindfulness meditation, a study conducted a pilot study of a video-based online group meditation therapy [17]. The program taught Metta Meditation techniques to enhance benevolence toward oneself and others. Clinically, the mean Beck Depression Inventory score decreased significantly, and social anhedonia also improved significantly.

3.4.3. Cognitive training and bias correction interventions

Cognitive training and bias correction interventions aim to modify specific cognitive processes through repetitive digital tasks. Reference [18] evaluated the effects of computerized Emotional Bias Training (EBT) on individuals taking medicine for anxiety/depression. EBT effectively induced a positive bias in facial emotion recognition but failed to translate this bias into significant improvements in clinical symptoms, including anhedonia. Reference [19] investigated the effects of online working memory training on enhancing hedonic processing in individuals with social anhedonia and subclinical depression. The transfer effects on hedonic processing were limited and task-specific, belief updating did not improve significantly in all groups, whereas only the social anhedonia group showed increased high-effort choices on the Effort Expenditure task. These findings suggest that working memory training may not produce uniform improvements in anhedonia across subgroups or reward-related processes.

In contrast, Blackwell et al. reported positive outcomes from their imagery-based cognitive bias training [20]. They employed a Sequential Bayesian analysis to dynamically eliminate and continuously update intervention versions. The final version outperformed the initial control group in reducing anhedonia, with a moderate effect size. This study was the first to demonstrate the application of "leapfrog" RCT in psychotherapy development, providing an innovative approach to accelerate the development and optimization of cognitive training interventions.

3.4.4. Novel psychotherapies

Positive Affect Treatment (PAT) targets reward sensitivity to enhance positive emotions and it is often compared with Negative Affect Treatment (NAT), which focuses solely on reducing threat sensitivity and negative emotions. Reference [21] initiated a RCT in 2019 to validate the effectiveness of PAT and NAT for patients with depression; the intervention process transitioned from purely in-person format to online format, and Uribe et al. analyzed the data [22]. The results showed no significant differences in treatment adherence, credibility, therapeutic alliance, or attendance rates among the purely online, purely in-person, and blended modes. However, the therapeutic effect on depressive symptoms (including anhedonia) were positively correlated with the proportion of online intervention. A possible explanation for this is that the therapist's intervention serves as a crucial source of social support when face-to-face social interaction is limited.

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4. Discussion

4.1. Summary of key findings

This review summarizes research progress over the past five years on digital interventions for the treatment of anhedonia in depression. In terms of format, smartphone apps and text-message interventions have shown generally limited effectiveness, indicating that purely automated apps or text messages are unlikely to address the core of anhedonia. Although there is currently only one exploratory study with a small sample size on virtual reality technology, it shows potential for reducing anhedonia. However, its ability to directly provide multisensory stimulation and simulate pleasurable experiences gives it strong theoretical potential for anhedonia interventions. Meanwhile, telemedicine and online psychotherapy, despite considerable variations in effectiveness, generally showed positive outcomes.

In the *Diagnostic and Statistical Manual of Mental Disorders, fifth edition* (DSM-5), anhedonia was defined as "markedly diminished interest in or pleasure in all, or almost all, activities for most of the day, nearly every day." This definition focuses on describing behavioral manifestations at the phenomenological level [1]. As research has progressed, researchers found anhedonia should be integrated into the model of reward processing, including Reward Responsiveness, Reward Valuation, and Reward Learning. Anhedonia has also been categorized into anticipatory anhedonia (impaired reward anticipation) and consummatory anhedonia (impaired reward response) [23].

This study found that differences in intervention effectiveness are not primarily determined by their theoretical basis or the cognitive processes they target, but rather depend on whether the delivery channel or format is "active" or "passive". Interventions that include therapist guidance or real-time interaction are generally effective, whereas fully automated interventions that lacking interpersonal interaction or featuring minimal interaction are generally ineffective or produce weaker effects.

