

Alleviating Foreign Language Speaking Anxiety: A Meta-Analysis of Pedagogical Interventions

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Abstract: Background: Foreign Language Speaking Anxiety (FLSA) is a significant affective barrier that impedes oral proficiency and overall language acquisition for many learners. While numerous studies have proposed interventions to mitigate FLSA, their effectiveness varies, and a quantitative synthesis of the evidence is lacking.

Aims: This meta-analysis quantitatively synthesizes the results of experimental and quasi-experimental studies to determine the overall effectiveness of interventions designed to reduce FLSA. It also investigates potential moderating variables, including intervention type, duration, and participant proficiency level, to identify the most impactful pedagogical conditions.

Method: A systematic literature search was conducted across major academic databases. Studies were included if they employed an intervention, utilized a control group, and provided sufficient statistical data to calculate Hedges' g as the effect size. A random-effects model was used to compute the overall effect size and conduct moderator analyses to account for significant heterogeneity (assessed via Q -statistic and I^2 index).

Results: The analysis of 62 studies, encompassing 4,318 learners, revealed a large and statistically significant overall effect size (Hedges' $g = 0.85$, 95% CI [0.71, 0.99], $p < .001$), indicating that interventions are highly effective in reducing FLSA. Significant heterogeneity was observed ($I^2 = 75.4\%$). Moderator analysis revealed that technology-based interventions yielded significantly larger effects than traditional pedagogical approaches. Furthermore, intervention duration was positively associated with a greater reduction in anxiety, and unpublished dissertations reported larger effect sizes than peer-reviewed articles.

Conclusion: The findings provide robust evidence that targeted interventions can substantially reduce foreign language speaking anxiety. The analysis highlights the comparative effectiveness of different approaches, offering valuable, evidence-based guidelines for educators and curriculum developers seeking to create more supportive and effective language learning environments.

Keywords: Foreign Language Speaking Anxiety (FLSA), Intervention, Meta-Analysis, Speaking Skills, Language Education, Affective Filter, Second Language Acquisition.

Introduction: 1.1. Background: The Primacy of Speaking Skills in Language Acquisition

In the contemporary landscape of second and foreign language acquisition, the attainment of communicative competence is widely regarded as the principal objective for the vast majority of learners worldwide. Among the four primary language skills—listening, speaking, reading, and writing—the skill of speaking occupies a uniquely critical and often central position. It represents the most direct and dynamic

manifestation of a learner's capacity to operationalize the target language, effectively transforming latent, passive linguistic knowledge into active, functional, and reciprocal communication [106]. Proficient oral expression is far more than a mere academic accomplishment; it functions as an indispensable instrument for meaningful social integration, tangible professional advancement, and profound intercultural understanding within an increasingly globalized and interconnected society [14]. In recognition of this, pedagogical paradigms have undergone a significant evolution, progressively shifting away from traditional

grammar-translation and audiolingual methods, which historically prioritized written accuracy and rote memorization, toward more holistic, learner-centered frameworks. Modern approaches such as Communicative Language Teaching (CLT) and Task-Based Language Teaching (TBLT) now place a premium on authentic, meaningful oral interaction as the primary vehicle for language development [19]. Consequently, the overarching goal of the modern language classroom is to cultivate learners who can not only produce grammatically correct sentences but also confidently, appropriately, and effectively express themselves in a diverse array of real-world communicative situations. This makes the systematic development of speaking skills a foundational and non-negotiable tenet of contemporary language education [72, 110].

However, the journey toward achieving oral proficiency is frequently encumbered by a host of formidable challenges that transcend the purely linguistic domain. While learners may successfully acquire a substantial lexical repertoire and develop a sophisticated understanding of grammatical structures, the complex act of producing spontaneous, coherent speech in a non-native language introduces an intricate interplay of cognitive, psychological, social, and affective factors [74]. Unlike the skill of writing, which affords the learner the luxury of time for meticulous planning, deliberate editing, and careful revision, the act of speaking unfolds in real-time. It demands the nearly instantaneous orchestration of multiple cognitive processes—including conceptualization, linguistic encoding, retrieval of lexical items, and motor articulation—all performed under the evaluative gaze of an interlocutor [14]. This inherent demand for immediacy and performance, coupled with the ever-present risk of miscommunication or social judgment, renders speaking a uniquely vulnerable and profoundly anxiety-provoking activity for a significant proportion of learners. This psychological barrier, often termed speaking anxiety, represents one of the most substantial and persistent hurdles to the ultimate attainment of communicative competence.

1.2. Foreign Language Speaking Anxiety (FLSA) as a Barrier

The psychological dimension of the language learning experience has garnered considerable scholarly attention over the past several decades, with a particularly sustained focus on the role of affective variables in either facilitating or impeding the acquisition process. Among these variables, language

anxiety has emerged as one of the most pervasive, well-documented, and debilitating factors. The seminal work of Horwitz, Horwitz, and Cope [54] provided a foundational definition of foreign language anxiety, characterizing it as "a distinct complex of self-perceptions, beliefs, feelings, and behaviors related to classroom language learning arising from the uniqueness of the language learning process" (p. 128). This construct is critically distinguished from more generalized anxiety traits, such as shyness or public speaking apprehension, as it is a situation-specific emotional response tied directly and uniquely to the contexts of learning and using a non-native language. The tripartite model of foreign language anxiety posits that it typically comprises three interrelated components: communication apprehension, which involves fear and avoidance of communicating with others; fear of negative evaluation, the apprehension about others' judgments of one's language performance; and test anxiety, which relates to fear of academic failure [54].

While anxiety can manifest across any of the four language skill modalities [29, 67, 82], it is most acutely, frequently, and intensely associated with oral performance. Foreign Language Speaking Anxiety (FLSA), a specific facet of this broader construct, is widely considered to be the single most significant affective barrier to active classroom participation, risk-taking, and ultimate skill development [8, 108]. Learners who experience high levels of FLSA are often plagued by a fear of being judged negatively by their peers or instructors, an obsessive worry about making linguistic errors, and a feeling of overwhelming pressure to perform flawlessly in the target language [94]. This acute anxiety can trigger a cascade of debilitating responses, ranging from physiological symptoms like an accelerated heart rate, perspiration, and trembling, to profound cognitive interference, such as memory blocks ("going blank"), difficulty concentrating, and an inability to access known vocabulary and grammar [125]. As a direct behavioral consequence, highly anxious learners tend to adopt avoidance strategies: they may avoid making eye contact, remain silent in class unless directly called upon, provide minimal one-word responses, and actively shun opportunities for interactive practice [30, 111, 118]. This avoidance behavior precipitates a damaging and self-perpetuating vicious cycle: the anxiety leads to a reduction in speaking practice, which in turn leads to stagnated or lower oral proficiency, thereby reinforcing the learner's negative self-perceptions of their ability and consequently heightening their original anxiety [113].

