

Social Anxiety in the Age of Technology: A Psychosocial Analysis

اضطراب القلق الاجتماعي في عصر التكنولوجيا: تحليل نفسي-اجتماعي

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ABSTRACT:

Social anxiety disorder (SAD) is characterized by persistent fear of negative evaluation, self-focused attention, physiological arousal, and avoidance of social or performance situations. Digital technology creates a conditional rather than uniformly harmful or beneficial context: problematic patterns of Internet and social-media use may reinforce avoidance and self-evaluative processes, whereas structured digital interventions may facilitate evidence-based treatment. This structured narrative review used a reproducible evidence-identification strategy and thematic synthesis, prioritizing systematic reviews, meta-analyses, randomized controlled trials, longitudinal studies, and theoretically relevant empirical research. Evidence was organized around two pathways: technology as a maintenance context and technology as a therapeutic delivery system. The literature consistently shows positive associations between problematic Internet/social-media use and social anxiety, but predominantly observational evidence does not establish a simple causal direction. In contrast, Internet-delivered cognitive behavioral therapy (iCBT) has substantial support, while virtual-reality exposure therapy (VRET) shows promising but more heterogeneous effects. The review proposes that the psychological function of digital use is more informative than exposure to technology itself. Digital tools are most plausibly beneficial when they target established maintaining mechanisms, including self-focused attention, safety behaviors, negative appraisals, and avoidance, rather than merely replacing face-to-face contact with digital contact.

Keywords: Social anxiety, Digital technology, Virtual communication, Mental health.

الملخص:

يُعد اضطراب القلق الاجتماعي من الاضطرابات النفسية التي تتميز بالخوف المستمر من التقييم السلبي، وارتفاع الوعي بالذات، والاستثارة الفسيولوجية، وتجنب المواقف والتفاعلات الاجتماعية. ومع الانتشار المتسارع للتكنولوجيا الرقمية، أصبحت علاقتها بالقلق الاجتماعي أكثر تعقيداً. تهدف هذه الدراسة إلى تحليل العلاقة بين القلق الاجتماعي والتكنولوجيا من منظور معرفي-سلوكي، مع التركيز على الآليات التي قد تجعل الاستخدام الرقمي عاملاً للمحافظة على القلق أو وسيلة للتخفيف منه. اعتمدت الدراسة مراجعة سردية منظمة للأدلة العلمية، من خلال استراتيجية بحث قابلة لإعادة الإنتاج وتحليل موضوعي للنتائج المتعلقة باستخدام الإشكالي للإنترنت ووسائل التواصل الاجتماعي، والعلاج المعرفي السلوكي المقدم عبر الإنترنت، والعلاج بالتعرض باستخدام الواقع الافتراضي. تشير الأدلة إلى وجود ارتباط بين القلق الاجتماعي والاستخدام الإشكالي للإنترنت ووسائل التواصل الاجتماعي، مع احتمال وجود علاقة ثنائية الاتجاه؛ إذ قد يلجأ الأفراد القلقون اجتماعياً إلى البيئة الرقمية لتجنب المواقف الاجتماعية، في حين قد يؤدي هذا التجنب إلى تعزيز أنماط القلق على المدى الطويل. كما أظهر العلاج المعرفي السلوكي عبر الإنترنت، نتائج واعدة في خفض أعراض القلق الاجتماعي، بينما يظل الواقع الافتراضي أكثر ارتباطاً بطبيعة المواقف المخيفة وشكل التدخل. وتخلص الدراسة إلى أن الأثر النفسي للتكنولوجيا لا يتحدد بالتكنولوجيا ذاتها، بل بالوظيفة التي تؤديها في دورة التجنب والمواجهة والتغيير العلاجي. كلمات مفتاحية: القلق الاجتماعي، التكنولوجيا الرقمية، التواصل الافتراضي، الصحة النفسية.

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1- Introduction:

Human social functioning depends on the ability to enter, maintain, and adapt interpersonal relationships across family, educational, occupational, and community settings. Social anxiety disorder (SAD), also referred to as social phobia, can substantially interfere with these processes. It is characterized by marked fear or anxiety in situations in which an individual may be observed or evaluated by others, together with avoidance or endurance of such situations with intense distress (American Psychiatric Association, 2022; Leichenring & Leweke, 2017). The disorder may affect academic participation, occupational functioning, interpersonal relationships, and quality of life (Dryman et al., 2016).

