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The Influence Codebook : A Taxonomy of Influence Tactics in Time-Pressured High-Challenge Online Decision Making Collaborations

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ABSTRACT

We derived a comprehensive, empirically-grounded taxonomy of 47 influence tactics, organized into four themes of relational, emotional, cognitive, cognitive and a combination of such strategies. This work bridges cognitive science and organizational behavior on influencing, negotiating and decision making in emotionally-tense online settings; offering a novel framework for adaptive influence. Moving beyond traditional, static models like Cialdini's principles or Feser's typologies, which often present context-neutral inventories, our research captures the real-time, adaptive, and often hybridized nature of strategic communication under pressure. Through a rich, role-based simulation of a time-pressured corporate crisis, we observed how practitioners dynamically sequence and blend influence tactics to convince each other. Our research paves the way for a richer, multimodal understanding of digital persuasion, highlighting the need to integrate verbal analysis with nonverbal cues and physiological measures in future work.

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Introduction

In any domain, from business to professional settings or even everyday interactions, part of our collaboration requires compliance, influencing and pursuing each other to become united and work harmoniously towards a common goal. Compliance enables one to think differently about another person, object or issue. (Petty & Cacioppo, 1986). Compliance leads to persuasion and "persuasion is an activity that involves one party trying to get another party to do (or not do) some action or to believe (or not believe) something" (Hunter, 2018, p.15). It's a process in which someone (a persuader) tries to get the other person (the persuadee) to see things in a way he/she wants or do a certain act as he/she wishes (DellaVigna and Genzkow, 2010). In organizations and work teams, persuading others comes from having control over important resources like information or decision-making power (Anderson et al., 2012).

Persuasion and influence have a rich history, perhaps since human beings realized that for improving their life conditions, they would benefit from living together over living alone; and that to change and shape other's opinions and actions towards a higher-order common goal, influencing each other effectively would be needed. Ibrahim (PBUH) was an ancient influencer (around 2000 BC) who saw that people of his time worshipped the sun, or stars and the moon. He was surprised but to help them find the right, he initially followed each of these different groups: he worshipped the sun like those who worshipped it. But when the sun set, he said I don't like to worship something that is sometimes available and sometimes unavailable to me. He then joined another group who worshipped the stars and the moon. But when the sun rose and the trace of the moon and stars faded away, he raised the same logic. He then introduced the God he knew that was always available - in one's heart and everywhere. Many people were convinced and converted to him.

Modern research on persuasion and influence is not a one-dimensional topic driven from one or a few research areas, but a complex interdisciplinary field that draws insights from various academic domains, including Economics (Camerer, 2003), Politics (Druckman, 2022), Marketing (Cialdini, 2001), Social Psychology (Petty & Cacioppo, 1986), Communication Studies (Perloff, 2017), Information Systems (Ajzen, 1991), and Artificial Intelligence (Hunter, 2018). The massive literature and numerous theories in this realm can be overwhelming, and researchers need to take a comprehensive perspective embracing multiple theories and viewpoints when narrowing into a specific topic. Effective influence and persuasion are crucial skills, specifically needed in high-risk situations such as team crisis management (Yukl, 2013). These skills can help us achieve most desired outcomes through efficient communication and interaction during time pressure. They also allow us to shape team attitudes, beliefs and behaviors in limited times, leading towards personal and social success. Today, one of the most important areas for applying social influence techniques is in "online platforms". These techniques are used to shape individuals' attitudes and behaviors in digital environments. Guadagno and Cialdini (2009) reported strategies commonly used for online persuasion such as reciprocity, commitment, and social proof. Websites often use testimonials and user reviews to build trust and develop a sense of community among their users, encouraging compliance with calls to action.

Persuasion and Negotiation

Negotiation is a fundamental skill for an individual to achieve a desired outcome and as mentioned in the previous paragraph, negotiation and persuasion are closely intertwined (Acuff, 2008). Persuasion techniques are often employed within negotiations to influence the process of decision-making through changing ideas or behavior, often focusing on reaching a joint agreement for different needs or ideas (Saee, 2008; Fisher and Ury, 2012). This area of research embraces a vast domain of human interactions and flows into various fields such as politics, business, family and everyday life. Studies highlight that persuasion involves tailoring

arguments to the personality of the persuade and the context of the negotiation, which can significantly enhance the outcome (Cialdini, 2021, p. 101). For those who want to create more compelling arguments in negotiations, it is more successful when using influence tactics like rational persuasion or inspirational appeals (Yukl & Tracey, 1992). Influence tactics like reciprocity, scarcity, and authority play a noteworthy role in persuasion during negotiation too. It's also important for negotiators to have the ability to read emotional cues and understand the underlying needs of each other. In other words, it takes 'emotional intelligence' for collaborators to manage their own emotions and emotions of their peers, so they would achieve better outcomes (Schlegel et al., 2018; Kazemitabar et al., 2022). Furthermore, effectiveness of persuasion enhances by selecting the right influence tactics based on personality and negotiation context (Cable & Judge, 2003). Selecting the right combination of tactics, helps negotiators maximize their influence and consequently reach favorable agreements (Hargie, 2016).

Frameworks and Models in Persuasion

There are different types of frameworks, helping us understand approaches leading to persuasion. The "Persuasion Knowledge Model" (PKM, Friestad & Wright, 1994) is one of such models. This framework explains individuals' *responses* to various persuasion strategies, and includes three main processes: acquisition, activation, and reaction:

Acquisition of Persuasion Knowledge: Involves people learning persuasion tactics through various resources including their own experiences, social interactions, and media consumption. As people age and gain more exposure to a number tactics, their persuasion knowledge improves and evolves (Hamby & Brinberg, 2018).

Activation of Persuasion Knowledge: Happens when individuals recognize and interpret the true intention and underlying motives behind a persuasion attempt. The activation can trigger their perception about the persuaders's intent either in positive or negative ways (Isaac & Grayson, 2017, 2020).

Reaction to Persuasion Knowledge: As persuasion knowledge gets activated, collaborators start to copy behaviors so they can achieve their salient goals. Various goals may range from making informed purchase decisions to avoiding manipulative tactics (Kirmani & Campbell, 2004).

This framework provides valuable insights for both theoretical and practical applications. It helps predict collaborators' reactions by understanding how they process persuasion, so we would be able to influence them. This can also help us design more transparent and ethical campaigns. (Eisend & Tarrahi, 2022). By using this framework, persuasion strategies can be improved based on identifying which tactics may provoke negative responses (Aguirre-Rodriguez, 2013) and collaborates can enhance their education to be able to resist manipulative tactics (Ham & Kim, 2019). However, although this framework can at times be useful, there are several limitations to the PKM model. PKM was developed in the 1990s, primarily addressing traditional advertising, thus its relevance to modern digital environments and online settings is limited. PKM presents the persuasion process in a fairly linear and one-way direction (agent → target). Research is needed to understand how persuasion (especially digital) is interactive and dialogic, e.g., in social media, and how it unfolds over time towards co-creation of meaning. This framework also underemphasizes contextual factors like mood, personality, environment, social norms, and platform effects. Its predictive power in real-world settings is also limited.

Model of the "Nine Influence Tactics"

Feser (2016) identified two main types of persuasion approaches: hard influence tactics and soft influence tactics. These approaches form the model of "Nine Influence Tactics," which range from self-focused to other-focused strategies.

Hard influence tactics include the following:

1. Requesting: The simplest form of influence is to make direct demands in order to get others act. It often reinforces with reminders.
2. Legitimating: Using authority, credentials, or rules in turn to justify actions. This also includes management directives, laws, or expert opinions.
3. Coalition: Enlisting the support of others to persuade someone. It can be implemented by creating a network of supporters constructing consensus or an "us-versus-them" dynamic.

Soft Influence Tactics include the following:

4. Rational Persuasion: supporting a claim by using logical arguments and evidence. It also helps to show its feasibility or importance.
5. Socializing: Using praise, flattery, and warm behavior to build relationships and influence others.
6. Personal Appeals: making a request by leveraging friendship, loyalty, or past relationships, so these appeals make the request approved.
7. Exchanging: Offering something valuable in order to take something in return for desired actions. It is based on reciprocity and mutual benefit.
8. Consultation: Counseling, seeking input and suggestions from other people to improve or support a proposed activity or change.
9. Inspirational Appeals: Appealing to people's values, ideals, or emotions to gain their commitment to a request or proposal

These tactics vary in their focus, from direct and authoritative approaches to more relational and emotional methods, providing a range of strategies to influence others effectively. However, this model is over-simplified and doesn't account enough for contextual factors such as organizational culture, power dynamics, or industry-specific constraints. Also, Feser's model views the nine tactics as distinct and relatively stable, without guidance on how to shift between tactics or combine them dynamically based on evolving interpersonal feedback. Another drawback to this model is that is emphasizes what the influencer can do, but it underrepresents the responder's mindset, personality, motivation, and readiness to change. In other words, Feser's 9 tactic model is rather one-sided and doesn't consider mutual understanding or emotional intelligence deeply enough to understand when and why one should use each tactic strategically over time.

Unidirectional and Bidirectional Persuasion

Unidirectional persuasion involves a one-way communication process, including a persuader delivering a message or claiming an argument and a persuadee who receives it. In this process, the persuader provides no opportunity for the persuadee to respond and there would be little to no immediate feedback or dialogue. Commonly, this method is implemented in scenarios where the goal is to inform, instruct, or influence without direct interaction (Hunter, 2018; O'Keefe, 2016). There are diverse examples of areas in which unidirectional persuasion can be expanded, including: a) product advertising (i.e., television or magazine advertisements, as they're trying to persuade consumers to purchase a certain product), b) political speech (politicians deliver speeches to persuade voters before elections), c) government advisory messages (i.e., public service announcements encourage behaviors such as recycling).

Lateral unidirectional persuasion: This process involves persuasion between colleagues, teammates or peers where both the persuader and the persuadee are from similar organizational positions. For example, when a project manager tries to persuade a fellow team leader for adopting a new process, lateral unidirectional persuasion happens. There are certain factors determining the effectiveness of this approach, including the credibility and influence the persuader has among peers, plus the clarity and appeal of the message that is delivered.

Upward unidirectional persuasion: This process is allocated for persuading superiors or anyone in higher positions. An example would be a project manager aiming their senior

management to receive funding for a project. It's clear that in this type of persuasion, structured arguments supported by evidence and data are demanded, as it must align with goals and priorities of the organization to gain approval.

Downward unidirectional persuasion: This type occurs when someone wants to persuade a subordinate or those in lower positions. When a project manager leads team members to follow a new project plan, s/he is using downward unidirectional persuasion. This approach relies on how clear and fair the message is going to be perceived by persuadees, as well as the authority and credibility of the superior.

In contrast, bidirectional persuasion involves a two-way communication process where there's an interaction between the persuader and persuadee, engaging in dialogue. In this approach, there would be enough space and opportunity for feedback, discussion, and mutual influence, which makes this process more reciprocal with further informed outcomes. Sales meetings (e.g., interaction between a salesperson and a customer in a car showroom); medical counseling (e.g., dialogue between a counselor and a patient about treatment options); and basically, most of our everyday discussions (e.g., an employee negotiating a raise in their wages with their employer) are example of this kind.

Lateral bidirectional persuasion: This process includes peers or teammates at the same organizational level, having interactions in order to achieve a mutually-agreed upon decision. It gives them the potential for mutual influence and collaboration. The effectiveness of this approach relies on open communication, active listening, and the ability to reach a consensus. For example, when two project managers discuss their methods and decide to integrate their respective teams' efforts, lateral bidirectional persuasion occurs.