1.3. An Overview of Interventions to Reduce FLSA

In recognition of the profoundly detrimental impact of FLSA on language learning outcomes and learner well-being, a substantial body of research has been dedicated to the development and investigation of a diverse array of interventions aimed at fostering more supportive, confidence-building, and less threatening learning environments. These interventions, varying widely in their theoretical underpinnings and practical applications, can be broadly categorized into three principal types: technological, pedagogical/methodological, and psychological/affective.

Technological interventions have witnessed a surge in popularity, propelled by the ubiquitous availability of Web 2.0 tools, the rise of mobile-assisted language learning (MALL), and recent advancements in virtual and augmented reality. These technologies offer a unique set of affordances for anxiety reduction by mediating communication, providing a psychological buffer, and reducing the perceived threat of immediate, face-to-face social evaluation. For instance, computer-mediated communication (CMC), in both its synchronous forms (e.g., voice or text chat) and asynchronous forms (e.g., video blogs, podcasts, or online forums), allows learners to practice their speaking skills in lower-stakes environments where they often feel a greater sense of control and reduced inhibition [16, 90, 103, 105]. Artificial intelligence-driven technologies, such as chatbots and voice recognition software, can serve as infinitely patient and non-judgmental conversational partners, enabling learners to engage in extensive practice without the fear of making mistakes in front of human interlocutors [13, 28]. Furthermore, immersive virtual reality (VR) environments can effectively simulate public speaking scenarios, such as classroom presentations, allowing for systematic desensitization through repeated, controlled, and safe exposure to anxiety-provoking stimuli [37, 57, 120]. Other innovative technological approaches, including the use of gamified mobile applications [5], the creation of animated avatars like Voki to represent the speaker [4], and the implementation of video-recorded speaking tasks for self-assessment [48], have also been demonstrated to enhance learner engagement and lower the affective filter.

Pedagogical and methodological interventions are centered on the strategic structuring of classroom activities, interaction patterns, and learning environments to be inherently less anxiety-provoking and more conducive to communication. The Flipped

Classroom model, for example, represents a significant pedagogical restructuring where direct instruction and content delivery are moved outside the classroom (e.g., via pre-recorded lectures), thereby freeing up valuable in-class time for interactive, collaborative, and application-oriented speaking tasks. In this setup, the teacher transitions from a "sage on the stage" to a "guide on the side," providing scaffolding and support in a more hands-on, less intimidating setting [1, 7, 25, 33, 66]. Cooperative Learning strategies, which require students to work together in small, interdependent groups to achieve a common goal, are another powerful approach. These strategies foster positive interdependence, individual accountability, and supportive peer relationships, which can significantly buffer against the feelings of isolation and fear of evaluation that fuel speaking anxiety [20, 83, 86]. Creative and performance-based pedagogical methods, such as the use of Drama, Readers Theatre, and role-playing, encourage learners to step outside of themselves by taking on different personas. This focus on conveying meaning and emotion for a specific communicative purpose, rather than on perfect linguistic accuracy, effectively lowers their affective filter and promotes fluency [12, 40, 60, 65, 114]. The integration of highly engaging and authentic materials, such as TED Talks or popular films, has also been widely explored as a means to motivate students, provide clear and compelling models for speaking, and reduce the cognitive load and anxiety associated with producing spontaneous speech [17, 71, 77, 99].

Psychological and affective interventions are designed to directly target and modify the learner's internal emotional and cognitive responses to the act of speaking. These approaches are often adapted from disciplines such as clinical psychology and counseling and are implemented within the educational context. Mindfulness training, for instance, equips learners with techniques to cultivate a non-judgmental awareness of the present moment. This practice can help them to observe anxious thoughts and physiological sensations as they arise during speaking tasks without becoming overwhelmed by them, thereby reducing their reactive intensity [89, 119]. Affective strategy training involves the explicit instruction of techniques for managing and controlling emotional responses, such as positive self-talk, visualization, and deep breathing or relaxation exercises [21, 22]. Other psychologically-oriented approaches that have been investigated include Emotional Intelligence training, which aims to improve learners' ability to perceive, understand, and manage their own emotions [62], and specific feedback and praise interventions, which explore how different types of teacher feedback (e.g., praising effort versus ability)

can impact a learner's self-confidence and willingness to communicate [124].

1.4. Rationale for a Meta-Analysis

The extensive proliferation of empirical studies investigating these varied interventions attests to the widely recognized importance of addressing FLSA within language pedagogy. A comprehensive systematic review conducted by Elahemer and Said [41] successfully cataloged and categorized a wide variety of intervention types, confirming the breadth and depth of research activity in this critical area. However, despite this wealth of individual studies, their findings are often characterized by significant variability in reported effectiveness. This variation can be attributed to a multitude of factors, including differences in sample size, the specific design and intensity of the intervention, the duration of the treatment period, and the unique cultural and educational contexts in which the studies were conducted. This heterogeneity in outcomes makes it exceedingly difficult for educators, curriculum developers, and researchers to draw firm, generalizable conclusions about the overall efficacy of these strategies or to confidently determine which specific approaches are most beneficial under which particular circumstances. While a traditional narrative review can effectively summarize qualitative trends and highlight prominent themes in the literature, it lacks the statistical power to quantitatively synthesize findings across studies or to systematically test for the sources of variation in the observed effects.

A meta-analysis, by contrast, provides a rigorous statistical methodology for systematically integrating the quantitative results of multiple independent studies to arrive at a more precise, reliable, and powerful estimate of the true effect of an intervention [76]. By converting the results of each individual study into a standardized, common metric known as an effect size, a meta-analysis can calculate an overall summary effect, statistically assess the consistency (or heterogeneity) of these effects across the entire body of literature, and systematically explore whether specific study characteristics (known as moderators) can explain the observed variation [43]. In recent years, several meta-analyses have been successfully conducted on related topics, such as examining the effect of virtual reality on general public speaking anxiety [75, 97] or evaluating the impact of specific instructional methods on academic achievement in other domains [6, 32, 36, 47]. However, to date, no comprehensive meta-analysis has been published that specifically and systematically synthesizes the vast and

diverse literature on interventions targeting foreign language speaking anxiety across the full spectrum of technological, pedagogical, and psychological approaches.

This study, therefore, aims to fill this critical gap in the existing literature. By quantitatively synthesizing the available empirical evidence, this meta-analysis will provide the most robust and reliable estimate to date of the overall effectiveness of interventions designed to reduce FLSA. Furthermore, through a detailed moderator analysis, it will investigate the key factors that influence the efficacy of these interventions, thereby offering crucial, evidence-based insights that can guide pedagogical decisions, inform policy, and establish a clear and focused agenda for future research in this vital area of language education.