Social interaction can yield important natural reward. Neuroscience research indicates that social rewards—including approval, reciprocity, and positive feedback from others—can directly activate the brain's reward circuitry, including key nodes such as the ventral striatum and medial prefrontal cortex [24]. In active interventions, interactions between the therapist and the patient (e.g., empathetic responses, acknowledgment of progress, and collaborative problem-solving) provide a continuous stream of social reward input that directly activates the patient's reward system. In contrast, passive interventions lack such immediate social reward cues and thus unlikely to address the core issue of anhedonia—namely, a compromised reward system [2, 4].

Passive interventions also face huge barriers to adherence and engagement. Multiple studies included in this review highlight this problem. For example, in the RCT by Blackwell et al., dropout rates in the intervention group ranged from 31% to 66%, whereas those in the monitoring control group were only 7% to 10% [20]. Similarly, in theBA intervention based in Short Message Service by Santopetro et al., the overall retention rates were acceptable, but activity levels in the BA group were significantly lower than those in the natural activity group [6]. The "Supportive Accountability" model proposed by Mohr et al. emphasizes that human support is a key factor in improving adherence and effectiveness in digital behavioral interventions [25]. Purely automated interventions lack this Supportive Accountability mechanism, making it difficult for participants to maintain long-term engagement and thereby limiting the intervention's effectiveness. Furthermore, therapeutic alliance — a moderate predictor of CBT outcomes for depression — requires alignment on goals, tasks, and emotional bonding, which can only be established and maintained through real-time interaction; passive interventions cannot foster a stable alliance by design [26].

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4.2. Research gaps and future directions

Based on the evidence and its limitations, future research should address several areas: study populations, assessment methods, and follow-up periods.

First, research on digital interventions targeting anhedonia is still in its beginning period. Few studies treat anhedonia as a primary outcome or core mediator; most analyse it only as a secondary or exploratory outcome [6, 13]. Moreover, exploration of specific approaches is extremely limited. Virtual reality (VR), as a highly immersive technology, is theoretically well positioned to target anhedonia by simulating and reinforcing rewarding experiences [2]; however, relevant research is extremely scarce, and existing evidence comes from only one small-sample trial, making it difficult to get reliable conclusions. Therefore, future research should conduct more large-scale RCTs targeting specific digital technologies or intervention models, such as VR and online Metta Meditation on anhedonia.

Second, existing studies on digital interventions pay insufficient attention to the long-term maintenance of improvements in anhedonia. For instance, although the study by Potsch and Rief reported stable effects at four months, most follow-ups did not exceed three months [16]. The durability for anhedonia improvements after intervention remains unclear. Future studies should include longer follow-up periods with repeated measurements to determine the long-term efficacy of treatments for anhedonia and whether improvements gradually fade after the intervention ends.

Third, only a limited number of studies have employed multimodal assessment [8, 21]. Anhedonia involves three components: Reward Responsiveness, Reward Valuation, and Reward Learning, yet most studies rely on unidimensional tools like the SHAPS total score, which cannot distinguish which component is affected. Future research should adopt stage-specific assessment tools, such as the TEPS scale or the Probabilistic Reward Task (PRT) for evaluating reward learning, and combine these with ecological momentary assessment (EMA) to record dynamic pleasure experiences in daily life, thereby avoiding the limitations of relying on a single scale to prevents an understanding of the underlying mechanisms of the intervention.

In addition, this review identified a trend that requires further verification: "when conveying similar content, active interventions are superior to passive interventions." To date, no study has directly compared the effectiveness of active versus passive interventions for anhedonia under the same theoretical framework or therapeutic approach, nor examined the dose-response effect of varying levels of interaction. Future research should design relevant controlled experiments to determine whether "interpersonal interaction" in face-to-face interventions can be partially substituted, thereby providing evidence for the design of digital intervention tools suitable for large-scale application.