Social anxiety is not adequately explained by a single biological or psychosocial factor. Behavioral inhibition, personality characteristics, early interpersonal experiences, cognitive biases, social skills, and physiological reactivity may interact across development (Fox et al., 2021; Morrison & Heimberg, 2013; Nikolić et al., 2018). A central clinical feature, however, is avoidance. Avoidance can reduce anxiety in the short term while preventing corrective experiences that might disconfirm feared predictions. This negative-reinforcement process is particularly relevant to understanding the role of digital technology.

Digital technologies have transformed the conditions under which social interaction occurs. Messaging applications, social networking sites, online gaming, video communication, virtual environments, mobile applications, and artificial intelligence can reduce geographical and interpersonal barriers. For someone who fears face-to-face evaluation, this flexibility may provide immediate relief and a sense of control. At the same time, repeated reliance on mediated interaction may become part of an avoidance pattern. Recent systematic evidence supports an association between problematic Internet use and social anxiety in adolescents and young adults, while a separate meta-analysis found a positive association between social anxiety and problematic social media use (Ding et al., 2023; Wu et al., 2024). Importantly, these findings establish association rather than a simple one-directional causal effect.

The relationship becomes more complex when technology is used therapeutically. Internet-delivered CBT, computer-assisted CBT, virtual reality exposure, and other digital mental health interventions can reproduce important components of evidence-based treatment while potentially reducing barriers associated with travel, stigma, cost, or fear of attending therapy. Recent meta-analytic evidence indicates that remote CBT can produce substantial reductions in social anxiety symptoms and may perform at least comparably to face-to-face CBT in some settings (Winter et al., 2023). Virtual reality interventions have also demonstrated clinically meaningful effects, although the evidence remains heterogeneous (Tan et al., 2025; Wong et al., 2023).

The central problem addressed by this review is therefore not whether technology is intrinsically harmful or beneficial. Rather, it is necessary to determine how, why, and under what conditions a technology-mediated behavior contributes to the maintenance of social anxiety or supports its treatment. This functional question provides a stronger theoretical basis for interpreting apparently contradictory findings.

1-1- Research gap

Existing literature is substantial but fragmented. One body of research examines technology as a context associated with problematic Internet use, social media use, gaming, social comparison, and avoidance. A second body examines technology as a delivery mechanism for CBT and exposure-based treatment. These literatures are often discussed separately. Consequently, there is insufficient integration of the two perspectives within a single cognitive-behavioral account explaining why the same broad technological environment can reinforce avoidance in one context and facilitate exposure in another. Moreover, evidence concerning established digital interventions is considerably stronger than evidence concerning newer technologies such as autonomous artificial intelligence and social robots. A critical synthesis must therefore distinguish mature evidence from emerging evidence rather than treating all digital technologies as equivalent.

1-2- Objectives and review questions

This review has four objectives: (1) to examine the relationship between social anxiety and problematic technology-mediated behavior; (2) to identify the psychological mechanisms through which digital interaction may maintain or modify social anxiety; (3) to synthesize evidence concerning technology-assisted CBT, with particular emphasis on ICBT and virtual reality-based interventions; and (4) to identify limitations, clinical implications, ethical issues, and priorities for future research.

The review addresses the following questions: (a) What is the empirical relationship between social anxiety and problematic Internet/social media use? (b) How can this relationship be interpreted within a cognitive-behavioral maintenance model? (c) What does current evidence indicate about the efficacy of ICBT, computer-assisted CBT, and virtual reality interventions for SAD? (d) What are the potential roles and limitations of AI and social robots? and (e) Under what conditions may technology function as an avoidance mechanism versus a therapeutic exposure tool?

2- Methodology

2-1- Review design

A structured narrative review with a reproducible evidence-identification strategy and thematic synthesis was adopted. The design was selected because the literature includes heterogeneous evidence, including observational studies of technology use, randomized controlled trials of digital interventions, and systematic reviews/meta-analyses. The purpose was not to calculate a new pooled effect estimate, but to identify and critically integrate evidence across two domains: technology as a potential risk/maintenance context and technology as a therapeutic delivery mechanism.

2-2- Search strategy

The evidence base was updated in September 2026 through targeted searches of PubMed and verification of relevant records in publisher databases. Search concepts combined social-anxiety terms with digital-use and intervention terms, including: (“social anxiety disorder” OR “social phobia” OR “social anxiety”) AND (“problematic Internet use” OR “social media” OR “digital technology” OR “online interaction” OR “Internet-delivered CBT” OR “virtual reality” OR “virtual

reality exposure” OR “artificial intelligence” OR “social robot”). Backward reference checking of key reviews and meta-analyses was used to identify additional relevant studies.