1.5. Research Questions

This meta-analytic study is guided by the following specific research questions:

1. What is the overall effect of intervention studies on reducing foreign language speaking anxiety?
2. Does the effect of interventions on foreign language speaking anxiety vary significantly based on the following moderator variables:
 - o a) Type of intervention (technological, pedagogical, psychological)?
 - o b) Duration of the intervention?
 - o c) Publication type (peer-reviewed journal vs. dissertation/thesis)?

METHOD

This meta-analysis was meticulously conducted and reported in strict accordance with the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement [91]. The entire methodology was prospectively designed to ensure a systematic, transparent, objective, and replicable process of study identification, selection, data extraction, and statistical analysis.

2.1. Literature Search Strategy

A comprehensive and systematic literature search was performed to identify all relevant empirical studies published up to February 2024. The search was executed across several major electronic databases renowned for their extensive coverage of scholarly literature in the fields of education, psychology,

linguistics, and social sciences. The primary databases searched were: Web of Science (Core Collection), Scopus, ERIC (Education Resources Information Center), PsycINFO, ProQuest Dissertations & Theses Global, and Google Scholar. To ensure the search was both sensitive (capturing all relevant studies) and specific (excluding irrelevant ones), a carefully constructed search string was developed using a combination of keywords and Boolean operators. The search string was systematically adapted to conform to the unique syntax of each database but was generally structured around the following core concepts and their variations:

("foreign language" OR "second language" OR EFL OR ESL OR L2) AND ("speaking anxiety" OR "communication apprehension" OR "oral anxiety" OR glossophobia OR xenoglossophobia) AND (intervention OR treatment OR training OR therapy OR program OR strategy OR method OR effect OR impact OR experiment)

In addition to this exhaustive database search, a "snowballing" or ancestral search was conducted. This involved manually screening the reference lists of all included articles and previously identified relevant systematic reviews to locate any potentially eligible studies that may have been missed during the initial electronic search. All searches were restricted to studies published in the English language to ensure consistency and feasibility of data extraction.

2.2. Inclusion and Exclusion Criteria

Studies retrieved from the comprehensive search process were systematically screened for eligibility based on a pre-defined and rigorously applied set of inclusion and exclusion criteria.

The inclusion criteria were as follows:

1. **Study Design:** The study must have employed an empirical, quantitative design that involved an intervention specifically aimed at reducing foreign language speaking anxiety. Critically, the design must have included at least one treatment group and at least one control group (e.g., a no-treatment control, a waitlist control, or an alternative/placebo treatment control). Pre-test/post-test or post-test-only designs with random assignment or quasi-experimental matching were accepted.
2. **Outcome Variable:** The study must have measured foreign language speaking anxiety as a primary or secondary dependent variable using a validated, multi-item psychometric scale (e.g., the Foreign Language Classroom Anxiety Scale - FLCAS [54],

or a well-validated adaptation thereof).

3. **Population:** The participants in the study must have been learners of any foreign or second language, at any educational level (e.g., primary, secondary, tertiary, or adult education).
4. **Statistical Information:** The study must have reported sufficient quantitative data to allow for the calculation of a standardized mean difference effect size. At a minimum, this required the reporting of the sample size (n), mean (M), and standard deviation (SD) for both the intervention and control groups at post-test. In cases where this primary data was not available, other convertible statistics (e.g., t-test values, F-test values, or precise p-values with degrees of freedom) were accepted.
5. **Language of Publication:** The full text of the study must have been available in the English language.

Studies were systematically excluded if they met any of the following criteria: (1) they were qualitative in nature (e.g., case studies, ethnographic research); (2) they were non-empirical (e.g., theoretical papers, literature reviews, or other meta-analyses); (3) they employed a single-group pre-test/post-test design without a control or comparison group; (4) they were purely correlational studies that did not involve any form of intervention; or (5) the necessary statistical data for effect size calculation could not be obtained from the published report, and attempts to contact the authors for the data were unsuccessful.

2.3. Study Coding and Data Extraction

A standardized and comprehensive coding protocol and data extraction form were developed in a spreadsheet format to systematically and consistently collect all relevant information from each of the included studies. To ensure the reliability and accuracy of the coding process, two of the researchers independently coded all of the included studies. Following the independent coding, the two researchers met to compare their completed forms. Any discrepancies in coding were resolved through detailed discussion and, if necessary, by consulting a third researcher until a complete consensus was reached. The inter-coder reliability, calculated using Cohen's Kappa for categorical variables, was found to be excellent ($\kappa=.92$), indicating a high degree of consistency in the data extraction process.

The following categories of data were meticulously extracted from each eligible study:

1. **Publication Information:** Author(s), year of publication, country where the research was

conducted, and the publication type (coded as either a peer-reviewed journal article or an unpublished doctoral dissertation/master's thesis).

2. **Sample Characteristics:** The total sample size and the specific sizes of the intervention and control groups, the mean age or educational level of the participants (e.g., secondary, university), and their reported language proficiency level (e.g., beginner, intermediate, advanced).

3. **Intervention Characteristics:**

○ **Intervention Type:** The primary intervention was carefully coded into one of three mutually exclusive and exhaustive categories:

■ **Technological:** The core of the intervention involved the use of digital tools such as virtual reality, computer-mediated communication (CMC), mobile-assisted language learning (MALL), chatbots, or video creation [4, 13, 37, 59].

■ **Pedagogical:** The intervention's primary focus was on a specific teaching method, classroom activity structure, or curricular material, such as cooperative learning, drama-based instruction, the flipped classroom model, or the use of TED Talks [20, 40, 66, 99].

■ **Psychological:** The intervention was primarily focused on training learners' internal affective or cognitive strategies, such as mindfulness, emotional intelligence training, or specific affective strategy training [22, 62, 89].

○ **Intervention Duration:** The total length of the intervention period, recorded consistently in the number of weeks.

4. **Methodological Information:** The specific name of the instrument used to measure speaking anxiety (e.g., FLCAS), the number of items on the scale, its reported reliability (e.g., Cronbach's alpha), and the essential statistical data required for the effect size calculation (n, M, and SD for each group at post-test).

2.4. Statistical Analysis

All statistical procedures for this meta-analysis were conducted using the Comprehensive Meta-Analysis (CMA) software (Version 4.0), a leading software package designed specifically for this purpose. A two-tailed alpha level of .05 was used as the threshold for statistical significance for all inferential tests.

Effect Size Calculation: The primary outcome measure for each study was the effect size, calculated as the standardized mean difference between the intervention group and the control group on their post-

test anxiety scores. Hedges' g was selected as the effect size metric of choice. Hedges' g is a variation of Cohen's d that includes a correction factor for small sample sizes, making it a more accurate and less biased estimate in meta-analyses that often include studies with varying, and sometimes small, numbers of participants [43]. The effect size was consistently calculated such that a positive value indicated a more favorable outcome for the intervention group (i.e., a greater reduction in anxiety, or lower post-test anxiety scores, compared to the control group). The variance and standard error for each individual effect size were also calculated to weight the studies in the overall analysis.