Upward bidirectional persuasion: In this approach, collaboration transpires between juniors and seniors, where they exchange ideas and feedback and enhance the process of participatory decision-making. The effectiveness of this method has several factors, especially how openly superiors accept feedback and the way subordinates can communicate. For example, in a hospital setting, junior doctors might suggest updated treatments or methods based on recent research by senior physicians in order to improve patient care protocols. If senior doctors are open to this feedback and integrate these suggestions into the hospital's practices, a dynamic interaction shapes here where both parties contribute to refining patient care decisions.

Downward bidirectional persuasion: When interactive persuasion towards subordinates happens and there's also room for discussion and feedback, downward bidirectional persuasion is used. The effectiveness of this approach depends on the senior's skills for creating an open and safe environment, plus the junior's willingness to have a role in the discussion. For example, in an educational setting, a teacher might use this approach when she/he introduces a new learning method in class. The students can be encouraged and share their thoughts and ideas about the method and give the teacher some feedback. By using this dynamic, the teacher creates a collaborative environment, which not only motivates students but also enhances their sense of ownership over the learning process.

Direct & Indirect Influence Tactics

Direct persuasion is about intending the message or request through transparent and explicit communication. In this approach, there would be little ambiguity about the persuader's real intention and the process proceeds clearly. There are a bunch of examples displaying this process including (a): The persuader requests a message straightforwardly and the desired outcome is also transparent. For instance, a child might say, "I'll work really hard and get better grades if I have my own iPad. (b) unilateral assertion: The persuader expresses the demand firmly and doesn't consider the persuaders' perspective on the claim. For example, "Let's go to the amusement park!", and (c) direct persuasion, practically the persuader's intentions and desired outcomes are explicit and can be achieved through clear communication.

In contrast, indirect persuasion involves nimbler methods in order to acquire the desired goals. This technique doesn't make any explicit demands, but mostly uses various hints, suggestions, analogies, or metaphors to convey the looked-for message. There are a few examples explaining the nature of indirect persuasion including: (a) using hints and suggestions by the persuader to imply what he /she wants without stating it outright. For example, "Amir has an iPad, and he got an A in history," subtly makes a sign that having an iPad might help him in achieving better grades. (b) Indirect threats can change and persuade people's perception of the situation, make him/her think about negative consequences if the desired action is not taken. For instance, "I will never ever talk to you!" can be an indirect way to persuade someone to play with a toy.

Persuasion Styles, Persuasion Strategies

Cialdini (2001) has shown that characteristics of the persuadee play an important role on choosing an approach between all the various approaches that exist. Persuadees might have diverse personalities, for example they can be analytical-aggressive (i.e., having a detailed preparation, using logical arguments, and showing assertive behavior). They may also be ethical, which means their priority is sticking with moral principles, honesty and integrity. Or unethical and goal-directed, who only care about the goal to be achieved and not how it should be based on morality issues. Other distinctions include being sociable, who emphasize on positive relationships in a friendly and cooperative atmosphere, or non-sociable, preferring being alone in getting work done.

In the same article, Cialdini (2001) identifies six core strategies that persuadees with different styles may apply in discussion and decision-making sessions:

1. Cooperating: Emphasizes on finding common ground and collaboration to reach an advantageous solution for both parties. It is focused on mutual benefits and is about positive relationships.

2. Negotiating: This process seeks an agreement which benefits both parties by balancing different interests, and its final goal is mutual satisfaction. It requires a degree of interdependence and a willingness to compromise.

3. Struggling: This approach is more aggressive compared to others, including one party aiming to dominate or outmaneuver the other. Focusing on winning and competition often happens among collaborators in this process.

4. Collaborating: Various methods such as joint problem-solving, working together to find mutually beneficial solutions and leading to win-win outcomes are used in this approach. Especially when negotiations get complex, these methods can be demanding.

5. Competing In this procedure, the focus is on achieving exclusive goals and prioritizing personal success, sometimes including others' expense too. This strategy is useful in high-stakes situations but may lead to risk relationships.

6. Compromising: When both parties focus on finding a middle ground even by means of giving up something, compromising happens. This approach is a quick way to decrease the conflict but may not always be the best way to get the most efficient outcome.

Robert Cialdini's (2001) persuasion principles are among the most widely cited frameworks in the fields of psychology, marketing, and leadership. However, the model potentially oversimplifying the complexity of real-world influence into its six principles. Also, similar to Feser's (2016) model, Cialdini's principles are presented as static tools rather than part of a fluid, adaptive process; and it is not clear for a novice to know how to select or combine these six principles based on goals, timing, or audience personality and profile.

From this stage and based on gaps of the previous models, we will introduce factors that can help strengthen our research on influence, namely factors that can guide "how to select" and/or "combine influence tactics", in order to understand where and how which tactic(s) is/are best

to be used. Effects of linguistic style and vocal tone is mentioned, and afterwards the link between personality and negotiation is elaborated.

Choosing Influence Tactic Antecedents

Choosing the appropriate influence tactic in negotiations and collaborative decision-making sessions is more of an art. It is also very crucial for having a good influence on others and has various aspects that have to be considered, involving a suitable understanding of the style of argumentation, persuaders' nature, language of persuasion and also persuade's personality. There are experiential knowledge and psychological studies supporting this claim, including a psychological investigation by Cialdini & Goldstein (2004) which demonstrates that more favorable outcomes can be achieved by adapting strategies to individual personality traits. They all guide us to design an effective influence strategy to achieve more favorable outcomes.

Argumentation Style

According to Hunter (2018), argument style includes a myriad of dimensions: personality of the persuader, the language used, and the structure of the dialogue.

Personality of the Persuader: It plays a significant role in the success of persuasion. For instance, some features like authority, expertise, and knowledge are traditionally seen as positive traits, while other features like attractiveness or celebrity status are conditional depending on how they would be perceived by the audience. A teenager might be more persuaded by a celebrity than a government expert (Amgoud & Prade, 2005). By figuring out the personality traits of the persaudee, selecting the right strategy can be done more efficiently. The OCEAN model (Openness, Conscientiousness, Extroversion, Agreeableness, Neuroticism) is a framework which characterizes personality traits (Baumann & Brewka, 2010). For example, you can persuade individuals who "follow the crowd" by telling them the fact that the majority voted, while persuading others who "follow rules" is through claiming that it's the responsibility of a citizen to vote (Amgoud & Cayrol, 2002).

Emotions Invoked by Arguments: Emotional arguments can be very useful in persuasion. They are a powerful device to influence others by invoking various emotions such as stress, guilt or pride in them. Emotional arguments (e.g., making parents proud by completing a thesis) can be more effective with certain audiences compared to logical arguments (e.g., higher chances of a high-paying job with a PhD) (Atkinson et al., 2005). Studies show that audiences with personality types such as conscientiousness, openness, and agreeableness are more influenced by emotional arguments (Baumann, 2012).

Language/Framing of Arguments: The effectiveness of an argument relies on some strong ingredients, including words, metaphors, and other rhetorical tools, as they have a strong impact on the result of persuasion. For example, using terms like "freedom fighter" versus "terrorist" can strongly manipulate the perception of the audience. Newspapers often use such tricks (framing effect, ingroup bias, affect heuristic, semantic priming, and many more) by using specific language to align with their viewpoints, supporting the idea of how powerful word choice in argumentation is.

Selection of Arguments: It claims that effectiveness of persuasion doesn't necessarily arise as we use all possible arguments but depends on selecting ones that are more suitable to change the persuadee's mind. It's essential to consider the personality of the persuader, the way of persuasion, and the persuadee's personality (Baroni et al., 2011). Cialdini (2001) highlights that arguments with an appealing style of authority (e.g., citing health experts) are particularly persuasive. Attitudes and other psychological aspects, such as the psychology of color, language, and cultural traits, can offer valuable insights for persuasion strategies (Baroni et al., 2011).

Effect of Linguistic Style and Vocal Tone on Persuasion

Many factors affect the impression of persuasion. One of them is the way the speaker uses language, especially in terms of linguistic style and vocal tone. There are some rhetorical tools

which are very efficient as they have a strong impact on how a message is getting perceived by the audience and how the listeners will react to it (Tom & Eves, 2012). Usually, they are found in political speeches, advertisements, and propaganda. Hypophora is the act of posing and answering a question. It can be used in order to frame the arguments clearly (McGuire, 2000). In contrast, rhetorical questions invite reflection and do not expect an answer (Harris et al., 1997). The repetition at the end or beginning of sentences is an approach we see in epistrophes and anaphora (Katrandjiev et al., 2016). By using that, the speaker can create a rhythm, which has two effects: It makes the speech more memorable and evokes the emotions of the audience including anger and joy (Harris et al., 1997). Other tools exist, such as repetition (McGuigan, 2011) or antanagoge, a strategy to pair criticism with optimism (Cui & Zhao, 2014). They are usually used to balance tone and increase familiarity, which can lead to boosting the impact of persuasion. These approaches highlight important ideas and influence the emotions and cognitive engagement of the audience with the message.

Method

Purpose of the study

Based on the aforementioned review of literature, the aim of the current research is to explore a comprehensive list of influence tactics that can be used within high-stakes simulated authentic contexts characterized by time pressure and complex decision-making. The crisis management scenario of the current study demands swift persuasion and rapid consensus-building, making this research an especially relevant and under-explored area in the study of influence dynamics.

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Simulations in Learning Soft Skills

Contemporary simulations are a potent pedagogical tool for developing soft skills like leadership, communication, and decision-making. By replicating real-world scenarios within controlled, low-risk environments, they provide immersive experiential learning (Kolb, 2014). This bridges the gap between theory and practice, enhancing engagement and knowledge retention (Seidel et al., 2019). Their efficacy is maximized when integrated into comprehensive educational programs (Baldwin & Ford, 2018), with collaboration between educators and industry experts ensuring scenario authenticity. However, simulations present limitations. Their development is often costly and resource-intensive, and the resulting models may oversimplify the complexity and unpredictability of real human interactions (Lovelace et al., 2016). Furthermore, their effectiveness can vary with individual learning styles, potentially disadvantaging those who benefit more from direct peer and mentor interaction. Therefore, while superior to passive learning for skill mastery, they are most effective as a component of a broader curriculum.

Participants

Participants were 24 MBA students (M age=25, 8 female) from a leading Middle Eastern university, primarily with STEM backgrounds and limited practical business negotiation experience. All provided informed consent for multi-modal data collection following institutional ethics approval.

Team Formation

Based on the research objective to investigate the use of influence tactics, three-person groups were determined to be optimal. This size allows for observing dynamic interpersonal responses while remaining analytically manageable, resulting in eight groups. Participants completed the Big Five personality test, and a final team composition was derived through iterative trials. For the simulation, group roles were assigned based on personality scores so that roles would best match each students' personality trait: audit committee heads were selected for high extraversion and toughness, founders for the next highest extraversion, and strategy committee leaders for low extraversion but high agreeableness.

Context and Student Roles

The simulation scenario involved a corporate crisis at "AZS" in the fictional nation of "Slovetzia." To ensure preparation, participants received a "Public Information" PDF and supporting videos detailing the company's context and a two-year backstory. The corporate governance framework is a two-tier system, consisting of a high-level supervisory board responsible for policy and macro decision-making (supervisory), and a lower board is in charge of executive work (executive board). As illustrated in Figure 1, all three simulation roles are positioned on the supervisory board and possess similar formal power.