Priority was given to peer-reviewed empirical studies, systematic reviews, meta-analyses, randomized controlled trials, and longitudinal studies. Foundational theoretical and clinical papers were retained when necessary to establish the cognitive-behavioral framework. Protocol papers were not treated as evidence of treatment efficacy. Evidence published through 2026 was considered when directly relevant to the review question.

2-3- Eligibility and evidence organization

Studies were considered relevant when they addressed clinically relevant social anxiety or social anxiety symptoms and examined either (a) technology-mediated behavior associated with social anxiety or (b) a technology-assisted intervention targeting social anxiety. Studies unrelated to social anxiety, technology-mediated behavior, or relevant psychological treatment mechanisms were excluded from the synthesis. Rather than combining statistically incompatible outcomes, findings were grouped into thematic categories: problematic technology use; avoidance and reinforcement; ICBT and remote CBT; guided versus unguided digital treatment; virtual reality exposure and VR-CBT; and emerging AI/robot-assisted approaches.

2-4- Synthesis strategy

Evidence was synthesized according to the cognitive-behavioral function of technology rather than according to the brand, device, or platform. Particular attention was given to the direction of association, study design, comparison condition, degree of therapist involvement, intervention mechanism, follow-up period, and major limitations. Quantitative results reported by existing meta-analyses are presented as evidence from those reviews and are not treated as new pooled estimates generated by the present article.

Because this article is a structured narrative review rather than a *de novo* systematic review, it does not claim a PRISMA flow count, formal independent screening, or a newly calculated risk-of-bias estimate. This distinction is stated explicitly to avoid presenting a narrative synthesis as a formal systematic review.

3- Conceptual and Theoretical Framework

3-1- Social anxiety as a cognitive-behavioral process

The cognitive-behavioral model provides the primary theoretical framework for this review. Clark and Wells (1995) proposed that social anxiety is maintained by dysfunctional assumptions about social evaluation, self-focused attention, negative self-imagery, biased interpretation of social events, anticipatory processing, and safety behaviors. Rapee and Heimberg's cognitive-behavioral account similarly emphasizes the individual's representation of how he or she appears to others and the perceived discrepancy between the expected social standard and one's own performance. These models are particularly useful for analyzing technology because digital environments can alter both the perceived threat and the behavioral response to that threat.

Within this framework, a social situation activates predictions such as “I will be judged negatively,” “others will notice my anxiety,” or “I will fail.” Attention becomes focused on internal sensations and perceived signs of poor performance. Anxiety increases, safety behaviors are

employed, and avoidance reduces immediate distress. However, because the feared situation is not fully confronted, the person receives limited corrective evidence. The belief therefore remains available for future social situations. Technology may enter this cycle at several points: it can provide an alternative route for avoidance, intensify self-presentation and comparison, or provide a controlled environment in which feared situations can be approached gradually.

3-2- Integrating physiological mechanisms

Physiological arousal is not an alternative explanation to the cognitive-behavioral model; it can be integrated into the same maintenance cycle. Individuals with social anxiety may experience increased autonomic activation during social-evaluative situations. Electrodermal activity (EDA), heart rate, and related measures have been used as indicators of physiological arousal, and research has linked heightened EDA or sympathetic skin responses with social anxiety in some samples (Bayraktutan et al., 2020; Nikolić et al., 2018). Importantly, electrodermal activity is primarily interpreted as an index of sympathetic rather than parasympathetic activation. Evidence from social-evaluative tasks has also shown increased heart rate and skin conductance in social phobia (Gerlach et al., 2003).

The clinical significance of physiological arousal emerges through its interaction with cognition. A person may notice sweating, trembling, blushing, or a rapid heartbeat and interpret these sensations as visible evidence of inadequacy. This interpretation increases self-focused attention and fear that others will detect the symptoms. The resulting anxiety can trigger safety behaviors—such as avoiding eye contact, speaking briefly, rehearsing statements, or leaving the situation—and technology can provide another safety behavior when it allows the individual to substitute mediated communication for direct contact. Thus, the relevant pathway is not simply “physiological arousal causes avoidance,” but rather: social threat perception → autonomic arousal → interpretation of internal sensations → heightened self-monitoring and fear of negative evaluation → safety behavior/avoidance → short-term relief → maintenance of anxiety.