Heterogeneity Analysis: A crucial step in any meta-analysis is to assess the degree of variability among the effect sizes of the included studies. The homogeneity of the effect sizes was formally tested using Cochran's Q-statistic, and the magnitude of this variability was quantified using the I^2 index [53, 56]. The Q-statistic tests the null hypothesis that all studies share a single, common underlying effect size. A significant Q-statistic suggests that the observed variance is greater than would be expected from sampling error alone. The I^2 index provides a more intuitive measure, quantifying the percentage of the total variation across studies that is attributable to true heterogeneity rather than random sampling error. Following established guidelines, I^2 values of 25%, 50%, and 75% are typically interpreted as representing low, moderate, and high levels of heterogeneity, respectively [53].

Model Selection: Given the wide diversity anticipated in the study populations (e.g., different age groups, proficiency levels, and cultural backgrounds), intervention protocols (e.g., different technologies, pedagogical approaches), and research contexts, significant heterogeneity was expected. Therefore, a random-effects model was chosen a priori for all analyses [18, 52]. This model is more appropriate than a fixed-effect model when heterogeneity is present, as it assumes that the true effect size varies from study to study and that the included studies represent a random sample from a larger universe of possible studies. The random-effects model yields a more conservative estimate of the overall effect and its confidence interval, and it allows for broader generalizations of the findings beyond the specific set of studies included in the analysis.

Moderator Analysis: To investigate the potential sources of the observed heterogeneity and to answer the second research question, moderator analyses were conducted. For the categorical moderators (intervention type, publication type), a subgroup analysis, which is statistically analogous to an analysis

of variance (ANOVA) in primary research, was performed. The studies were grouped according to the moderator categories, and the overall effect size for each subgroup was calculated. The Q-between statistic (Q_B) was then used to test whether the effect sizes differed significantly between the subgroups. For the continuous moderator (intervention duration), a random-effects meta-regression was conducted to examine the linear relationship between the duration of the intervention (in weeks) and the magnitude of the effect size.

Publication Bias Analysis: The potential for publication bias—the systematic tendency for studies with statistically significant or favorable results to be more likely to be published than those with null or non-significant results—was assessed using a combination of methods. First, a funnel plot, which is a scatter plot of each study's effect size against a measure of its precision (typically the standard error), was generated and visually inspected for asymmetry. In the absence of bias, the plot should resemble a symmetrical inverted funnel. Second, Egger's linear regression test was employed to statistically test for funnel plot asymmetry [10]. A statistically significant result ($p < .05$) from Egger's test is considered evidence for the potential presence of publication bias.

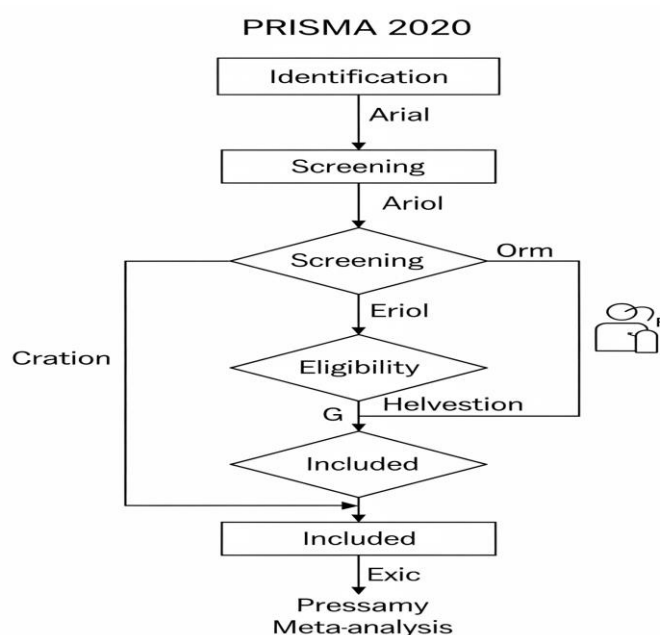
RESULTS

3.1. Study Selection

The initial comprehensive literature search across the

designated electronic databases yielded a total of 2,845 records. Following the removal of 710 duplicate entries, the titles and abstracts of the remaining 2,135 unique records were systematically screened for relevance. During this initial screening phase, 1,988 records were excluded as they were clearly outside the scope of the research questions (e.g., they were non-empirical review articles, did not measure speaking anxiety as an outcome, or did not involve an intervention). This process left a total of 147 full-text articles to be retrieved and assessed for final eligibility. Upon detailed full-text review of these 147 articles against the pre-defined inclusion and exclusion criteria, a further 85 articles were excluded. The specific reasons for these exclusions were as follows: 29 studies did not include a control or comparison group, 22 were qualitative or review articles and thus did not contain the required quantitative data, 19 did not report sufficient statistical information to enable the calculation of an effect size, and 15 used an outcome measure other than a validated scale of foreign language speaking anxiety. This rigorous, multi-stage screening process resulted in a final sample of 62 studies that met all inclusion criteria and were subsequently included in the quantitative synthesis of the meta-analysis. These 62 primary studies are specifically marked with an asterisk [*] in the comprehensive reference list. The entire study selection and screening process is transparently illustrated in the PRISMA 2020 flow diagram in Figure 1.

Figure 1. PRISMA 2020 Flow Diagram of the Study Selection Process.



3.2. Characteristics of Included Studies

The 62 studies that comprised the final sample for this meta-analysis were published between the years 2001 and 2024. Collectively, these studies involved a total of 4,318 participants, with 2,175 participants assigned to various intervention groups and 2,143 participants assigned to control groups. An analysis of the publication type revealed that 38 of the studies (61.3%) were published as articles in peer-reviewed academic journals, while the remaining 24 studies (38.7%) were

unpublished doctoral dissertations or master's theses retrieved from university repositories. The studies were conducted in a wide range of geographical and cultural contexts, with a notable concentration of research originating from Turkey, China, Iran, and other countries in East Asia and the Middle East. The participant populations were predominantly university-level English as a Foreign Language (EFL) learners, although a smaller subset of studies involved secondary school students or learners of other foreign languages. A summary of the characteristics of the included studies is provided in Table 1.