Based on the "Public Information" file, the simulation's crisis was triggered when the Chairman of AZS's Supervisory Board gave an unauthorized, politically charged interview, creating a critical situation for the company. An urgent meeting was convened with four board members: the Chairman (who acted as a non-participating observer), the Founder, the Head of Audit (Z), and the Head of Strategy (Y). The chairman is the only observer in this meeting (one of the authors fulfilled this role as the observer of each team), while the other three individuals will assume one of the three mentioned roles. The three active participants were required to collaboratively reach a consensus on one of three predetermined response options:

1. The chairman publicly apologizes for the "misquotation" in the interview and blames the journalist. However, this may lead to negative media attention and a widespread crisis.
2. In public, the founder criticizes the chairman's point of view and announces his removal from the chairmanship of the company.
3. The chairman quietly resigns, and the founder sends an informal message that the situation has been addressed.

Three distinct "Private Information" files were distributed exclusively to the participants in each role (Founder, Head of Audit, Head of Strategy). These files detailed role-specific backgrounds, preferences, and a unique scoring table. The scoring table quantified the outcomes of the meeting's three main topics. Each participant's objective was to maximize their own score by persuading the others to agree on favorable options, with their final performance assessed against these predefined criteria.

1. Accuracy of the "Planning Document", and its intime submission prior to the meeting
2. Correct performance of ascribed roles according to the private and public information
3. Total points obtained from the final voting
4. Analysis of the topics and characters of the meeting in two parts

Participants had to reach a timely consensus on three urgent issues: the chairman's resignation terms, his replacement candidate, and a response strategy for the magazine.

Schedule of the event

A "Simulation Introduction" was distributed one day prior, outlining the schedule, process, and a two-stage grading system emphasizing agreement within a one-hour deadline. On the simulation day at 7:00 AM, participants received "Public Information," a "Planning Document," and their role-specific "Private Information" files. The "Planning Document" was submitted by 11:50 AM, followed by a collective briefing on Skype where authors addressed questions. From 12:00 to 13:00, teams conducted their negotiation in separate Skype meetings supervised by trained assistants. A one-minute video from the chairman initiated the session. Post-negotiation, participants had a 20-minute debrief, followed by a 40-minute written analysis of the interview conditions. They subsequently completed a "Project Questionnaire" by 8:00 AM the next day. The final deliverable was a team report, due one month later, comprising: (a) individual and peer analyses, (b) a merged team analysis, and (c) a transcript of the negotiation and debriefing.

Materials

The main sources for the research included the Big Five personality test answer sheets completed by the participants. The Skype meetings from 12:00 to 14:20 on the simulation day were fully recorded by the assistants, providing voice and video files for eight teams, which were primary sources for our data analysis. Additional sources included audio files sent by participants to the assistants after the negotiation and in response to 10 questions. Also, each team member was required to submit a reflection questionnaire with 30 questions by 8:00 am the following day. The researchers enforced these deadlines to reduce recall errors and capture the participants' emotional state. The open-ended nature of the questionnaires allowed for in-depth responses in the participant's own words, offering insight into their

understanding of the situation. Due to the questionnaires' unstructured and qualitative nature, reliability and validity measures were not applicable. The final source was the negotiation report prepared by each team.

Procedure of Data Gathering

This study employed a problem-based learning (PBL; Hmelo-Silver, 2004) framework, structured in three phases. The initial phase introduced organizational behavior concepts—such as crisis management, negotiation, and emotion regulation—through instructor-facilitated activities. The second phase was the core simulation event, conducted on Skype for its recording and breakout room capabilities. The final phase consisted of two reflective activities (detailed in Figure 3), designed to consolidate learning and promote long-term knowledge retention.

Coding scheme

We needed an initial theory-driven top-down codebook based on existing literature to identify various influence tactics for our project. These are the steps we followed to develop the initial version of the codebook:

1. We conducted a search for articles relevant to our topic and compiled an online file containing the most pertinent ones. Simultaneously, we completed our list of synonyms and keywords to aid in our search.
2. We reviewed abstracts and categorized the articles accordingly.
3. We identified different influence techniques, tactics, and strategies mentioned in previous literature. Also, we recorded all noteworthy information while saving the corresponding references.
4. Using deductive reasoning or a top-down approach, we created an initial codebook by categorizing and subcategorizing the tactics.
5. We deliberated on the categories with researchers to ensure that the sections were distinct enough to prevent overlap in coding. Additionally, we included additional comments to provide clearer definitions for any ambiguous categories.

Results

We first elaborate on the codes derived from the context of this study. Each code is provided with an explanation and an example induced from the data. The total codebook is provided at the end of the results section.

Relational Strategies

In negotiation, relationship strategies focus on creating and strengthening healthy, long-term relationships between negotiation parties. These strategies are formed by trust, mutual respect and collaboration, and aim to build a sense of security in the other party. For example, showing interest in the needs of the other party, avoiding deceptive tactics and focusing on problem-solving rather than short-term self-centered advantages are all among these strategies. Specially for negotiations that require future cooperation, this approach has a significant impact.

Active Relational Strategies

These strategies include explicit and deliberate actions which focus on strengthening relationships between both parties. As an example, active listening to the opinions of the other party, asking open-ended questions to better understand their needs and feelings or suggesting solutions that shows empathy and interest in solving their problems, are part of this approach. This procedure also affects interactions positively and creates an environment based on trust and collaboration.

Using Reciprocal Exchange. This tactic includes offering discounts or services in order to create a sense of obligation or commitment, so that the other party feels under debt and enhanced responsibility, and gets persuaded to collaborate. The two below examples provide illustrations as to how this code is used in influencing others in negotiations. As an example, "*The basis of our plan in the first stage is to somehow leverage our influence with that organization-whether through the favors you provide for them or the connections you have with them-in order to persuade them so they refrain from their previous position and accept responsibility and apologize for spreading fake news*".

Having Legitimate Power. This code refers to using the power individuals have based on their official position, company rules or organizational contracts. Each party can convince the other that accepting their condition is necessary because of the existing regulations or organizational power. An example is when one says: "*I am the owner and the manager of this company and Mr. Z has 20 percent of its equity. Neither of us wants this company to face any losses*".

Coalition. This tactic includes building an alliance with other individuals or groups in order to strengthen power and intensify influence and pressure on the other party. By attracting the support of a third party, negotiators increase their bargaining leverage; e.g., "*That's okay, and we will do that. But I want you to respect me and X's opinion on this matter too, and what we see as appropriate may be something you don't see from your perspective*."

Passive Relational Strategies

These strategies focus on indirect or unclear behaviors that help improve relationships implicitly and indirectly. For example, avoiding negative or maladaptive feedback, bearing silence in a meeting to reduce tension, or even using positive body language (for example, smiling or making eye contact) without speaking, are part of this category. These strategies are commonly used to manage the emotions of other parties and create a sense of calmness in the negotiation atmosphere.

Leaving the Decision to Others and Withdrawing Oneself. This tactic refers to decreasing contributions and active participation in the negotiation and leaving space for other parties to reach the final decisions. This strategy is usually applied to decrease tension, create an environment of cooperation and avoid direct conflict. As an example: "*We can have you as the supervisor for now and for the next week, we can think about it later*."

Relational & Emotional Strategies

These strategies are a combination of emotion management and relationship creation, and they specifically focus on influencing by building emotional connections. For example, showing empathy for the problems of others, using positive language and gratitude, and even talking about personal issues, such as mutual interests, can increase trust and sincerity. These tactics help people to feel they have been understood and, consequently, motivate them to collaborate more. Managing negative emotions such as anger or disappointment is also part of this maneuver.

Hard Relational & Emotional Strategies

These strategies include tactics which influence others through emotional pressure or strong feelings. For example, showing controlled anger, creating a sense of anxiety or worry about the consequences of a decision, or even using heavy silence in order to induce feelings of guilt fall into this category. These methods are usually applied when a person wants to direct the other towards his/her own desired direction, albeit caution should be taken in order to prevent any potential harm to the relationship.

Threatening Others. Using direct or indirect threats to scare people and persuade them to accept the conditions of the other party; e.g., "*If we get into the blacklist, there will be no organization left anymore and not only will we all become unemployed, but also all of our capital will get destroyed. It makes us lose the organization we built just because of a few spoken words or a simple mistake*."

Threatening to Leave the Meeting. Expressing the intention of leaving the negotiation session with the purpose of building a mental pressure and speeding up the decision process. An example of this code is when one says: "*There is really no reason for me to stay in this discussion any longer unless we can reach an agreement on this issue*."

Blaming Others for Lack of Responsibility. Transferring responsibility for failure or problems to the other party or third parties to weaken their position. This tactic is getting used in order to divert attention from one's own shortcomings and place the other side on the defensive; e.g., "*I expected people to use their own power resources more and at least put me in a certain predicament, but this did not happen*".

Exaggeratedly Taking Something as an Insult. An extreme reaction to a simple comment or action and conversion of it to a personal offense in order to put the other party under pressure; e.g.: "*This suggestion of yours shows that you have no respect for my efforts*".

Accusing Others of Selfishness. Expressing that the other party only cares about his/her own profits in order to question their opinion's validity: "*Look, it's not really fair to dismiss them only because they expressed their personal opinion and a journal publication quoted them correctly or incorrectly. It can have negative organizational consequences for us".*

Insulting Others. Using harsh language to weaken the opponent and gain an advantage over the opponent. This tactic aims to provoke emotional reactions, shake the other party's confidence, or shift the focus away from the main issue by creating tension or intimidation: "*Because you argue like this, it seems like I have been personally insulted, that is my inference*".

Giving Rewards. Using material or non-material rewards (such as praise or promotion) as leverage for persuading the other party to accept the conditions: "*Agreeing to this proposal now could put you in a great position for future collaborations with our company*."

Soft Relational & Emotional Strategies

These strategies focus on creating positive feelings and friendly and sincere environments. For instance, showing sympathy, thanking for the other party's time and effort, or creating a sense of safety and comfort in negotiations are in this category. This approach is especially effective when the purpose of using it is for reinforcing trust and creating long-term relationship. Soft strategies make the other party feel valued and tend to cooperate more. An example is where one says: "*I really appreciate your time and the effort you've put into this. I just want to make sure we're both feeling comfortable moving forward*."

Ingratiation. This tactic involves compliments or showing affection along with good manners in order to please the other person, beyond their efforts and contributions; e.g.: "*Now Mr. X, you are more in charge and more experienced*".

Showing Empathy. Understanding and expressing support for the other person's feelings to create a deeper connection. As an example; "*We know that the previous boss was a very good boss. However, I'm really upset that these things happened in the last two or three days and that Mr. Bayat wasn't aware of the company's interests and talked like that. Especially since my relationship with him was becoming more intimate and personal*".

Using Inspirational Appeal. Presenting a motivating perspective to encourage the other party to cooperate. This tactic aims to inspire action by appealing to emotions, values, or ideals such as integrity, purpose, or a shared mission: "*Excellent, thank you very much my friends for attending this meeting. I hope that together, we make a decision that is in the best interest of the company, its members, and its future*".

Using Referent Power. Appealing to personal credibility, experience, or position to influence. This tactic relies on the respect, admiration, or authority the speaker holds to gain trust and shape the other party's decisions without needing direct persuasion: "*As I said the final opinion will be Mr Bayat's opinion. I have already presented my arguments*".

Using Religious Beliefs/Swearing to God. Appealing to religious values or divine oaths to increase the sincerity of statements. This tatic can create a powerful emotional bond and it makes it harder for the other party to doubt or challenge the speaker's intentions: "*Unfortunately, we have no other choice. The reputation of the holding matters. If we even ignore our own company's prestige, the reputation of the holding will be tarnished*".