This interpretation also prevents overstatement. Physiological measures are neither unique diagnostic markers nor sufficient explanations of social anxiety. Naturalistic research has shown that physiological differences may be more consistent than some behavioral indicators, while gaze avoidance is not necessarily present in every socially anxious individual (Rösler et al., 2021). Physiological findings should therefore be treated as one component of a multidimensional process.

3-3- Why the function of technology matters

A complementary perspective is provided by the Interaction of Person-Affect-Cognition-Execution (I-PACE) model, which conceptualizes problematic Internet use as emerging from interactions among person characteristics, affective and cognitive responses, and executive-control processes (Brand et al., 2016, 2019). In the context of social anxiety, online environments may become reinforcing because they offer greater control over self-presentation and reduced immediate exposure to evaluation. The I-PACE model therefore complements the Clark and Wells framework by explaining why some individuals may become increasingly reliant on digital environments, while the CBT model explains how avoidance and safety behaviors can maintain social anxiety.

The same device can have opposite psychological functions. Sending a message instead of speaking to another person may function as avoidance if it consistently replaces feared face-to-face

situations. Conversely, completing a therapist-guided virtual presentation may function as exposure because it deliberately activates the feared response in a controlled setting and permits learning. Therefore, the clinical meaning of technology depends less on the technology itself than on the behavioral function it serves within the individual's anxiety-maintenance cycle.

4- Social Anxiety and Technology as a Risk or Maintenance Context

4-1- Problematic Internet use

The association between social anxiety and problematic Internet use has been repeatedly documented, but its interpretation requires caution. A 2023 systematic review and meta-analysis focused on adolescents and young adults included 37 studies and 36,013 participants and found a significant positive association between problematic Internet use and social anxiety ($r = .333$, 95% CI [.292, .373]). Importantly, the authors' analyses did not support a simplistic interpretation in which Internet use alone causes social anxiety; the directionality and mechanisms remain complex (Ding et al., 2023).

This distinction is important because people with social anxiety may turn to online environments precisely because they are less threatening than direct interaction. Online communication can offer greater control over self-presentation, time to formulate responses, and reduced exposure to immediate nonverbal evaluation. These features can be adaptive when they supplement rather than replace social contact. They can become maladaptive when online activity systematically functions as a substitute for feared situations and prevents corrective interpersonal learning.

4-2- Social media and problematic use

Evidence concerning social media is similarly stronger for association than causation. Wu et al. (2024) synthesized 53 studies involving 59,928 participants and reported a positive association between social anxiety and problematic social media use. The significance of this finding lies not in demonstrating that social media causes SAD, but in identifying a relationship that may be shaped by reciprocal processes. Social anxiety can increase reliance on online environments, while problematic use may maintain patterns of avoidance, social comparison, reassurance seeking, or excessive self-monitoring.

The distinction between ordinary use and problematic use is therefore essential. Digital communication can increase opportunities for connection, particularly for people who experience geographical or accessibility barriers. The risk appears more relevant when use becomes compulsive, displaces offline activities, or functions primarily to avoid situations that would otherwise provide opportunities for social learning. Future longitudinal studies should distinguish these pathways rather than treating “screen time” or “Internet use” as homogeneous exposures.

4-3- Online communication as safety behavior

From a CBT perspective, online communication can function as a safety behavior. Safety behaviors are actions intended to prevent feared outcomes or reduce anxiety during exposure to social situations. They may provide short-term relief but can prevent individuals from discovering that feared outcomes are less likely or more manageable than expected. If a person uses messaging exclusively to avoid speaking, online communication may maintain avoidance. By contrast, if

messaging is used to initiate contact that later develops into direct interaction, it may facilitate approach behavior. The distinction is therefore functional rather than technological.

4-4- Technology-related evidence: what can and cannot be concluded

Table 1. Technology-Related Evidence: Associations, Mechanisms, and Remaining Uncertainties

Evidence-supported conclusion	Interpretation	Remaining uncertainty
Problematic Internet use is positively associated with social anxiety.	The relationship is clinically relevant and consistent across studies.	Directionality and causal mechanisms remain uncertain.
Problematic social media use is positively associated with social anxiety.	Avoidance, comparison, reassurance seeking, and self-presentation may contribute.	Associations vary by population, measure, and context.
Online interaction can feel safer to socially anxious individuals.	Control over timing and self-presentation may reduce immediate evaluation threat.	This may be adaptive or may become a safety behavior.
Technology can support treatment.	Evidence is substantially stronger for structured CBT-based interventions than for general digital use.	Optimal level of therapist support and long-term implementation remain under study.