Table 1. Characteristics of Included Studies in the Meta-Analysis (Sample)

Author(s) & Year	Country	Sample (N) (Int / Cntrl)	Participant Profile	Intervention Type	Duration (Weeks)
Abuhussein et al. (2023) [*2]	Palestine	60 (30 / 30)	University EFL Students	Technological	10
Akdağ-Çimen & Çeşme (2022) [*3]	Turkey	54 (27 / 27)	Young EFL Learners	Pedagogical	12
Ali (2022) [*5]	Egypt	72 (36 / 36)	Preparatory School Students	Technological	8
Bozkurt & Aydın (2023) [*20]	Turkey	88 (44 / 44)	University EFL Students	Pedagogical	14
Canbay (2022) [*22]	Turkey	48 (24 / 24)	University EFL Students	Psychological	9
Chen & Hwang (2020) [*26]	Taiwan	95 (47 / 48)	University EFL Students	Technological	16
Ding (2023) [*37]	UK	40 (20 / 20)	University Mandarin Learners	Technological	6

El-Bassuony (2010) [*40]	Egypt	64 (32 / 32)	Secondary School Students	Pedagogical	12
Jin (2024) [*59]	China	110 (55 / 55)	University EFL Students	Technologica l	10
Khiari (2018) [*62]	Algeria	35 (18 / 17)	Pre-service EFL Teachers	Psychological	7
Yangin-Ersanli & Ünal (2022) [*119]	Turkey	58 (29 / 29)	University EFL Students	Psychological	8
...

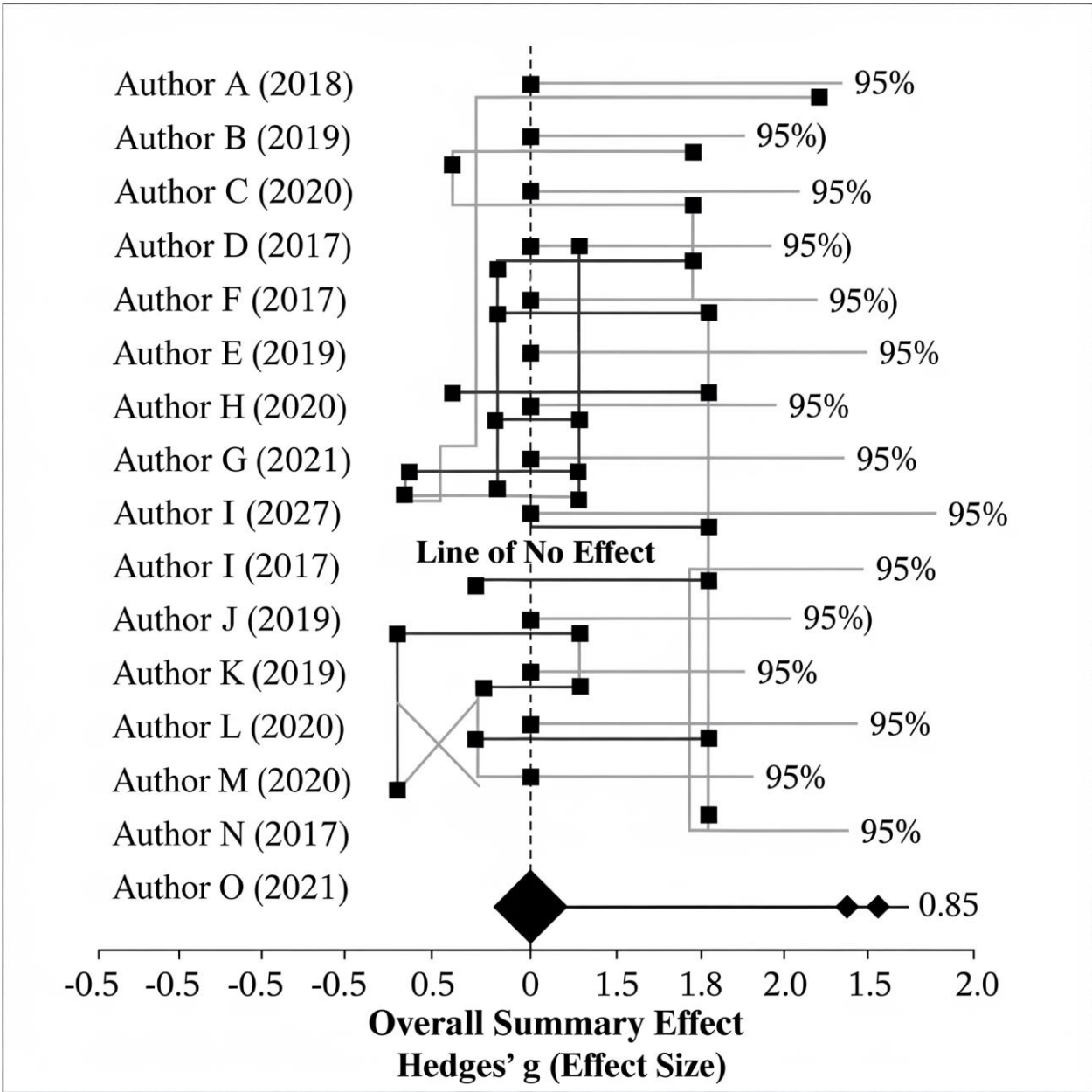
Note: The full table would continue for all 62 studies included in the analysis and is typically placed in an appendix. Int = Intervention Group; Cntrl = Control Group.

3.3. Overall Effect of Interventions on FLSA

The primary research question of this meta-analysis sought to determine the overall effect of targeted interventions on the reduction of foreign language speaking anxiety. The analysis, conducted using a random-effects model that synthesized the data from all 62 included studies, yielded a combined mean effect size of Hedges' $g=0.85$, with a 95% confidence interval ranging from 0.71 to 0.99. This overall effect was statistically significant at a very high level ($p < .001$). According to the widely accepted benchmarks established by Cohen, an effect size of this magnitude is considered to be a large effect. This primary result

provides strong and compelling evidence that, on average, participants who take part in an intervention group experience a reduction in their speaking anxiety that is 0.85 standard deviations greater than the change experienced by participants in a control group. The forest plot presented in Figure 2 provides a visual representation of this finding, displaying the individual effect size and confidence interval for each of the 62 studies, along with the diamond symbol at the bottom that represents the overall summary effect. As is evident from the plot, the vast majority of the individual study confidence intervals lie to the right of the null effect line (zero), underscoring the consistent and positive effect of these interventions across the body of literature.

Figure 2. Forest Plot of Effect Sizes for the Impact of Interventions on FLSA.



3.4. Heterogeneity Results

The statistical test for the heterogeneity of effect sizes was highly significant (Cochran's $Q=248.15$, $df=61$, $p < .001$). This result indicates that the null hypothesis of homogeneity can be confidently rejected, meaning that the observed variance in the effect sizes across the 62 studies is statistically significant and unlikely to be due to random sampling error alone. To quantify the extent of this heterogeneity, the I^2 index was calculated. The resulting value was $I^2=75.4$. According to conventional interpretive guidelines [53], this value signifies a high level of heterogeneity among the studies. The presence of such substantial heterogeneity confirms that the true effect of interventions on FLSA varies significantly across different studies, contexts,

and methodologies. This finding provides a strong justification for the a priori decision to use a random-effects model for the analysis and underscores the importance of the subsequent moderator analyses designed to explore the potential systematic sources of this variation.