Motivational Speeches. Using inspirational speeches to stimulate the motivation of the other party. These speeches aim to energize, uplift, and emotionally engage the listener: "*We've faced challenges before and come out stronger—this is our moment to rise above and make it happen!*"

Express Gratitude for Past Services. Thanking the other party for their previous cooperation or efforts to strengthen the relationship: "*I have learned so many things from him and we are definitely going to have him as a board advisor, invitee of the board or as part of this organization. After all, he has worked very hard and we shouldn't ignore the efforts of such individuals*".

Cognitive Strategies

Cognitive strategies relate to how individuals think and process information during a negotiation. These strategies include using logic, deeply analyzing the situation, and presenting compelling reasons to support their opinions. For instance, using detailed information and statistics, comparing different scenarios, and offering creative solutions can influence the other party's thinking. These strategies are especially effective when the other party is looking for logical and reasoned reasons in order to make a decision; e.g.: "*According to last quarter's data, our customer retention increased by 25% after implementing this approach. If we apply the same method here, we're likely to see similar growth trends*".

Using One's Expertise. Using specialized knowledge, skills or personal experience to increase the validity of opinions and influence on the other party; e.g.: "Based on the data we've gathered from over 200 successful projects, this approach consistently delivers the best results."

Guiding People by Rhetorical Questions. Asking questions that seem obvious in order to indirectly lead the other party to your point of view. This approach creates a conversational flow that feels collaborative rather than pushy, making it easier to build consensus; e.g.: "*Isn't it clear that we all want the most efficient outcome possible?*"

Using Information Power. Controlling or disseminating key information to strengthen your negotiating position; e.g.: "*We have access to the latest industry forecasts, and they clearly indicate a downturn—this gives us a strong reason to renegotiate the terms*".

Using Rational Persuasion. Presenting rational reasoning or logic based to prove the correctness of your opinion This strategy relies on facts, evidence, and structured arguments to appeal to the other party's sense of reason and objectivity; e.g.: "*If we reduce operational costs by just 10%, our profit margin will increase by at least 5%—the numbers clearly support this decision*".

Understanding Others' Opinion First. Listening to the other party's point of view and understanding them before expressing their own opinion in order to build trust and decrease resistance; e.g.: "*As Mr. Z is older than me I prefer that he says his opinion first and then I will tell you*".

Cognitive Emotional Strategies

Cognitive emotional strategies are a combination of logic and emotion and they help parties be influenced rationally as well as emotionally. These strategies include using data and rational analyses besides infusing positive emotions or sympathy. For example, presenting a logical argument alongside expressing the emotional impact of a decision can persuade the other party to accept your point of view. This is especially true in situations where there is a need to balance rationality and emotion to resolve conflict. These strategies help build trust and mutual understanding and can lead to positive, lasting outcomes. An example is where one says: "*Based on our analysis, this plan will reduce costs by 15%, but more importantly, it ensures job security for the entire team — and that's something we all care deeply about*".

High Positive Cognitive-Emotional Strategies

These strategies focus on inducing strong positive and motivating emotions in the other party. For example, using sincere praise, showing excitement and enthusiasm for the collaboration, or providing logical reasons that create a sense of hope and future opportunities fall into this category. This approach effectively increases the other party's motivation and encourages them to accept the proposals or joint decisions; e.g.: "*Your team's creativity has been truly impressive, and with our combined strengths, I'm confident we can create something groundbreaking together. The potential here is enormous*".

Trust Building Through Benevolence. Showing benevolence and honesty in behaviors for strengthening the trust of the other party; e.g.: "*I want to be transparent with you; I've taken your concerns into account because I genuinely want this to work well for both sides*".

Collaborative Decision Making. Involving the other party in the process of decision making in order to create a sense of ownership and shared commitment; e.g.: "*How about we list all the options together and decide which one works best for both of us*?"

Active Listening & Positive Feedback. Paying full attention to what the other party is saying and providing positive confirmation for strengthening the relationship; e.g.: "*Your opinion is very interesting. It looks like you have a lot of experience in this area*".

Soothing Bitterness with Kind Words. Using a compliment or friendly words before bringing up sensitive topics; e.g.: "*We appreciate our previous CEO as he made positive changes in the company, but the political climates such that this interview could end up being very damaging for us*".

Alleviating Problem Difficulty. Breaking the problem into smaller pieces or offering simple solutions for reducing the stress of the other party. This approach helps maintain a positive atmosphere and encourages collaboration, even when the task seems daunting; e.g.: "*Let's tackle the easiest part first, and the rest will feel much more manageable*".

Moderate Cognitive-Emotional Strategies

These strategies are a combination of logic and gentle emotions that influence the other party in a balanced way. For example, presenting logical arguments along with expressing neutral or mildly positive emotions, or using language that is both rational and friendly, fall into this category. This approach is useful when the goal is to balance rationality and emotions to reach an agreement and avoid provoking strong reactions; e.g.: "*I see where you're coming from, and I agree this solution makes sense logically. Let's also make sure it feels right emotionally, so we both feel confident and move forward*".

Trust Building Through Ability. Showing practical skills and abilities to prove competence and gain the other party's trust. This approach builds credibility by demonstrating results and reliability; e.g.: "*You've seen how I managed tight deadlines before—I'm confident we can make this happen together*".

Trust Building Through Expertise. Using technical knowledge or relevant education for increasing the credibility of the opinion. This approach strengthens trust by demonstrating authority and deep

understanding; e.g.: "*Given my experience in this field, I can assure you that this approach is both scientifically sound and practical*".

Reminding of Ethical Issues. Invoking ethical principles to influence the decision of the other party. This approach not only highlights moral considerations but also aligns choices with shared values to encourage responsible decision-making; e.g.: "*Before we move forward, let's make sure this aligns with the ethical guidelines we stand for*".

Using Complicated Terms to Intensify Words. Saying simple concepts with technical or complex words to increase the seriousness of the statements. This approach adds weight to the message by creating a perception of expertise or sophistication; e.g.: "*Our findings are predicated on a comprehensive inferential synthesis, not just surface-level observations*".

Filtering Out Undesirable Options. Limiting options to what the person is willing to accept, without explicitly rejecting other offers. This approach gently steers the decision toward the most reasonable choice and it keeps the conversation positive and focused; e.g.: "*Out of the possibilities we've discussed, this one clearly aligns best with our goals*".

Persisting on One's Position. Insisting on one's position to force the other party into submission because of weariness; e.g.:

"Y: I will take the responsibility for it so rest assured. If I fail to do this, I will resign my position.

X: But your resignation will take one of our valuable team members from us.

Y: Then be assured as I really believe in my work and negotiation skills that I know I can solve this problem and none of these problems we discussed right now will arise and the sense of commitment that CEO has to this company naturally develop in employees and there is no danger threatening us".

Acquiring Guarantee to Accept an Opinion. Requesting a written or verbal commitment to carry out the proposal. This approach builds trust and accountability and it ensures that both sides are clear on the next steps; e.g.: "*Let's get this in writing so we both know exactly what's expected*".

Using Collective Words. Expressing opinions with plural pronouns (such as "we") to create a sense of community in decision making; e.g.: "*If we all pitch in and tackle this together, we'll get it done faster and no one has to go it alone*".

Highlighting Similarities. Pointing out commonalities between your opinion and the other party to strengthen your position; e.g.: "*I know you value clear communication as much as I do, so I'll keep everyone in the loop at every step*".

Emphasizing Vagueness of Consequences. Downplaying the negative consequences of a decision to reduce the fear of the other party; e.g.: "*Look, there's a chance that things won't be perfect, but chances are you'll be fine—so let's not overthink it*".

Emphasizing Quick Agreement. Encouraging the other party to accept quickly before they reconsider or change their mind. It's about gently pushing for a decision while keeping things light and confident, so they feel comfortable moving forward; e.g.: "*We should make a decision as soon as possible as the next meeting is going to start and we cannot think about this case for a long time*".

Reminding Time Pressure or External constraints. Forcing opponent(s) to lower their expectation by reminding about external determinants like time constraint, law, superior norms, etc. to reach consensus sooner; e.g.: "*We only have 30 minutes left before the offer expires, so we need to come to an agreement now*".

Postponing the Decision. Postponing the final answer to gain time or more information. This tactic can be used strategically to reduce pressure, reassess options, or wait for a more favorable moment to decide; e.g.: "*I think we should hold off on this decision until we have the latest market analysis next week*".

High Negative Cognitive-Emotional Strategies

These strategies include infusing extremely negative emotions such as fear, hopelessness or anxiety to the other party. For instance, stressing the undesirable consequences of decision-making, using heavy silence for implementing mental pressure or expressing negative truths in a way to make the other person worried, fall into this category. This approach is usually used when someone wants to make the other party to change his mind or action, but it should be used with caution to avoid any damage to the relationship. An example is when one says: "*If we don't act now, the entire project could fail, and everyone's efforts will be wasted*".

Attacking Others' Words. Rejecting or sharply criticizing the other party's views by pointing out apparent flaws or contradictions in their statements; e.g.: "*What you're saying doesn't add up and contradicts the facts we've already established*".

Attack to Others' Expertise. Belittling the other person's knowledge or experience to question the validity of their opinions; e.g.: "*With all due respect, your limited background in this field makes it hard to trust your judgment on such a complex issue*".

Attack to Others' Reasoning. A strong criticism of the logic and arguments of the other party by pointing out the instability or flaws in their analysis; e.g.: "*Your proposal overlooks key market trends and relies heavily on outdated statistics, which makes your conclusions unreliable*".

Bolding Mistakes in Others' Arguments. Highlighting blunders or misinformation in the other party's statements to weaken their position. By pointing out inaccuracies clearly and confidently, it can shift the momentum of the negotiation in the user's favor; e.g.: "*Your timeline doesn't add up — the project can't be completed in three weeks based on the resources you've outlined*".

Guarantee to Avoid Problems & Promise Future Alternatives. This tactic includes offering guaranties for decreasing risk and offering substitution options in the future to persuade the other party; e.g.: "*I will try to bring in the legal team for the upcoming meetings so with their help we can find the best plan for both gaining some leverage over the journal and minimizing the advantages we give them. In this way, we can achieve a win-win negotiation. So please don't worry about this matter at all*".

Taking Benefits or Avoiding Future Risks. This approach is to develop the idea that current decision can lead to long-term profits or prevent potential risks; e.g.: "*By securing this contract now, we'll protect ourselves from market fluctuations that could cost us dearly down the line*".

All codes are themed and categorized into a concise table (see Table 1).