The table (1) indicates that evidence is more consistent for an association between problematic digital use and social anxiety than for a unidirectional causal effect. This distinction is central to the review: the observed relationship can reflect reciprocal processes in which social anxiety increases reliance on mediated communication while problematic use may simultaneously reinforce avoidance, reassurance seeking, or social comparison. Accordingly, the evidence supports a functional interpretation rather than technological determinism.

5- Technology as a Therapeutic Tool

5-1- Internet-delivered cognitive behavioral therapy

The strongest evidence for technology-assisted treatment concerns interventions that preserve established CBT mechanisms. ICBT can deliver psychoeducation, cognitive restructuring, behavioral experiments, exposure tasks, homework, symptom monitoring, and therapist feedback through an Internet platform. This is theoretically important because the therapeutic value does not arise simply from removing the therapist or moving treatment online; it arises from preserving the active ingredients of CBT in a different delivery format. A randomized controlled trial in Hong Kong further demonstrated efficacy of therapist-guided Internet cognitive therapy in a different cultural setting (Thew et al., 2022).

A meta-analysis of 20 randomized controlled trials involving 1,743 participants found that ICBT significantly improved outcomes for SAD compared with control conditions, with no significant difference between ICBT and face-to-face CBT in the relevant subgroup analysis (Carlbring/Andersson-related evidence synthesized in the meta-analysis). A more recent meta-analysis of remote CBT included 31 studies and 2,905 participants. Remote CBT showed large pre-to-post effects, and between-group analyses indicated greater effects than passive controls and non-CBT remote treatments; the analysis also found remote CBT to be at least as effective, or slightly more effective, than face-to-face CBT in the included comparisons (Winter et al., 2023).

These findings should nevertheless be interpreted within the limits of trial evidence. Participants in digital-treatment trials may be more motivated or technologically comfortable than routine clinical populations. Intervention platforms and therapist support differ substantially across studies. Consequently, evidence for efficacy does not mean that every commercially available mental-health application is equivalent to evidence-based ICBT. A recent randomized trial of intensive seven-day iCBT also found lower social-anxiety symptoms and functional impairment than waitlist at post-treatment and one-month follow-up, while emphasizing the need for larger active-comparator trials (Steele et al., 2025).

5-2- Guided versus unguided ICBT

The question of therapist involvement is especially relevant because technology is sometimes presented as a replacement for professional care. Evidence does not support such a simple conclusion. A meta-analysis of 11 randomized trials involving 1,414 adults with anxiety and related disorders found a small short-term advantage for guided ICBT over self-guided ICBT, although the difference was not significant at follow-up (Oey et al., 2023). In a SAD-specific randomized study, clinician-supported ICBT has also been examined using scheduled versus on-demand support, illustrating that the relevant question is increasingly how guidance can be delivered efficiently rather than whether support is needed at all (Käll et al., 2023).

The clinical implication is that technology may extend the reach of therapists rather than eliminate the therapeutic relationship. Guided digital CBT can combine the scalability and accessibility of online delivery with monitoring, troubleshooting, personalization, and encouragement. At the same time, unguided interventions may be appropriate for some individuals and may increase accessibility where professional resources are limited. Matching the level of guidance to symptom severity, risk, motivation, and treatment complexity is therefore more defensible than assuming one delivery model is universally superior. A SAD-specific trial comparing scheduled therapist support with support on demand likewise found similar improvement between the two guidance formats, suggesting that the organization of therapist contact can be flexible without assuming that all support must be intensive (Käll et al., 2023).

5-3- Integrated digital CBT and exposure

Digital treatment formats can combine structured cognitive-behavioral material with therapist input and exposure exercises. The most informative recent evidence comes from integrated approaches rather than from technology in isolation. In a randomized controlled trial of 329 adults with SAD, Pan et al. (2025) evaluated a 14-week Internet-based CBT program incorporating VRET in web-based and app-based formats. Both treatment formats outperformed waitlist control, and gains were maintained at three- and six-month follow-up. This finding is consistent with the central framework of the review: digital delivery is most useful when it preserves evidence-based CBT mechanisms and moves the patient toward approach rather than avoidance.