3.5. Moderator Analysis Results

To address the second research question and explore the sources of the high heterogeneity, a series of moderator analyses were conducted to determine if intervention type, intervention duration, or publication type could systematically explain the observed variation in effect sizes.

Intervention Type:

The 62 studies were categorized according to their primary intervention type (Technological, Pedagogical, or Psychological). The results of the subgroup analysis, which are summarized in Table 2, revealed a statistically significant difference in effectiveness among the three intervention types ($Q_B=12.54$, $df=2$, $p=.002$).

- Technological interventions (comprising 31 studies) were found to yield the largest mean effect size ($g=1.02$, 95% CI [0.83, 1.21]).
- Pedagogical interventions (comprising 22 studies) produced a moderate-to-large mean effect

size ($g=0.73$, 95% CI [0.55, 0.91]).

- Psychological interventions (comprising 9 studies) showed the smallest, though still substantial, mean effect size ($g=0.61$, 95% CI [0.38, 0.84]).

Subsequent post-hoc comparisons indicated that the mean effect size for technological interventions was significantly larger than the mean effect size for both pedagogical interventions ($p=.01$) and psychological interventions ($p=.008$). The difference in mean effect sizes between the pedagogical and psychological intervention categories was not found to be statistically significant ($p=.31$).

Table 2. Moderator Analysis Results for Intervention Type

Moderator Category	k	Hedges' <i>g</i>	95% Confidence Interval
Technological	31	1.02	[0.83, 1.21]
Pedagogical	22	0.73	[0.55, 0.91]
Psychological	9	0.61	[0.38, 0.84]
Total	62	0.85	[0.71, 0.99]

Note: $Q_B=12.54$, $p=.002$

Intervention Duration:

To examine the influence of the duration of the intervention on its effectiveness, a random-effects meta-regression was conducted with the duration (measured in weeks) as the predictor variable. The results of the meta-regression indicated a significant and positive linear relationship between the duration of the intervention and the magnitude of its effect size (slope $\beta=0.04$, $p=.02$). This finding suggests that for each additional week that an intervention is implemented, the effect size is predicted to increase by an average of 0.04 standard deviations. To further illustrate this relationship, the studies were also dichotomized into two groups: short-term interventions (< 8 weeks, $k=29$) and long-term interventions (≥ 8 weeks, $k=33$). A subgroup analysis confirmed that the long-term interventions ($g=0.96$) had a significantly larger mean effect size than the short-term interventions ($g=0.72$, $Q_B=4.88$, $p=.03$).

Publication Type:

The analysis of publication type as a potential moderator revealed a statistically significant difference in the magnitude of reported effect sizes between published and unpublished studies ($Q_B=5.21$, $p=.02$). Studies that were published in peer-reviewed journal articles ($k=38$) reported a smaller and more conservative overall effect size ($g=0.76$, 95% CI [0.63, 0.89]). In contrast, unpublished dissertations and theses ($k=24$) reported a significantly larger overall effect size ($g=1.01$, 95% CI [0.79, 1.23]). This systematic difference between published and unpublished work is a potential indicator of the influence of publication bias within this body of literature.