Table 1. Summary of influence tactics in terms of macro and micro-level codes, their definition and their example

Macro-Level Codes			Micro-level Codes	Definition	Example	Symbol
Relational Strategies	Active		Using reciprocal exchange	Influencing others by giving them something so that they will return the favor back immediately or in the future.	"If you accept this condition, we will also show flexibility in payment deadlines."	RA1
			Having legitimate power	Influencing others because of one's formal position or authority in an organization or society.	"According to Article 5 of the contract, this is a non-negotiable issue."	RA2
			Coalition	Forming a smaller group of people who agree to act together and use their collective power to force the remaining others to accept something or act similarly	"Our supplier group also agrees with this approach and considers it necessary."	RA3
	Passive		Leaving the decision to others and withdrawing oneself	Stepping back and refraining from being actively involved in a group decision making process.	"This is your decision. I will be neutral on this."	RP
Relational & Emotional Strategies	Unethical	Hard (Direct)	Threatening others	Expressing or suggesting a threat of harm, danger, etc.	"If you don't agree, we will cancel the project."	REH1
			Threatening to leave the meeting	Attempting to control and change the power dynamic of the team, where all of the sudden, everyone must console and appease the threatener	"If this condition is not acceptable to you, I have to end this meeting."	REH2
			Blaming others for lack of responsibility and imposing all problems on other(s)	Transferring responsibility for failure or problems to the other party or third parties to weaken their position.	"This problem was caused by the lack of cooperation of your team."	REH3
			Exaggeratedly taking something as an insult relative to oneself	An extreme reaction to a simple comment or action and conversion of it to a personal offense	"This language of yours is not appropriate for this meeting."	REH4
			Accusing other(s) that they only think about themselves	Expressing that the other party only cares about his/her own profits	You only care about your own needs and don't consider ours at all.	REH5
			Insulting others	Using sardonic language	"This idea of yours is completely impractical and useless!"	REH6
		Soft(indirect)	Ingratiation	Praising insincerely or too eagerly.	"I am always honored by your honest support on projects."	RES1

		Ethical	Hard (Direct)	Giving Rewards	Returning for good that is offered or given for some service or attainment	"If you accept the offer today, you will receive an additional ten percent discount."	REH7
			Soft (Indirect)	Showing empathy	The action of being sensitive to, understanding, and showing care to others, when they are experiencing or have experienced problems.	"I understand how stressful this has been for you."	RES2
				Using inspirational appeal	Appeal designed to evoke enthusiasm or emotion. When someone arouses our enthusiasm for an issue by touching our values or what we want to become or obtain, they are using inspirational appeal.	"With your cooperation, we can make a big difference in this area."	RES3
				Using referent power	Influencing others due to their admiration, respect, or identification with us.	"Given my 20 years of experience in this field, this approach is the most effective option."	RES4
				Using religious beliefs, Swearing to God	Pressuring through using values, morals and religious beliefs	"I swear to God, this is my final offer."	RES5
				Motivational Speeches	Encourage others that they can do something although they may think they cannot	"I believe in your ability to lead this change. Everyone is counting on you to take the next step."	RES6
				express gratitude for past services	Thanking the other party for their previous cooperation or efforts to strengthen the relationship.	"Thank you very much for helping us with the previous project. We need your experience this time too."	RES7
	Cognitive Strategies			Using one's expertise	Influencing others to listen because of one's skill or knowledge in a particular field	"As I have 15 years of experience in this field, this method is the best option."	C1
				Guiding people in one's desired way by asking rhetorical questions (Socratic)	Using argumentative dialogue based on asking and answering questions in effort to highlight common beliefs and opinions between discussants.	"Do you really think this approach will reduce costs?"	C2
				Using information power	Influencing others because one has more information about the topic.	"New data shows this strategy is 30% more effective."	C3
				Using rational persuasion	Using logical arguments and factual evidence to prove something is worth considering or not.	" Our analysis shows this investment has a 20 percent return".	C4
				Understanding other's opinion first before revealing one's point of view	Hiding one's thoughts away from others until after they explicate their viewpoints, to adopt responses accordingly	"I want to know how you look at this matter before I say my opinion."	C5
Cognitive Emotional Strategies			High Positive	Trust Building Through Benevolence	Showing benevolence and honesty in behaviors for strengthening the trust of the other party	"I want to be transparent with you; I've taken your concerns into account because I genuinely want this to work well for both sides"	CEHP1
	Cognitive Emotional Strategies		High Positive	Collaborative decision making	Including everyone in the decision-making process to reach consensus and shared commitment to the decisions.	"Let's explore together how to solve this challenge."	CEHP2
				Active Listening and giving positive feedback	Being a mindful and focused member in the decision-making process, welcoming others to express their thoughts more.	" Sounds great! I have heard the remarks of both gentlemen."	CEHP3
				Soothing the bitterness of words by saying something nice	Using soft answers to decrease the harshness of critiques and making others imply more to one's suggestions.	"I always appreciate your attention to detail. If you'll allow me to give my opinion on this..."	CEHP4
				Alleviating the level of difficulty of a problem	To make problems associated with a decision seem less severe than anticipated.	" This challenge looks big, but with small steps, we can manage it."	CEHP5

Moderate	Trust Building Through Ability	Showing practical skills and abilities to prove competence and gain the other party's trust.	"You've seen how I managed tight deadlines before—I'm confident we can make this happen together"	CEM1
	Trust Building Through Expertise	Using technical knowledge or relevant education for increasing the credibility of the opinion.	"Given my experience in this field, I can assure you that this approach is both scientifically sound and practical"	CEM2
	Reminding of ethical issues	Mentioning ethical issues to stimulate other's emotion and change their mind.	"This decision may conflict with our work values."	CEM3
	Using Complicated Terms to Intensify Words	Using jargon and complicated expressions that are difficult for others to understand, to intensify the effect of one's words	"This approach requires holonomic?? Analysis and systemic interactions."	CEM4
	Filtering Out Undesirable Options	Highlighting one's favorite option(s) or distracting others from one's undesired option(s)	"Between these two options, the first is certainly more cost-effective."	CEM5
	Persisting on One's Position	Continue stating an opinion repeatedly in spite of difficulty or opposition until others get tired and accept.	"I still believe this is the only way."	CEM6
	Acquiring guarantee to accept an opinion	Providing assurance of the decision to be made, often with a promise to fulfill obligations. Guarantee that one can avoid problems, and giving promises	"If you agree, we should record this agreement in the contract."	CEM7
	Using Collective Words	Using words such as "we" instead of "I" to intensify the strength of one's propositions.	"We must take this risk to achieve our goals."	CEM8
	Highlighting Similarities	Focusing on similar backgrounds and common experiences with others in the meeting to strengthen one's position.	"Like you, I care about the quality of the project."	CEM9
	Emphasizing Vagueness of Consequences	Showing there is a lack of preciseness and high risk in what is being thought or decided upon.	"It is impossible to predict the exact results of this action, but it is not a serious risk."	CEM10
	Emphasizing Quick Agreement	Insisting decisions to be made soon to avoid possible disagreements in the future.	"If we agree today, we can launch the project tomorrow."	CEM11
	Reminding others about time pressure or external constraints	Forcing opponent(s) to lower their expectation by reminding about external determinants like time constraint, law, superior norms, etc. to reach consensus sooner.	"We have to finalize by the end of the hour."	CEM12
	Postponing the Decision	Refraining from making a decision and leaving it to perhaps an unknown future because maybe others will resist less and downgrade from their interest later.	"Let's postpone this discussion until the next meeting."	CEM13
High Negative	Attacking to others' words	Attacking and cutting down others word to weaken their position.	"This suggestion of yours is completely untenable and has no connection to reality!"	CEHN1
	Attack to others' expertise	Attacking to other's skills and knowledge to decrease the others' expertise power.	"You don't have a single piece of credible evidence in this area; how can you claim this method is correct?"	CEHN2
	Attack to Others' Reasoning	Attacking to others' reasoning and justifications to undermine the strength of their rational.	"Your argument is based on false assumptions, and you did not provide any real data to support it."	CEHN3
	Bolding Mistakes in Others' Arguments	Trying to correct others' mistake to weaken their words and power.	"You misread the report numbers! It's 30%, not 50%."	CEHN4

Figure 1 presents the frequency of code usage in descending order. Based on the analysis, the codes highlighted in dark blue were those that used 80% of the total codes using. The three most frequently applied codes were C4 (Using rational persuasion), REH1 (Threatening others) and C2 (Guiding people in one's desired way by asking rhetorical questions). Due to brevity, additional analyses based on this codebook are provided in a separate manuscript (blinded authors, submitted) showing the impact of personality on choosing influence tactics, and also the blend of different influence tactics that can be

effective in convincing the other party, at different timepoints of the time-pressured high-stakes interaction.

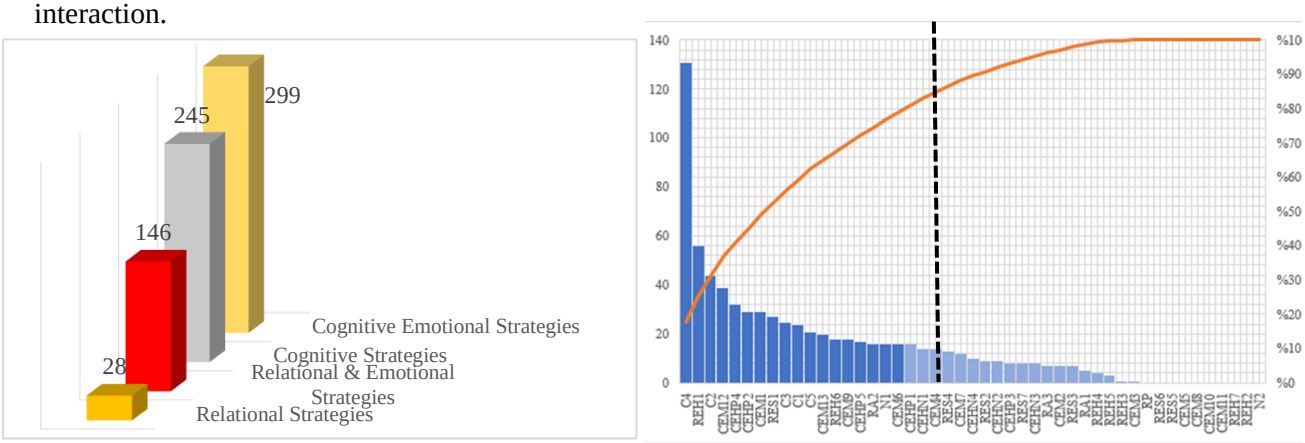

Figure 1. Total number of times each code was used by all individuals and groups

Discussion and Conclusion

The present research aimed to create a comprehensive taxonomy of influence and persuasion techniques in a time-pressured, high-stake simulated online business collaboration. Traditional taxonomies of influence, often derived from controlled settings or retrospective surveys, may fail to capture the multi-modal, and often improvised nature of strategic communication under duress.

Influence in Modern Digital Environments

A key strength of this research is its online, time-pressured setting, which reflects modern remote work challenges. The constraints of a one-hour deadline and limited non-verbal cues led participants to rely heavily on cognitive and cognitive-emotional persuasion tactics. In such conditions, participants relied predominantly on cognitive (Cognitive Strategies = 245 uses) and cognitive-emotional tactics (Moderate = 156, High Positive = 102). The findings indicate that effective virtual influence requires a blend of rational argument and emotional intelligence. Specific tactics like rational persuasion (C4), rhetorical guidance (C2), and empathic support (RES2) were particularly successful, likely because they provide the clarity and emotional calibration that replace missing in-person cues. This aligns with the broader understanding that both logical structure and emotional awareness are essential for productive remote collaboration.

Real-World Authenticity and Simulation Validity

A critical advantage of this research is that unlike lab-based or survey-driven persuasion studies, this study used a rich, role-based simulation that mirrored the complexity of real corporate crises, including mixed motives, individual goals, role conflict, and time constraints. This authenticity allowed us to observe naturally occurring persuasion tactics, including subtle micro-tactics like withdrawing from influence or strategically delaying decisions.

A Comprehensive Model of Influence Tactics

The key contribution of this research is the development of a comprehensive, empirically-derived taxonomy of influence tactics, inductively observed and deductively analyzed within the context of a time-constrained, emotionally-tense online crisis simulation. While established frameworks—such as Cialdini's principles of persuasion, Feser's tactical typologies, and the Persuasion Knowledge Model (PKM)—provide valuable structured lists and rules, they are often presented as static, context-neutral inventories. This study directly addresses this gap by demonstrating how classical principles are dynamically adapted, sequenced, and hybridized in real-time by practitioners. It captures tactics unique to a digitally-mediated environment, where the limited level of non-verbal cues, the pressure of a ticking clock, and the high cost of miscommunication force a wise blend of cognitive argumentation with emotional appeals.