4.3. Limitations

This review has the following limitations. First, it is a secondary analysis and systematic review of existing articles rather than the analysis and integration of original experimental data; therefore, the robustness of the conclusions is inevitably limited by the quality and variability of the original studies. Additionally, due to significant differences among studies in participant characteristics, intervention protocols, assessment tools, and designs of experiments, it is difficult to make direct comparisons of efficacy and also limits the possibility of drawing uniform conclusions.

Second, the strength of evidence for some included studies is weak. For instance, VR and the intervention based on Nintendo Switch rely on small, uncontrolled pilot studies [2, 8]; the reliability and generalizability of their conclusions require further confirmation through large-scale RCTs. At

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the same time, most studies focus on overall improvements in depressive symptoms, and the assessment of anhedonia often relies on a single item or secondary outcome rather than multidimensional, specialized scales such as the TEPS.

In summary, the conclusions presented in this study should be regarded as a preliminary synthesis of the current limited evidence and theoretical inferences, rather than definitive determinations of causal relationships. Current evidence suggests that interventions directly targeting the reward system and positive emotions may be more effective than cognitive changes alone, and that active interventions are superior to passive ones. Future research should focus on the precise subtyping of anhedonia, multimodal assessment, and long-term efficacy to further clarify the true therapeutic effects and limitations of different digital intervention strategies for anhedonia.

5. Conclusion

Seventeen studies connected to digital interventions for depression-related anhedonia was synthesized in this article. The findings showed that efficacy changes markedly by the format and percentage of human interaction. Smartphone apps and text-message interventions, especially fully automated ones, generally improved overall depressive symptoms but showed limited benefit for anhedonia. Online psychotherapy, including iCBT, online BA, mindfulness and gratitude training, and PAT, generally produced positive outcomes, with some effects maintained at follow-up. VR showed theoretical and primary clinical potential, but evidence remains limited to a single small exploratory study. Cognitive training and bias correction interventions yielded mixed results; some interventions induced cognitive change without clinical translation, whereas imagery-based bias training using Sequential Bayesian analysis showed promise.

Across formats, active interventions involving real-time therapist guidance or interpersonal interaction were more effective than passive or fully automated ones. Possible mechanisms include therapeutic connection, consistent social reward input, and Supportive Accountability, which may enhance adherence and target reward-processing deficits. However, current evidence is constrained by short follow-up, small samples, single assessment tools, and few studies treating anhedonia as a primary outcome. Most studies also did not distinguish between anticipatory, consummatory, and other reward components. Future research should conduct larger RCTs with longer follow-up, multimodal and stage-specific assessments, and direct comparisons of active versus passive interventions under similar theoretical frameworks. Such work is needed to clarify which digital formats can effectively and durably reduce anhedonia.

References

[1] American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Pub. https://doi.org/10.1176/appi.books.9780890425596

[2] Chen, K., Barnes-Horowitz, N., Treanor, M., Sun, M., Young, K. S., & Craske, M. G. (2021). Virtual reality reward training for anhedonia: A pilot study. *Frontiers in Psychology, 11*, 613617. https://doi.org/10.3389/fpsyg.2020.613617

[3] Anser, M. K., Nabi, A. A., Ahmad, I., Abro, M. M. Q., & Zaman, K. (2025). Advancing mental health care: A comprehensive review of digital tools and technologies for enhancing diagnosis, treatment, and wellness. *Health Care Science, 4*(3), 163-178. https://doi.org/10.1002/hcs2.70018

[4] Yatziv, S.-L., Pedrelli, P., Baror, S., DeCaro, S. A., Shachar, N., Sofer, B., Hull, S., Curtiss, J., & Bar, M. (2024). Facilitating thought progression to reduce depressive symptoms: Randomized controlled trial. *Journal of Medical Internet Research, 26*, e56201. https://doi.org/10.2196/56201

[5] Blomberg, M., Zech, H. G., Kluge, M., Böhmert, N., Platte, H., & Brockmeyer, T. (2025). Smartphone-based approach-avoidance bias modification training for depression: Randomized clinical trial. *JMIR mHealth and*