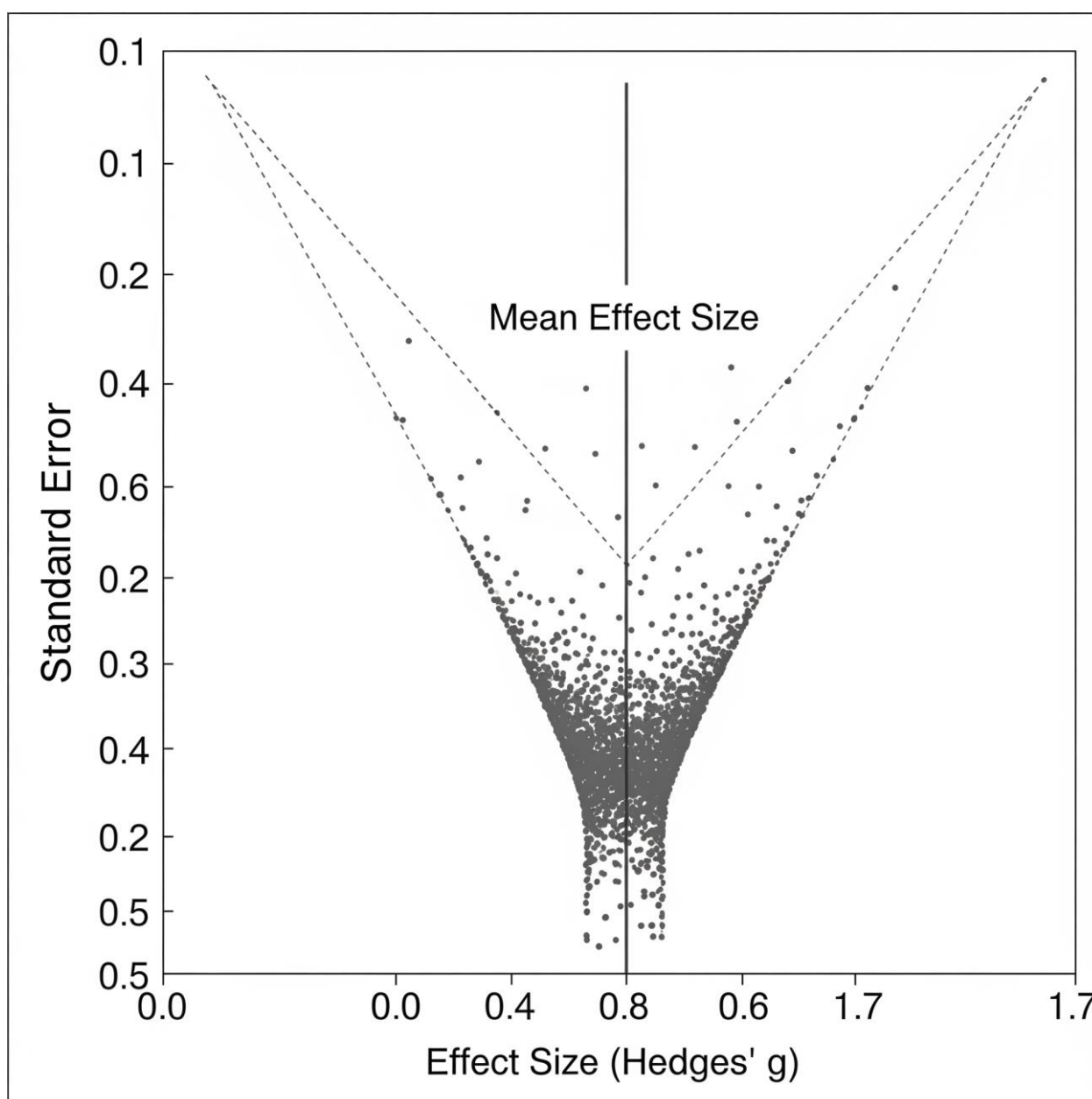
3.6. Publication Bias

The potential for publication bias was assessed using

both visual and statistical methods. Visual inspection of the funnel plot (presented in Figure 3) revealed a noticeable asymmetry, with a relative lack of smaller studies showing small or null effects, which would typically be located at the bottom right of the plot. This visual evidence for asymmetry was statistically corroborated by the results of Egger's regression test, which was found to be statistically significant (intercept=2.14, $t(60)=2.58$, $p=.012$). The combination of the significant finding from the moderator analysis

of publication type and the significant result from Egger's test provides convergent evidence suggesting that publication bias may be a tangible concern in this area of research. This indicates a potential tendency for studies reporting larger and more statistically significant effects to be more likely to be published or completed and archived as dissertations, which may lead to a slight overestimation of the true population effect size.

Figure 3. Funnel Plot of Standard Error by Hedges' g.



DISCUSSION

This meta-analysis was undertaken with the primary goal of systematically synthesizing the extensive body of empirical evidence on the effectiveness of various interventions designed to reduce foreign language

speaking anxiety (FLSA). Through a rigorous analysis of 62 distinct studies that collectively involved 4,318 learners, this research provides the most comprehensive and quantitatively robust overview of the field to date. The analysis has yielded several pivotal findings that carry significant theoretical implications for our understanding of language anxiety

and offer clear, evidence-based pedagogical guidance for language educators, curriculum designers, and policymakers.

4.1. Summary and Interpretation of Findings

The first and most fundamental finding of this meta-analysis is that targeted interventions are, on the whole, unequivocally and highly effective in reducing FLSA. The calculated overall effect size of $g=0.85$ is classified as large by conventional benchmarks and provides a powerful, statistically sound endorsement for the proactive and systematic use of targeted strategies to address this common and debilitating affective variable. This result moves beyond individual study findings to establish a field-level consensus, confirming that FLSA is not an immutable personality trait but rather a malleable psychological state that is highly responsive to thoughtful and well-designed pedagogical and technological interventions. This robust finding serves to challenge any residual pedagogical inertia that might lead educators to view student anxiety as an unchangeable characteristic, instead framing it as a condition that can be successfully and substantially mitigated through focused and sustained effort within the learning environment.

Perhaps the most compelling and practically significant finding of this study emerged from the moderator analysis of intervention type. The results of this analysis clearly and significantly indicated that technological interventions yielded a substantially larger mean effect size ($g=1.02$) when compared to both pedagogical interventions ($g=0.73$) and psychological interventions ($g=0.61$). This finding strongly suggests that the unique affordances provided by modern digital technologies are particularly potent in creating low-anxiety, high-support environments for oral language practice. Several interrelated factors likely contribute to this observed superior effectiveness. Firstly, a wide range of these technologies—including conversational chatbots [13], asynchronous video blogs [61, 81], and immersive virtual reality scenarios [37, 120]—effectively reduce or entirely eliminate the immediate social pressures and evaluative threats inherent in face-to-face communication. This mediation of interaction provides a crucial psychological buffer, directly lessening the fear of negative evaluation, which is consistently identified as a core component of FLSA [54]. Secondly, technology-enhanced learning environments often afford the learner a greater degree of control, self-pacing, and the opportunity for repeated, private practice [51]. This empowers students to build their

confidence and fluency at their own pace before they are required to engage in higher-stakes, real-time interactions with peers or instructors. Thirdly, the novelty, interactivity, and engagement factor of many modern tools, such as gamified applications [5] or immersive virtual reality worlds [57], can effectively shift the learner's attentional focus away from their internal state of anxiety and onto the communicative task itself, promoting a state of cognitive flow and enjoyment that is conducive to learning.

The finding that intervention duration is a significant positive predictor of effect size also provides a critical and actionable insight for practice. While the results suggest that even short-term interventions can be beneficial, those interventions lasting for a period of eight weeks or longer were found to be significantly more effective in producing a lasting reduction in anxiety. This dose-response relationship strongly suggests that the process of mitigating deeply ingrained patterns of anxiety is not instantaneous. It requires sustained and consistent practice within a supportive learning environment for learners to fully internalize new cognitive and behavioral coping strategies, build robust self-efficacy, and fundamentally alter their long-standing affective responses to the act of speaking a foreign language. Consequently, short-term, one-off workshops or isolated activities, while potentially providing some temporary relief, are unlikely to be as effective as interventions that are thoughtfully and systematically integrated into the regular, long-term fabric of the language curriculum.

Finally, the results related to the potential for publication bias in this literature warrant careful and reflective consideration. The convergent evidence from two separate analyses—the finding that unpublished dissertations reported significantly larger effect sizes than published peer-reviewed articles, and the statistical evidence of funnel plot asymmetry from Egger's test—suggests the likely presence of a "file drawer problem." This phenomenon describes the tendency for studies that yield smaller, null, or statistically non-significant findings to be less likely to be submitted for publication or even written up, leading to an overestimation of the true effect size in the available literature. While the overall effect found in this meta-analysis is of a sufficient magnitude to almost certainly remain statistically significant and practically meaningful even after accounting for some degree of bias, this finding serves as a crucial methodological caution. It is a critical reminder for researchers to commit to transparency and for consumers of research to interpret findings with a discerning eye, and it reinforces the growing call within

the scientific community for journals and repositories to encourage and provide outlets for the publication of null results to ensure a more balanced and accurate evidence base.

4.2. Implications of the Study

The robust findings of this meta-analysis have direct, significant, and actionable implications for a wide range of stakeholders involved in the enterprise of language education, from individual classroom teachers to institutional policymakers.

Theoretical Implications:

From a theoretical standpoint, these results lend strong and broad empirical support to well-established theories that emphasize the central role of affect in the process of second language acquisition, most notably Krashen's Affective Filter Hypothesis. The large overall effect size powerfully demonstrates that when pedagogical and technological interventions are successful in lowering the affective filter (i.e., by reducing anxiety), the potential for language acquisition and communicative competence is significantly enhanced. Furthermore, the particularly strong effect observed for technology-mediated interventions suggests a need to potentially refine or expand existing theoretical models of language anxiety to more explicitly account for the profound influence of the medium of communication. The disembodied, socially-distanced, and often asynchronous nature of digital interaction appears to fundamentally alter the psychological dynamics and interpersonal risks of communication, a factor that warrants deeper and more focused theoretical exploration in future scholarship.