What tactics dominated?

By looking at Figure 1, we discover that three tactics account for most of the influence moves used by participants: rational persuasion (C4), threatening others (REH1), and rhetorical questions (C2). The prominence of these tactics mirrors Feser's (2016) 'Nine-Influence-Tactics' model. Their dominance here suggests that teams try to default to the same tactics in prior models even under time-pressured

high-stake negotiations (Cialdini, 2001; Feser, 2016). We also showed for the first time that rhetorical questions (C2) repeatedly served as softeners to hard tactics like pressure, a combination that we didn't find in former studies. Also, finding that participants rely so heavily on data and rationality is aligned with earlier findings that show that negotiators default to logic whenever possible (Hindriks, Jonker, & Tykhonov, 2011). The results also show that hard tactics are still used commonly. As we can see in data, threats were the second most frequent tactic and right after that, rhetorical questions appear, which are considered a soft tactic.

From single codes to broader families

If we aggregate all our code into 4 macro-levels (Figure 5) we will see this order of use: 1. Cognitive-Emotional strategies, 2. Cognitive strategies, 3. Relational & Emotional strategies, and 4. Pure Relational strategies. What we discover from this data is the fact that participants most often paired evidence with a brief emotional cue and did not rely purely on facts or purely on rapport. This finding is supported by a previous study shows that a similar "head-and-heart" blend predicts faster convergence in other distributed teams (Alnuaimi, Robert, & Maruping, 2010), but here quantified second-by-second. Within the Relational-and-Emotional family (Figure 6), hard tactics (≈ 82) outnumbered soft tactics (≈ 64) but they both remained secondary to data-led approaches. An interesting finding was the very low count for Pure Relational tactic, that is supported by Guadagno and Cialdini's (2009), who noted that online settings strip away many cues which are necessary for personalizing persuasive appeals. Without eye contact or informal side-remarks, teams may see little value in purely social comments and instead lean on data plus brief emotions, as our Cognitive-Emotional totals show.

Limitations and Future Research

Similar to other research, this study faces several limitations. The sample was limited to 24 students from similar backgrounds, potentially limiting generalizability. The one-hour simulation, while useful, cannot fully replicate the prolonged pressure of real corporate emergencies. Furthermore, the analysis focused solely on verbal tactics, omitting critical nonverbal cues and measuring success primarily through agreement rates and tactical counts rather than decision quality or longitudinal learning. Future research will need to address these gaps by building a richer, multimodal model of digital persuasion. Planned extensions include integrating video coding for nonverbal cues (gestures, facial expressions, vocal qualities) and employing physiological measures like Galvanic Skin Response (GSR) bracelets to correlate emotional arousal with specific influence tactics and decision shifts. We also aim to explore the cognitive underpinnings of persuasion through immediate thought-listing prompts to understand the mental justifications for accepting or rejecting influence.

Conclusion

In conclusion, this study successfully developed a comprehensive, empirically-derived taxonomy of influence tactics within a simulated, time-pressured online collaboration, thereby addressing a significant gap in the literature. Unlike static, context-neutral models, the findings demonstrate how classical principles of persuasion are dynamically adapted and hybridized in real-time under the constraints of digital mediation. The research reveals that effective influence in such environments is predominantly a cognitive-emotional endeavor, characterized by the strategic blending of rational argumentation notably rational persuasion and rhetorical guidance with calibrated emotional appeals, such as empathic support. This "head-and-heart" approach emerged as a functional adaptation to the absence of non-verbal cues and the pressures of high-impact deadlines. While hard tactics like threats remained prevalent, their frequent coupling with softer rhetorical questions illustrates a novel tactical sequencing previously unobserved. Ultimately, the study confirms that authentic, complex simulations are vital for capturing the multi-modal reality of strategic communication, advancing our understanding of influence in modern remote work contexts.

Declarations

Author Contributions

All authors contributed actively to the conception, design, and execution of the research.

Data Availability Statement

We have permission to analyse and publish the simulation data results. Publishing videos, images, voice recordings and any other identifiable data from the simulation is not permitted. Anonymous data is accessible upon request.

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Ethical considerations

Informed consent to use written and verbal data for research purposes was obtained from all participants prior to the simulation. It was clearly stated that verbal data will be recorded and/or analyzed for academic research purposes, and participants were given the option to refuse their data to be recorded at any time prior, during or after the event.

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Conflict of interest

None.

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The Effectiveness of a Unified Transdiagnostic Cognitive and Emotional Self-Regulation Program on Reducing Externalizing Problems in Preschool Children with Behavioral Disorders

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ABSTRACT

Externalizing behavior problems in preschool children may represent part of normal developmental behaviors; however, if they persist, they can lead to serious psychological and social difficulties in the future. Deficits in emotional self-regulation are key factors in the development of such problems. The present study aimed to investigate the effectiveness of a unified program based on transdiagnostic treatment, focusing on teaching cognitive and emotional self-regulation skills, in reducing externalizing behavior problems among preschool children with behavioral disorders. An experimental single-subject design was employed and conducted in a preschool center in Shahrekord. The statistical population consisted of all preschool children aged 5 to 6 years with behavioral disorders who were enrolled in preschools in Shahrekord during the 2024-2025 academic year. Sampling was performed through purposive sampling based on specific criteria. The research instruments included the Achenbach Child Behavior Checklist (1991) and the Shields and Cicchetti Emotion Regulation Checklist (1997), completed by mothers during the three phases of baseline, intervention, and follow-up. The intervention program was conducted in ten sessions and consisted of two separate sections for children and parents. The parent sessions lasted 45 to 60 minutes, and the child sessions lasted 20 to 30 minutes. The findings indicated that after implementing this program, the children's behavioral symptoms showed considerable improvement across multiple dimensions, particularly in the externalizing behavior and emotional regulation subscales. The results demonstrated the effectiveness of the unified cognitive and emotional self-regulation program in reducing externalizing behavior problems and improving emotion regulation skills in preschool children.

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Introduction

Externalizing behavior problems encompass a wide range of maladaptive behavioral patterns that, in children, primarily manifest as impulsivity, oppositional behavior, emotional instability, aggression, or irritability (Achenbach et al., 2016). These behavioral patterns, in addition to their negative impact on the child's daily functioning, are associated in the short term with consequences such as interpersonal relationship difficulties and academic inefficiency (Kulkarni et al., 2021).

To better explain these patterns, it is necessary first to refer to the characteristics of behavioral disorders in the preschool period. Behavioral disorders refer to a persistent pattern of oppositional and aggressive behaviors that lead to impairment in children's functioning. Preschool children with behavioral disorders are five times more likely to experience these difficulties later in life (Axelrad et al., 2013). The preschool period is of particular importance because it involves extensive changes in social, cognitive, and behavioral domains, which can significantly affect a child's developing experiences related to school and learning (Yoder & Williford, 2019).

Although such behaviors are considered normative and transient phenomena in early childhood, their persistence and intensity can signal enduring problems that deviate from the natural course of development (Lassen et al., 2025). Furthermore, evidence indicates that externalizing behavior problems frequently co-occur with other psychological disorders, particularly internalizing behavior problems. This comorbidity can lead to broader consequences in personal, academic, social, and mental health domains (Oh et al., 2020).

If these behavioral patterns are not addressed through appropriate early interventions, they may persist throughout development and gradually give rise to more severe difficulties in adulthood (Olivier et al., 2020). Long-term outcomes such as antisocial behaviors (Pagani et al., 2025), engagement in criminal activities (Cammisso et al., 2024), and even vulnerability to suicidal ideation (Duncan et al., 2025) have been documented in this field. Estimates suggest that approximately 6.5% of preschool children experience externalizing behavior problems (Lassen et al., 2025).

In explaining this comorbidity, some researchers have emphasized the role of shared underlying mechanisms across both categories of problems (Oh et al., 2020). In this regard, Santens et al. (2020) identified emotional self-regulation as a transdiagnostic factor contributing to both externalizing and internalizing problems. The transdiagnostic approach, by focusing on shared underlying mechanisms across disorders, encompasses a wide range of emotional and behavioral difficulties (Kennedy et al., 2018). Although the primary goal of this treatment is to reduce emotional problems, given its focus on emotion regulation skills and considering the difficulties children with externalizing behaviors often face in this domain, its effectiveness in reducing behavioral problems has also been supported (Barlow et al., 2017).

To better understand the function of the transdiagnostic approach, it is essential to consider the nature of self-regulation. Self-regulation is a multidimensional construct resulting from the interaction between cognitive and emotional processes, which cannot be fully separated from one another (Edossa et al., 2018). Accordingly, self-regulation is viewed as a multilayered process through which an individual simultaneously responds to emotions while organizing cognitive resources to manage challenging situations. This ability involves processes such as response inhibition, sustained attention, modulation of emotional intensity, and behavioral expression (Liew & Zhou, 2022).

Through emotional self-regulation, an individual can select or modify situations, direct attention, and adjust behavioral and physiological responses. This skill develops by the preschool years and remains relatively stable thereafter (Rademacher & Koglin, 2019). Emotional self-regulation is considered one of the core components of many therapeutic

programs aimed at reducing behavioral problems. In this context, transdiagnostic treatment, while teaching emotion regulation skills, also addresses related cognitive aspects and demonstrates adaptive ways of expressing emotions and behaviors (Ghasemzadeh et al., 2021).

Building on these findings, Grossman and Ehrenreich-May (2020), in a case study, applied transdiagnostic treatment to an eight-year-old child exhibiting anger and irritability symptoms. The results indicated that this intervention was also effective in reducing externalizing behavior problems. In a quasi-experimental study, Arfaoui et al. (2022) implemented emotion-focused cognitive-behavioral therapy among 50 children and adolescents aged 9-18 years with behavioral disorders. This intervention led to a reduction in behavioral problems and improvement in emotion regulation among participants. Similarly, Kakolaki et al. (2024), in a quasi-experimental study, examined the effectiveness of transdiagnostic treatment on behavioral problems in 30 children aged 8-10 years with internalizing symptoms. The results showed a stable decrease in behavioral problems among the experimental group.

Despite growing evidence of the effectiveness of transdiagnostic interventions, limited data are available regarding the impact of this approach on preschool children. This is noteworthy, as the preschool period represents a critical stage in emotional and behavioral development, and early intervention during this stage plays a vital role in preventing the persistence and exacerbation of problems later in life. Moreover, many traditional interventions designed for behavioral problems have not adequately addressed the underlying emotional and cognitive factors contributing to their emergence, highlighting the necessity for research in this area.

Given that transdiagnostic treatment emphasizes shared underlying mechanisms and simultaneously teaches emotional, cognitive, and behavioral regulation, its application as an integrated and effective approach in preventive and therapeutic interventions becomes significant. Accordingly, the present study aimed to examine the effectiveness of an integrated cognitive and emotional self-regulation program based on transdiagnostic treatment in reducing externalizing behavior problems among preschool children with behavioral disorders.

Method

Research Design and Participants

The present study employed an experimental design using a single-subject methodology. The statistical population consisted of all preschool children aged 5 to 6 years with behavioral disorders who were enrolled in preschools in Shahrekord during the 2024–2025 academic year. Sampling was conducted through a purposive method based on specific inclusion criteria. Initially, among the preschools in Shahrekord, the “Shaghayegh” preschool which expressed willingness to cooperate in the implementation of the program was selected. Subsequently, all children in this center were screened using the Achenbach Child Behavior Checklist (CBCL). Through this process, five children (four girls and one boy) who met the initial eligibility criteria were identified.