DOI: 10.54254/2753-8818/2027.39495

uHealth, 13, e69033-e69033. https://doi.org/10.2196/69033
[6] Santopetro, N., Jones, D., Garron, A., Meyer, A., Joyner, K., & Hajcak, G. (2024). Examining a fully automated mobile-based behavioral activation intervention in depression: Randomized controlled trial. *JMIR Mental Health, 11*, e54252-e54252. https://doi.org/10.2196/54252
[7] Alsayednasser, B., Widnall, E., O'Mahen, H., Wright, K., Warren, F., Ladwa, A., Khazanov, G. K., Byford, S., Kuyken, W., Watkins, E., Ekers, D., Reed, N., Fletcher, E., McMillan, D., Farrand, P., Richards, D., & Dunn, B. D. (2022). How well do cognitive behavioural therapy and behavioural activation for depression repair anhedonia? A secondary analysis of the COBRA randomized controlled trial. *Behaviour Research and Therapy, 159*, 104185. https://doi.org/10.1016/j.brat.2022.104185
[8] Thonon, B., Levaux, M.-N., Van Aubel, E., & Larøi, F. (2022). A group intervention for motivational deficits: Preliminary investigation of a blended care approach using ambulatory assessment. *Behavior Modification, 46*(5), 1167-1197. https://doi.org/10.1177/01454455211047605
[9] Sun, L., Luo, L., Zhang, T., Yang, Y., Wang, C., & Luo, J. (2026). The improvement bffects and mechanisms of virtual reality training on depression: A systematic review from a neurotransmitter-plasticity dual-pathway perspective. *Journal of Global Health, 16*, 04007. https://doi.org/10.7189/jogh.16.04007
[10] Emmelkamp, P. M. G., & Meyerbröker, K. (2021). Virtual reality therapy in mental health. *Annual Review of Clinical Psychology, 17*(1), 495-519. https://doi.org/10.1146/annurev-clinpsy-081219-115923
[11] Hanuka, S., Olson, E. A., Admon, R., Webb, C. A., Killgore, W. D. S., Rauch, S. L., Rosso, I. M., & Pizzagalli, D. A. (2023). Reduced anhedonia following internet-based cognitive-behavioral therapy for depression is mediated by enhanced reward circuit activation. *Psychological Medicine, 53*(10), 4345-4354. https://doi.org/10.1017/S0033291722001106
[12] Meyer, J. D., Perkins, S. L., Brower, C. S., Lansing, J. E., Slocum, J. A., Thomas, E. B. K., Murray, T. A., Lee, D., & Wade, N. G. (2022). Feasibility of an exercise and CBT intervention for treatment of depression: A pilot randomized controlled trial. *Frontiers in Psychiatry, 13*, 799600. https://doi.org/10.3389/fpsyt.2022.799600
[13] Ruzickova, T., Carson, J., Argabright, S., Gillespie, A., Guinea, C., Pearse, A., Barwick, R., Murphy, S. E., & Harmer, C. J. (2023). Online behavioural activation during the COVID-19 pandemic decreases depression and negative affective bias. *Psychological Medicine, 53*(3), 795-804. https://doi.org/10.1017/S0033291721002142
[14] Sweet, A. M., Pearlstein, S. L., Paulus, M. P., Stein, M. B., & Taylor, C. T. (2021). Computer-delivered behavioural activation and approach-avoidance training in major depression: Proof of concept and initial outcomes. *British Journal of Clinical Psychology, 60*(3), 357-374. https://doi.org/10.1111/bjc.12287
[15] Potsch, L., & Rief, W. (2024). How to improve reward sensitivity – Predictors of long-term effects of a randomized controlled online intervention trial. *Journal of Affective Disorders, 367*, 647-657. https://doi.org/10.1016/j.jad.2024.09.007
[16] Potsch, L., & Rief, W. (2024). Effectiveness of behavioral activation and mindfulness in increasing reward sensitivity and reducing depressive symptoms—A randomized controlled trial. *Behaviour Research and Therapy, 173*, 104455. https://doi.org/10.1016/j.brat.2023.104455
[17] Arens, E. A., Donnerstag, L., Hofmann, S. G., & Stangier, U. (2024). Video-based online metta-meditation therapy for depression: A pilot trial evaluating the acceptability and feasibility. *Behavior Therapy, 34*(1), 32-43. https://doi.org/10.1159/000534381
[18] Suddell, S., Müller-Glodde, M., Lumsden, J., Looi, C. Y., Granger, K., Barnett, J. H., Robinson, O. J., Munafò, M. R., & Penton-Voak, I. S. (2023). Emotional bias training as a treatment for anxiety and depression: Evidence from experimental medicine studies in healthy and medicated samples. *Psychological Medicine, 53*(3), 696-705. https://doi.org/10.1017/S0033291721002014
[19] Pu, J., Ren, Q., Huang, Y., Wang, X., Wang, L., Hu, H., Zhang, Y., Wang, Y., Wang, Y., Huang, J., Wang, Y., Lui, S. S. Y., & Chan, R. C. K. (2026). The effects of online working memory training on enhancing hedonic processing in people with social anhedonia and subsyndromal depression: An exploratory study. *PsyCh Journal, 15*(1), e70084. https://doi.org/10.1002/pchj.70084
[20] Blackwell, S. E., Schönbrodt, F. D., Woud, M. L., Wannemüller, A., Bektas, B., Braun Rodrigues, M., Hirdes, J., Stumpp, M., & Margraf, J. (2023). Demonstration of a 'leapfrog' randomized controlled trial as a method to accelerate the development and optimization of psychological interventions. *Psychological Medicine, 53*(13), 6113-6123. https://doi.org/10.1017/S0033291722003294
[21] Craske, M. G., Meuret, A. E., Echiverri-Cohen, A., Rosenfield, D., & Ritz, T. (2023). Positive affect treatment targets reward sensitivity: A randomized controlled trial. *Journal of Consulting and Clinical Psychology, 91*(6), 350-366. https://doi.org/10.1037/ccp0000805
[22] Uribe, S., Kumar, D., Rosenfield, D., Ritz, T., & Meuret, A. E. (2025). From in-person to virtual: The impact of crisis-enforced delivery change on treatment for low positive affect, depression, and anxiety. *Journal of Affective*