The same principle applies to any computer-assisted intervention: digital content should not become another avoidance environment. If an intervention teaches cognitive skills without progressing toward behavioral approach and real-world learning, its capacity to modify the maintenance cycle may be limited. The therapeutic question is therefore whether digital delivery ultimately promotes corrective learning outside the screen.

5-4- Virtual reality exposure therapy

Virtual reality (VR) provides a distinctive therapeutic opportunity because it can simulate social-evaluative situations while controlling intensity, repetition, and progression. This corresponds closely to exposure-based CBT. The individual can practice presentations, conversations, interviews, or other social situations while remaining in a controlled clinical environment. VR therefore addresses a key barrier in SAD: the difficulty of arranging repeated, standardized, and graded exposure to feared social situations.

Evidence has become increasingly supportive. A systematic review and meta-analysis of 15 randomized controlled trials involving 720 participants found that VR therapy was effective compared with waitlist conditions and did not significantly differ from CBT on several social-anxiety outcomes, although heterogeneity in hardware, software, and intervention duration limited interpretation (Wong et al., 2023). A subsequent meta-analysis of 17 randomized controlled trials found that VR exposure therapy was more effective than waitlist controls at post-intervention and follow-up and showed effects similar to other interventions; combining VR exposure with CBT produced a greater effect among participants with symptomatic social anxiety in the subgroup analysis (Tan et al., 2025).

The evidence therefore supports VR as a useful exposure medium rather than as an inherently superior replacement for conventional exposure. Important questions remain regarding the realism of virtual social scenarios, transfer of learning to real-world settings, treatment dose, cost, accessibility, cybersickness, and long-term comparative effectiveness. These issues are particularly relevant when considering implementation outside specialized clinical settings.

5-5- Virtual reality CBT and emerging digital formats

VR-CBT is conceptually attractive because it combines the controlled exposure capabilities of VR with cognitive and behavioral techniques. The evidence summarized by Wong et al. (2023) and Tan et al. (2025) suggests that VR is most defensible as an exposure component within a broader CBT framework rather than as an inherently superior replacement for conventional CBT. The 2025 Hong Kong trial by Pan et al. provides a clinically relevant example of this integrated model. Further trials should determine which patients benefit most from combined cognitive and virtual-exposure procedures and whether gains transfer to real-world social functioning.

5-6- Artificial intelligence and social robots

Artificial intelligence and social robots represent a newer stage of technology-assisted intervention. Their potential advantages include continuous availability, personalized feedback, simulation of social situations, and reduced barriers to initial engagement. The original version of this article appropriately identified social robots as a promising area, but the evidence should now be characterized more cautiously: compared with ICBT and VR exposure, AI- and robot-assisted interventions have a smaller and less mature evidence base for SAD.

Social robots may be particularly useful as graded interaction partners because they can provide predictable and repeatable social exchanges. Experimental work suggests that some individuals with social anxiety may experience less anxiety when interacting with robots than with humans, supporting the possibility of using human-machine interaction as an intermediate exposure step. However, the therapeutic relevance of this effect depends on whether gains generalize from robot interaction to

human social situations. Concerns also include privacy, data governance, emotional simulation, algorithmic errors, overdependence, and the possibility that a highly controllable artificial partner could itself become a safety behavior. (Rasouli et al., 2022).

AI should therefore be framed as an emerging adjunct rather than an autonomous substitute for clinical judgment. Evidence-based digital care requires assessment of risk, informed consent, privacy safeguards, appropriate escalation pathways, and human oversight when clinically indicated.

6- Critical Synthesis: When Does Technology Maintain or Reduce Social Anxiety?

The central synthesis of the reviewed evidence is that the psychological function of technology is more informative than the technology category itself. The apparent contradiction between technology as a risk and technology as a treatment can be resolved through the CBT maintenance cycle.

Table 2. Functional Roles of Technology in the Maintenance or Reduction of Social Anxiety

Function of technology	Immediate effect	Potential longer-term process	Likely clinical interpretation
Avoidance of feared interaction	Reduced anxiety	Fewer corrective experiences; maintained avoidance	Potential maintenance factor
Reassurance/self-presentation control	Greater perceived control	Increased self-monitoring or dependence on safety behaviors	Potential maintenance factor
Social connection that supplements offline contact	Reduced isolation	Greater opportunities for interpersonal contact	Potentially adaptive
Therapist-guided cognitive restructuring	Increased insight and alternative interpretations	Modification of maladaptive beliefs	Therapeutic
Virtual exposure	Controlled activation of feared situations	Habituation/inhibitory learning and increased approach behavior	Therapeutic when properly implemented
AI/robot-supported practice	Predictable interaction	Possible rehearsal and graded approach	Promising but emerging
Unsupervised digital intervention	Convenience and accessibility	Variable adherence and limited monitoring	Depends on patient and intervention design