Afterward, the parents of these children were provided with detailed information regarding the purpose, rationale, and procedures of the intervention, and their questions were addressed. Diagnostic interviews based on the Diagnostic and Statistical Manual of Mental Disorders (5th ed. text rev.; APA, 2022) were then conducted with the selected children and their parents. However, the mother of one child (a boy) declined to participate in the sessions, and therefore he was excluded from the intervention. Another child (a girl) was also removed from the study due to being absent from more than two sessions. Ultimately, three girls remained as the main participants in the study sample.

Children were included in the study if they met the DSM-5 diagnostic criteria for behavioral problems, were within the preschool age range (5-6 years), and had a normal level of intelligence (as documented in their psychological records). In addition, their parents provided

both written and verbal informed consent to participate in the study. Conversely, children who, along with behavioral problems, also exhibited other disorders (such as mood or psychotic disorders), were taking psychiatric medication and/or receiving other psychological interventions, were absent for more than two sessions, or whose parents were unwilling to continue participating in the sessions were excluded from the study.

Measurement Tools

Achenbach Child Behavior Checklist (CBCL). This instrument was developed by Achenbach (1991) to assess externalizing behavior problems in children and was standardized in Iran by Minaee (2006). The preschool version of this checklist demonstrated a test–retest reliability coefficient of 0.85. Construct validity was reported as 0.94, and both content and criterion validity were also found to be satisfactory (Achenbach & Rescorla, 2000). In the study conducted by Yazdkhasti and Oreyzi (2011), Cronbach's alpha coefficients for the parent, teacher, and child forms were reported to be 0.90, 0.93, and 0.82, respectively, indicating high reliability. Construct validity was also evaluated as appropriate for this tool.

The checklist consists of two parts. The first part includes 13 items assessing the child's general competencies in activities, social interactions, and academic performance. The second part comprises 113 items that measure the child's emotional and behavioral problems. For data analysis, raw scores, percentile ranks, and T-scores are calculated. T-scores are determined based on the child's age and gender and identify borderline and clinical ranges. In the present study, this checklist was completed by the child's mother to assess externalizing behavior problems.

Shields and Cicchetti Emotion Regulation Checklist (ERC). This instrument, developed by Shields and Cicchetti (1997), consists of 24 items and includes two subscales: (1) Lability/Negativity, which assesses inflexibility, sudden mood changes, and disproportionate emotional reactions. a higher score on this subscale indicates greater mood instability and emotional reactivity; and (2) Emotion Regulation, which evaluates emotional management skills, including appropriateness of emotions to situations, empathy, and emotional self-awareness. a higher score reflects greater emotion regulation ability.

Items are rated on a 4-point Likert scale ranging from 1 (never) to 4 (always), with total scores ranging from 24 to 96. Cronbach's alpha coefficients indicate high internal consistency (0.96 for Lability/Negativity and 0.83 for Emotion Regulation). The subscales have shown negative correlations of −0.50 and −0.48, respectively, with the Aggression and Attention Problems subscales of the Teacher Form of the Achenbach Behavior Checklist, demonstrating acceptable discriminant validity. Moreover, the ERC's positive correlation (0.16) with the Peabody Picture Vocabulary Test supports its convergent validity. The Persian version of the checklist was standardized by Mahmoudi et al. (2016), with an overall reliability coefficient of 0.64, and its content validity was also reported as satisfactory. In the present study, the checklist was completed by the child's mother to assess the child's emotional self-regulation skills.

Procedure

In this study, an integrated emotional self-regulation program designed by the researcher was implemented. This intervention program was based on the transdiagnostic treatment approach and consisted of ten sessions divided into two sections; one for children and one for parents. Both groups received training related to cognitive and emotional self-regulation skills. In addition, the parent group received education on parenting and behavioral management skills. The content validity of the intervention program was evaluated by ten experts in the field of child mental health and emotional–behavioral disorders. Based on their judgments, the

Content Validity Ratio (CVR) of the intervention program was calculated as 0.98, indicating a high level of expert agreement regarding the necessity of the program content.

The parent sessions were conducted online, one day before the children's sessions, and lasted 45 to 60 minutes each. The sessions for children were held in person and lasted 20 to 30 minutes. The intervention program included structured session content, assignments, worksheets, and practical exercises. Worksheets and materials required for in-session activities were designed and prepared in advance. Furthermore, mothers were provided with supplementary exercises and assignments to be completed outside of the sessions. The main emphasis throughout the sessions was placed on the emotion of anger, frustration-inducing situations, and anger-triggering experiences. Details of the therapeutic session content are presented in Table 1.

Table1 Program Therapeutic Content

Session	Section	Content
1	**Child**	Familiarization with the structure and rules of therapy, introduction to emotions and their facial expressions, understanding the functions of emotions
	Parent	Familiarization with the structure of therapy, introduction to the three-component model of emotion, identification of emotional behaviors with emphasis on the anger cycle
	Joint	Practicing identification of emotions and their facial expressions
2	**Child**	Learning the three-component model of emotion, recognizing emotional behaviors, and learning to rate emotional intensity
	Parent	Learning emotion-focused parenting behaviors, introduction to the dual-tracking process (before, during, and after), opposite parenting behaviors: strategic attention
	Joint	Guiding parents in the use of strategic attention
3	**Child**	Learning opposite behaviors in response to emotional reactions; tracking emotions and behaviors
	Parent	Teaching opposite parenting behaviors, distress tolerance training, opposite parenting behaviors: adaptation and reward system
	Joint	Practicing distress tolerance and guiding parents in the use of reward systems
4	**Child**	Developing awareness of bodily cues, body scanning, and sensory exposure to bodily signals of anger and irritability
	Parent	Teaching bodily cues, body scanning skills, opposite parenting behaviors: expressing empathy
	Joint	Practicing body scanning and guiding parents in expressing empathy
5	**Child**	Teaching flexible thinking and identifying cognitive traps
	Parent	Teaching flexible thinking and cognitive traps, opposite parenting behaviors: effective commands
	Joint	Practicing identification of cognitive traps
6	**Child**	Teaching detective thinking
	Parent	Introducing detective thinking and cognitive flexibility, opposite parenting behaviors: effective disciplinary methods
	Joint	Practicing detective thinking
7	**Child**	Teaching and practicing problem-solving skills, identifying what can and cannot be controlled
	Parent	Introducing problem-solving skills, shaping and supporting problem-solving at home, opposite parenting behaviors: healthy autonomy support
	Joint	Practicing problem-solving and healthy autonomy support
8	**Child**	Teaching and practicing present-moment awareness, recognizing situational emotions
	Parent	Introducing present-moment awareness, opposite parenting behaviors: healthy emotional modeling
	Joint	Practicing present-moment awareness
9	**Child**	Teaching the logic and structure of exposure; practicing exposure to emotional situations
	Parent	Reviewing exposure principles and opposite parenting behaviors
	Joint	Practicing exposure exercises
10	**Child**	Reviewing learned skills, planning for coping with intense emotions in the future, reviewing treatment gains
	Parent	Reviewing learned skills, planning to support children in managing intense emotions
	Joint	Celebrating the child's progress

Before implementing the intervention, behavioral indicators and emotion regulation skills of the participants were measured using the Achenbach Child Behavior Checklist (Parent Form) and the Shields and Cicchetti Emotion Regulation Checklist during three separate baseline assessments. During the intervention phase, evaluations were conducted weekly and at the end of each session to monitor the child's behavioral and emotional progress. After the intervention, two follow-up assessments were carried out at one-month and three-month intervals to examine the stability of the effects.

Data were analyzed using a single-subject ABA design framework, meaning that data were evaluated across three stages; baseline, intervention, and follow-up. The results were reported through visual analysis and quantitative indices commonly used in single-subject research

Results

Table2 Demographic characteristics of participants

			Frequency	Percentage
Child	Gender	Girl	3	100
		Boy	0	0
		Total	3	100
	Age	5 years to 5 years and 6 months	2	66.6
		5 years and 6 months to 6 years	1	33.4
		Total	3	100
Parent	Gender	Female	3	100
		Male	0	0
		Total	3	100
	Age	20–30 years	0	0
		30–40 years	2	66.6
		40–50 years	1	33.4
		Total	3	100
	Education	Diploma	0	0
		Bachelor's degree	3	100
		Master's degree	0	0
		Total	3	100
	Employment status	Employed	2	66.6
		Housemaker	1	33.4
		Total	3	100

Based on the demographic data (see Table 2), all children who participated in the study were girls. In terms of age distribution, two children (66.6%) were in the age group of 5 to 5 years and 6 months, and one child (33.4%) was in the age group of 5 years and 6 months to 6 years. Their exact ages were 5 years and 2 months, 5 years and 3 months, and 5 years and 6 months, respectively. Among the parents, only mothers participated in the study, and no fathers were present. Regarding the mothers' age distribution, two participants (66.6%) were between 30 and 40 years old, and one participant (33.4%) was between 40 and 50 years old.

An examination of parents' educational levels showed that all of them held a bachelor's degree, indicating a uniform educational background within the sample. Concerning employment status, two mothers (66.6%) were employed, while one (33.4%) was a homemaker. These findings indicate that the sample group was homogeneous in terms of the children's

gender and parents' educational level, but there were slight variations in the mothers' age and employment status.

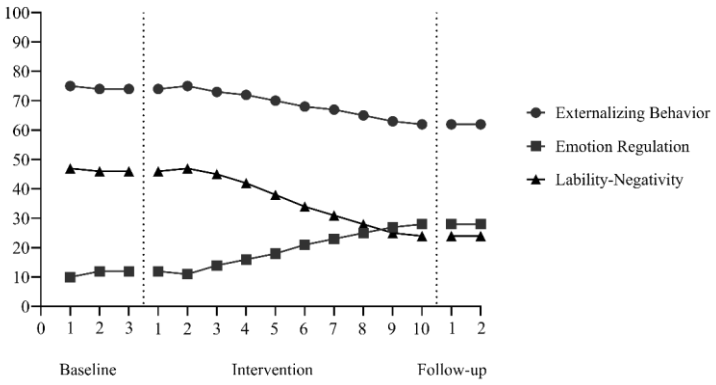

Figure1. Behavioral and Emotional Indicators Scores of Subject 1

An examination of the score trends for the first participant shows that the indices of externalizing behavior and lability/negativity demonstrated a decreasing trend throughout the implementation of the intervention program. In contrast, the emotion regulation index showed an increasing trend over the course of the sessions. During the follow-up stages, the values of these indices remained stable, showing no significant changes compared to the end of the intervention. This pattern is illustrated in Figure 1.

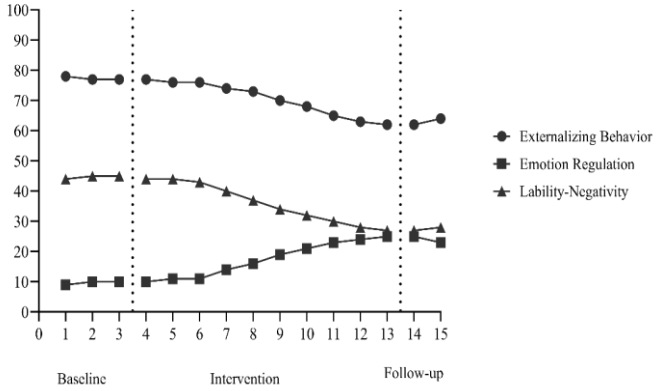

Figure2. Behavioral and Emotional Indicators Scores of Subject 2

According to the data presented in Figure 2, the externalizing behavior scores of the second participant show a decreasing but relatively moderate trend. Likewise, the lability/negativity index decreased during the intervention phase. The emotion regulation index also increased compared to the baseline phase. The changes observed during the follow-up phase were slight but remained stable.