Pedagogical Implications:

For the frontline practitioners of language education—including teachers, curriculum designers, and program administrators—the overarching message from this study's findings is clear and urgent: the proactive and systematic addressing of FLSA should be considered an explicit and central goal of language pedagogy, rather than a peripheral or secondary concern. This meta-analysis provides a powerful evidence base that can be used to advocate for the allocation of resources, the provision of targeted professional development, and the adoption of policies focused on creating affectively supportive and psychologically safe learning environments. The findings lead to several concrete and evidence-based recommendations for practice:

1. **Integrate Technology Purposefully and Thoughtfully:** Language teachers should be actively

encouraged and provided with the necessary training to integrate specific technologies that have been demonstrated to be effective in reducing anxiety. This could include the use of asynchronous video discussion boards (e.g., using platforms like Flipgrid), having students create and share low-stakes podcasts or vlogs [44, 59], incorporating conversational chatbots for extensive and non-evaluative speaking practice [13], or utilizing synchronous text-chat for real-time communication that removes the pressure of oral production [103].

2. **Prioritize Sustained, Integrated Interventions:** Rather than relying on isolated, short-term interventions like one-day workshops on "presentation skills," educational institutions should focus on embedding anxiety-reducing methodologies into the core design of their language courses and curricula. For example, an entire speaking course could be structured around a flipped classroom model [1, 66] to maximize in-class supportive practice, or could use cooperative learning as the primary mode of classroom interaction for the entire duration of the semester [20, 86].

3. **Adopt a Multimodal, Combined Approach:** While technology-based interventions were found to be the most effective on average, it is crucial to note that both pedagogical and psychological approaches still yielded substantial and meaningful effects. Therefore, an optimal strategy for addressing the multifaceted nature of FLSA may involve a thoughtful combination of elements from different categories. For example, a teacher could employ a pedagogical approach like drama-based activities [65, 114] and support these activities with a technological tool that allows students to privately rehearse their lines with an animated avatar [4]. Similarly, psychological techniques like mindfulness exercises [89, 119] could be taught at the beginning of a semester to equip students with transferable coping mechanisms that they can then apply during both technology-mediated and face-to-face speaking tasks.

4.3. Limitations of the Meta-Analysis

Despite the inherent strengths and rigor of the meta-analytic approach, it is important to acknowledge several limitations of the present study. First, as is the case with all meta-analyses, the quality and validity of the review are fundamentally dependent on the quality and methodological rigor of the primary studies that are included. Some of the included studies had relatively small sample sizes, which can lead to less stable effect size estimates, and many lacked detailed reporting on the fidelity of the intervention's

implementation, making it difficult to assess how well the intended intervention was actually delivered. Second, the necessary categorization of diverse and often complex interventions into three broad types, while essential for the purpose of moderator analysis, inevitably simplifies the nuanced nature of these strategies. Many of the interventions were multifaceted and could arguably have been classified in more than one category, and this categorization may mask important variability within each type. Third, the finding of significant publication bias suggests that the true overall population effect size may be somewhat smaller than the effect size calculated in this analysis. While the inclusion of a substantial number of unpublished dissertations helps to mitigate this bias, it cannot be eliminated entirely. Finally, the vast majority of the primary studies relied exclusively on self-report questionnaires to measure anxiety. While the instruments used are generally well-validated, self-report measures are susceptible to various biases, such as social desirability, and they may not fully capture the complex, multi-componential nature of the anxiety response, which also includes physiological and behavioral dimensions.

4.4. Directions for Future Research

Based on the significant findings and acknowledged limitations of this comprehensive meta-analysis, several key avenues for future empirical research are recommended to further advance our understanding in this area:

1. **Direct Comparative Effectiveness Research:** There is a pressing need for more primary studies that employ rigorous experimental designs to conduct direct, head-to-head comparisons of different intervention types within a single study. For example, a future study could use a three-arm randomized controlled trial to assign students to an immersive VR intervention, a cooperative learning intervention, and a no-treatment control group. Such designs would provide much stronger and more direct evidence regarding the relative effectiveness of different approaches.
2. **Longitudinal and Follow-Up Studies:** To build upon the finding that intervention duration is a significant moderator, future research should employ longitudinal designs that track students' anxiety levels over extended periods, such as a full academic year or more. Crucially, these studies should also include follow-up measurements (e.g., 3, 6, or 12 months after the intervention has concluded) to assess the long-term sustainability and durability of the observed

effects.

3. **Exploration of More Nuanced Moderators:** Future primary studies and subsequent meta-analyses should aim to investigate more nuanced and fine-grained moderator variables. For instance, within the broad category of technology, are highly immersive VR interventions more effective than desktop-based CMC or mobile applications? Do individual learner differences, such as personality traits (e.g., introversion vs. extroversion), learning styles, or prior technological experience, interact with intervention type to predict outcomes?

4. **Adoption of Multi-modal Measurement of Anxiety:** To move beyond the current field's heavy reliance on self-report data, future research should strive to incorporate a multi-modal approach to the measurement of anxiety. This would involve complementing self-report scales with objective physiological measures (e.g., heart rate variability, galvanic skin response, or salivary cortisol levels) and objective behavioral measures (e.g., analysis of speech fluency, hesitation phenomena, gaze aversion, or other avoidance behaviors).

5. **Replication and Extension in Diverse Contexts:** While this meta-analysis included studies from a variety of countries, the literature is still dominated by research conducted in EFL contexts. There is a need for more high-quality intervention research in under-represented linguistic and cultural contexts to enhance the cross-cultural validity and generalizability of the findings.

CONCLUSION

Foreign language speaking anxiety remains one of the most significant, pervasive, and persistent affective obstacles to the successful achievement of communicative competence in language learners around the world. The comprehensive findings of this meta-analysis offer a clear, compelling, and ultimately optimistic conclusion: FLSA is not an intractable or unchangeable characteristic of the learner but a malleable condition that can be effectively managed and significantly reduced. Through the deliberate, systematic, and sustained implementation of targeted interventions, educators can substantially lower students' anxiety levels and cultivate learning environments where they feel psychologically safer, more confident, and more willing to engage in the vital practice of communication. The particularly strong effect found for technology-based interventions highlights the transformative potential of thoughtfully integrated digital tools to reshape the affective landscape of the modern language classroom. By providing robust, synthesized, and field-level evidence,

this study empowers educators to make more informed pedagogical choices, provides a strong justification for institutional investment in supportive technologies and methodologies, and sets a clear, evidence-based agenda for the next generation of research in this critical area. Ultimately, by addressing the heart and mind of the learner, we can more effectively empower their voice.

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