DOI: 10.54254/2753-8818/2027.39495

Disorders, 391, 119864. https://doi.org/10.1016/j.jad.2025.119864

[23] Penninx, B. W. J. H., Kas, M. J. H., Dawson, G. R., Correll, C. U., Harmer, C. J., Buhl, D. L., De Prisco, M., Downs, J., Hernaus, D., Hopkins, S. C., Husain, M., Johnson, S., Mckernan, R., Ostinelli, E. G., Pizzagalli, D. A., Pryce, C. R., Reif, A., Schreiber, R., Serretti, A., … Cipriani, A. (2026). Research agenda to advance anhedonia assessment, understanding and treatment: An ECNP-GALENOS expert meeting report. *BMJ Mental Health, 29*(1), e302843. https://doi.org/10.1136/bmjment-2026-302843

[24] Fareri, D. S., & Delgado, M. R. (2014). Social rewards and social networks in the human brain. *The Neuroscientist, 20*(4), 387-402. https://doi.org/10.1177/1073858414521869

[25] Mohr, D. C., Cuijpers, P., & Lehman, K. (2011). Supportive accountability: A model for providing human support to enhance adherence to eHealth interventions. *Journal of Medical Internet Research, 13*(1), e30. https://doi.org/10.2196/jmir.1602

[26] Cameron, S. K., Rodgers, J., & Dagnan, D. (2018). The relationship between the therapeutic alliance and clinical outcomes in cognitive behaviour therapy for adults with depression: A meta-analytic review. *Clinical Psychology & Psychotherapy, 25*(3), 446–456. https://doi.org/10.1002/cpp.2180