Table (2) provides the main integrative argument of the review. Technology does not have a fixed psychological effect; its effect depends on the behavior it facilitates. When it primarily permits escape from feared evaluation, it may reduce distress immediately while limiting corrective learning. When it is used to structure exposure, cognitive restructuring, or gradual approach, temporary anxiety can become part of a therapeutic learning process. The same digital environment can therefore occupy different positions in the maintenance cycle depending on its function.

This functional model explains why observational studies of general technology use and randomized trials of digital treatment can produce apparently opposite conclusions. They are often measuring different psychological processes. Problematic technology use may reduce distress by allowing avoidance, whereas therapeutic technology intentionally produces manageable distress and uses it to facilitate new learning. The distinction is not whether anxiety occurs during technology use, but whether the intervention encourages escape from anxiety or structured approach to it.

6-1- Strength of evidence across technologies

Table 3. Current Evidence Across Technology-Based Approaches for Social Anxiety Disorder

Technology/domain	Current evidence level	Main conclusion	Main limitation
Problematic Internet use	Moderate observational evidence	Positive association with social anxiety	Causality and directionality
Problematic social media use	Moderate observational/meta-analytic evidence	Positive association with social anxiety	Heterogeneity and reciprocal effects
Remote/Internet CBT	Strongest digital intervention evidence	Effective reduction of SAD symptoms; comparable with face-to-face CBT in selected comparisons	Adherence, therapist support, generalizability
Guided ICBT	Strong evidence across anxiety; supportive SAD evidence	Small short-term advantage over self-guided formats	Optimal guidance model remains uncertain
VR exposure	Moderate-to-strong experimental evidence	Effective versus waitlist; broadly comparable with other active interventions	Protocol and hardware heterogeneity
VR-CBT	Emerging evidence	Promising effects, especially in immersive settings	Smaller evidence base
AI-assisted CBT	Emerging	Potential scalability and personalization	Clinical validation, privacy, safety
Social robots	Preliminary/emerging	Potential graded interaction and support	Transfer to human interaction and limited clinical trials

Table (3) represent Current Evidence Across Technology-Based Approaches for Social Anxiety Disorder. The distribution of evidence is uneven. Remote and Internet-based CBT currently have the most developed empirical base, supported by randomized trials and meta-analyses. Virtual reality also has substantial experimental support, but findings vary according to protocol, hardware, comparator, and follow-up. Evidence for AI-assisted approaches and social robots remains considerably less mature. This gradient of evidence should guide interpretation: emerging technologies should be described as promising adjuncts rather than established replacements for clinician-delivered care.

7- Discussion

The present synthesis supports a shift from a technology-centered question to a mechanism-centered question. Asking whether technology is a “problem or solution” is too broad because the same technological environment can serve avoidance, social connection, exposure, or treatment. A more precise question is: what behavior does the technology facilitate, what learning does it produce, and does it move the individual toward or away from feared social situations?

The CBT framework provides a coherent explanation for this distinction. When digital communication permits a person to avoid feared evaluation, the immediate reduction in anxiety may negatively reinforce avoidance. When a digital intervention deliberately activates feared situations while providing cognitive restructuring and graded exposure, the same reduction in barriers can

support treatment engagement. This interpretation also clarifies why therapist guidance may matter. A clinician can distinguish therapeutic approach from subtle avoidance and adjust tasks accordingly.

The evidence concerning problematic Internet and social media use should also be interpreted without technological determinism. The observed associations do not establish that Internet or social media exposure independently causes SAD. Social anxiety may predispose individuals to particular patterns of online use, and common third variables may contribute to both. Longitudinal and experimental designs are needed to establish temporal pathways. Current evidence is therefore better summarized as demonstrating a clinically meaningful association than as proving a single causal direction.

A 2026 Bayesian network meta-analysis including 42 randomized controlled trials found that digital interventions generally outperformed non-digital or waitlist controls across several outcomes, with iCBT showing robust effects across multiple outcomes (Li et al., 2026). These findings reinforce the conclusion that the most empirically mature role for technology in SAD is not unrestricted digital interaction but structured, CBT-based intervention.

Nevertheless, efficacy should not be equated with universal suitability. Digital treatment requires assessment of severity, comorbidity, suicidality or other risks where relevant, digital literacy, privacy, motivation, and capacity to engage with exposure tasks. Some patients may prefer digital delivery because it reduces initial interpersonal barriers, whereas others may require the relational and observational richness of face-to-face treatment. Technology should therefore expand treatment options rather than impose a single mode of care.

7-1- Clinical implications

First, clinicians should assess the function of technology use rather than simply asking how many hours a patient spends online. Questions should explore whether digital activity supplements relationships or replaces feared interactions, whether it is used to regulate anxiety, and whether it is associated with impairment.

Second, evidence-based digital interventions should retain the active ingredients of CBT. Psychoeducation without behavioral change may be insufficient. Digital programs should include cognitive restructuring, behavioral experiments, exposure, homework, and appropriate monitoring when clinically indicated.

Third, therapist guidance should be viewed as a flexible component rather than an all-or-none feature. Guided ICBT may be particularly appropriate when patients need assistance with formulation, exposure planning, adherence, or interpretation of setbacks. Lower-intensity self-guided approaches may have a role for selected individuals, particularly in stepped-care models.

Fourth, VR should be used to facilitate transfer to real-world social functioning. The goal is not for the patient to become comfortable only inside the virtual environment. Virtual exposure should ultimately support generalization to naturally occurring social situations.

7-2- Ethical and practical considerations

Digital mental health raises concerns that extend beyond efficacy. Patient data may include highly sensitive psychological information, and privacy protection must therefore be treated as a clinical requirement rather than a technical afterthought. AI systems may generate inaccurate or inappropriate responses, and automated systems may not reliably detect clinical deterioration. The

possibility of excessive reliance on digital agents also deserves attention. Ethical deployment should include transparent consent, secure data handling, human oversight, clear limits of automated systems, and pathways for escalation to qualified professionals.

7-3- Research priorities

Future research should prioritize longitudinal designs capable of distinguishing whether social anxiety precedes problematic technology use or vice versa. Intervention studies should report adherence, therapist involvement, dropout, adverse effects, and outcomes beyond symptom reduction, including real-world social functioning and quality of life. VR studies should examine transfer from virtual to real social situations and compare standardized protocols. AI studies require independent clinical validation, transparency regarding model behavior, privacy evaluation, and comparison with established therapist-guided treatments. Research should also include culturally diverse populations because most evidence currently comes from a limited range of countries and healthcare systems.

8- Limitations of the Present Review

This review has several limitations. First, it uses a structured narrative synthesis rather than a new meta-analysis; quantitative effect sizes are therefore drawn from existing systematic reviews and meta-analyses rather than recalculated from primary studies. Second, the technology literature is heterogeneous in terms of definitions, platforms, populations, outcomes, and study designs. Third, evidence for problematic technology use is largely observational, limiting causal inference. Fourth, emerging AI and social-robot interventions have a substantially smaller evidence base than ICBT and VR, so conclusions about these technologies should remain provisional. Finally, a full database-level PRISMA count was not generated for this revision; the manuscript therefore explicitly presents itself as a structured narrative review rather than claiming a de novo systematic review with quantitative pooling.

9- Conclusion

Social anxiety in the digital era should not be understood through a simple opposition between technology as a problem and technology as a solution. The reviewed evidence indicates that technology can participate in the maintenance of social anxiety when it functions primarily as an avoidance or safety behavior, but it can also reduce barriers to evidence-based treatment when it is designed around CBT mechanisms. The distinction is therefore functional and theoretical rather than technological.

The strongest evidence currently supports Internet-delivered and other remote CBT approaches, while virtual reality exposure has accumulated a substantial and growing evidence base. Emerging approaches involving AI and social robots are promising but require stronger clinical validation and careful ethical oversight. The most useful future direction is not to replace human social interaction with technology, but to use technology strategically to help individuals move from avoidance toward approach, from perceived threat toward corrective learning, and from controlled virtual practice toward meaningful real-world social functioning.

Accordingly, the contribution of technology to social anxiety should be evaluated according to three questions: Does it reinforce avoidance? Does it facilitate therapeutic exposure and cognitive change? And does learning transfer to real-life social functioning? Framing the evidence in this way

provides a theoretically grounded explanation for the apparently contradictory literature and offers a clearer basis for clinical implementation and future research.

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