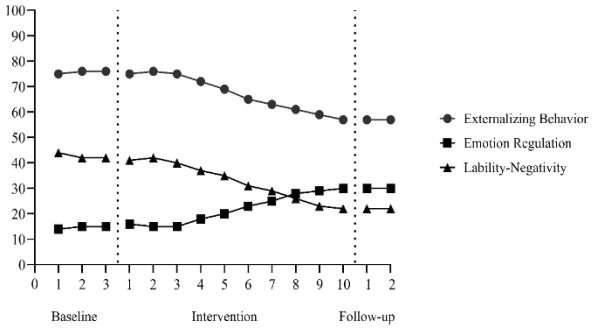

Figure3. Behavioral and Emotional Indicators Scores of Subject 3

An examination of the score trends for the third participant shows that the indices of externalizing behavior and lability/negativity decreased during the intervention period. In addition, the emotion regulation index demonstrated an increasing trend compared to the baseline phase. The changes recorded during the intervention phase were largely maintained at the same level in the follow-up period. These data are presented in Figure 3.

Table3 Visual analysis of inter-phase changes in the Achenbach Behavior Checklist

Step	Statistical indicators	Externalizing Behavior		
		Child1	Child2	Child3
Baseline	Number of Session	3	3	3
	Mean	74.33	77.33	75.67
	Middle	74	77	76
	Range	74-75	77-78	75-76
	Stability Envelope[a]	59.2-88.8	61.6-92.4	60.8-91.2
	Trend direction[b]	Descending	Descending	Ascending
	Relative level change[c]	-1	-1	1
	Absolute level change[d]	1-	1-	1
Intervention	Number of Session	10	10	10
	Mean	68.9	70.4	67.2
	Middle	69	71.5	67
	Range	62-75	62-77	57-76
	Stability Envelope	55.2-82.8	57.2-85.8	53.6-80.4
	Trend direction	Descending	Descending	Descending
	Relative level change	-8	-11	-14
	Absolute level change	12-	15-	18-
Follow-up	Number of Session	2	2	2
	Mean	62	63	57
	Middle	62	63	57
	Range	62-62	62-64	57-57
	Stability Envelope	49.6-74.4	50.4-75.6	45.6-68.4
	Relative level change	0	2	0
	Absolute level change	0	2	0
Baseline to Intervention	PND[e]	80%	90%	70%
	POD[f]	20%	10%	30%
	Relative level change	1-	1-	-1
	Absolute level change	0	0	-1
	Reliable change index[g]	21.4	26.85	32.79
	Improvement percentage	7.3%	8.9%	11.9%
	Cohen d	9.41	12.01	14.66

Note. a. Percentage of data points within ±25% of the median, reflecting phase stability
b. Overall slope of change (increasing, decreasing, or stable) across data points
c. Proportion of change from baseline to intervention relative to baseline level
d. Difference between the mean scores of two phases, showing the magnitude of behavioral change
e. (Percentage of Non-overlapping Data) Percentage of intervention data points that do not overlap with baseline; higher values indicate stronger effects
f. (Percentage of Overlapping Data) Percentage of overlapping points between phases; lower values reflect greater intervention impact
g. Indicates whether the observed change exceeds measurement error (|RCI| > 1.96 = significant)

Table 3 presents the visual and statistical indicators for the three participants across the baseline, intervention, and follow-up phases. In addition, data related to the between-phase analysis (baseline vs. intervention) are also reported. According to the ABA design, the scores of all three participants remained relatively stable during the baseline phase. However, with the beginning of the intervention phase, a consistent downward trend was observed in all participants. The mean scores of the participants decreased from 74.33, 77.33, and 75.67 in the baseline phase to 68.9, 70.4, and 67.2 in the intervention phase and further to 62, 63, and 57 in the follow-up phase.

Other indices confirmed this pattern. The relative level change during the intervention phase was −8, −11, and −14 for the three participants, all in the desired (decreasing) direction. The

absolute level change values were 12, 15, and 18, indicating a rapid reduction in scores immediately following the start of the intervention. The percentage of non-overlapping data (PND) was 80%, 90%, and 70%, showing that 70% to 90% of the intervention-phase data points fell outside the range of the baseline phase. In contrast, the percentage of overlapping data (POD) was low (10% to 30%), further supporting this finding.

The improvement percentage from baseline to the end of the intervention was calculated as 7.3%, 8.9%, and 11.9% for the three participants. The Cohen's d values ranged between 9.41 and 14.66, indicating a very large effect size. Similarly, the Reliable Change Index (RCI) values were 9.41, 12.01, and 14.66, all exceeding the critical value of ±1.96, suggesting that the observed changes were stable and clinically meaningful. The data trend in the follow-up phase remained stable or slightly declining, indicating the maintenance of therapeutic gains in the absence of ongoing sessions.

Overall, the general pattern of data and indices demonstrates that the emotional self-regulation program effectively led to a sustained reduction in externalizing behaviors among preschool children with behavioral disorders.

Table4 Visual analysis of inter-phase changes in the Shields and Cicchetti Emotion Regulation Checklist

Step	**Statistical indicators**	**Emotion Regulation**			**Lability/Negativity**		
		Subject1	Subject2	Subject3	Subject1	Subject2	Subject3
Baseline	Number of Session	3	3	3	3	3	3
	Mean	11.33	9.67	14.67	46.33	44.67	42.67
	Middle	12	10	15	46	45	42
	Range	10-12	9-10	14-15	46-47	44-45	42-44
	Stability Envelope[a]	9.6-14.4	8-12	12-18	36.8-55.2	36-54	33.6-50.4
	Trend direction[b]	Ascending	Ascending	Ascending	Descending	Ascending	Descending
	Relative level change[c]	2	1	1	-1	1	-2
	Absolute level change[d]	2	1	1	-1	1	2-
Intervention	Number of Session	10	10	10	10	10	10
	Mean	19.5	17.4	21/9	36	35/9	32/6
	Middle	19.5	17.5	21.5	36	35.5	33
	Range	11-28	10-25	15-30	24-47	27-44	22-42
	Stability Envelope	15.6-23.4	14-21	17.2-25.8	28.8-43.2	28.4-42.6	26.4-39.6
	Trend direction	Ascending	Ascending	Ascending	Descending	Descending	Descending
	Relative level change	11	12	13	-17	-13	-14
	Absolute level change	16	15	14	22-	17-	19-
Follow-up	Number of Session	2	2	2	2	2	2
	Mean	28	24	30	24	27.5	22
	Middle	28	24	30	24	27.5	22
	Range	28-28	23-25	30-30	24	27-28	22-22
	Stability Envelope	22.4-33.6	19.2-28.8	24-36	19.2-28.8	22-33	17.6-26.4
	Relative level change	0	-2	0	0	1	0
	Absolute level change	0	2-	0	0	-1	0
Baseline to Intervention	Absolute level change	0	0	1	0	-1	-1

	Relative level change	2	1	1	-1	-2	-2
	PND[e]	80%	90%	80%	80%	80%	90%
	POD[f]	20%	10%	20%	20%	20%	10%
	Reliable change index[g]	12.13	22.97	21.49	63.28	53.68	30.82
	Improvement percentage	72.1%	79.93%	49.28%	22.29%	19.63%	23.59%
	Cohen d	7.07	13.39	12.53	17.9	15.18	8.72

Note. a. Percentage of data points within ±25% of the median, reflecting phase stability
b. Overall slope of change (increasing, decreasing, or stable) across data points
c. Proportion of change from baseline to intervention relative to baseline level
d. Difference between the mean scores of two phases, showing the magnitude of behavioral change
e. (Percentage of Non-overlapping Data) Percentage of intervention data points that do not overlap with baseline; higher values indicate stronger effects
f. (Percentage of Overlapping Data) Percentage of overlapping points between phases; lower values reflect greater intervention impact
g. Indicates whether the observed change exceeds measurement error (|RCI| > 1.96 = significant)

The data from the Shields and Cicchetti Emotion Regulation Checklist are presented in Table 4. According to the ABA design, in the Emotion Regulation subscale, the mean scores for the participants during the baseline phase were 11.33, 9.67, and 14.67, respectively. With the onset of the intervention, the mean scores increased to 19.5, 17.4, and 21.9, and in the follow-up phase, they further increased to 28, 24, and 30. The data trend for all three participants was upward and stable, indicating a gradual and consistent improvement in emotion regulation ability.

In the Lability/Negativity subscale, the baseline mean scores for the participants were 46.33, 44.67, and 42.67, which decreased to 36, 35.9, and 32.6 during the intervention phase and to 24, 27.5, and 22 during the follow-up phase. The data trend in this subscale was consistently downward, reflecting a reduction in emotional instability and negativity.

Analysis of the quantitative indices revealed that the relative level change during the intervention phase in the Emotion Regulation subscale was +12, +12, and +11, while in the Lability/Negativity subscale it was −17, −13, and −14. The absolute level change for Emotion Regulation was −16, −15, and −14, and for Lability/Negativity it was 22, 17, and 19—all changes were in the desired direction. The Reliable Change Index (RCI) for the change from baseline to intervention was 12.13, 22.97, and 21.49 for Emotion Regulation and 63.28, 53.68, and 30.82 for Lability/Negativity, all exceeding the critical value of ±1.96, indicating stable and clinically significant changes.

The percentage of non-overlapping data (PND) for both subscales ranged between 80% and 90%, while the percentage of overlapping data (POD) ranged between 10% and 20%. The treatment improvement percentage for Lability/Negativity was 22.29%, 19.63%, and 23.59%, and for Emotion Regulation it was 72.1%, 79.93%, and 49.28%. The Cohen's d effect size was 17.9, 15.18, and 8.72 for Lability/Negativity and 7.07, 13.39, and 12.53 for Emotion Regulation, representing very large effect sizes across both subscales.

Overall, the data indicate that the integrated cognitive and emotional self-regulation program led to a sustained improvement in emotion regulation skills and a reduction in emotional instability and negativity among preschool children. Furthermore, these positive effects were maintained during the follow-up phase, confirming the stability of the treatment outcomes.

Discussion and Conclusion

The present study was conducted to examine the effectiveness of an integrated cognitive and emotional self-regulation program based on transdiagnostic treatment in reducing externalizing behavior problems among preschool children with behavioral disorders. The findings of this

single-subject study indicated that implementing this program can positively influence the improvement of emotional regulation and the reduction of behavioral problems in preschool children.

The results of the present research confirmed the fundamental role of emotional self-regulation in externalizing behavior problems, which is consistent with the findings of Fernandes et al. (2023). Similarly, in line with the studies of Grossman and Ehrenreich-May (2020) and Kakolaki et al. (2024), it was found that teaching emotional self-regulation strategies based on transdiagnostic treatment can reduce externalizing behaviors such as anger and irritability in children. Integrating parent training in behavioral management and parenting skills alongside emotional self-regulation training for children may enhance the overall effectiveness of behavioral interventions. A similar outcome was reported by Pham et al. (2024), who also observed the beneficial impact of parental involvement on child behavior outcomes.

The use of a transdiagnostic treatment approach which, rather than focusing on superficial symptoms, targets shared underlying mechanisms across disorders by teaching emotion regulation, cognitive flexibility, and exposure to negative emotions, resulted in deep and lasting changes in the study participants. Specifically, concurrent with a notable reduction in anxiety and an improvement in social interactions, behavioral problems also decreased significantly. Additionally, the active participation of the mothers in therapy sessions and their consistent practice of the learned skills at home were key factors contributing to the maintenance and generalization of the therapeutic effects.

Based on the findings of this study, the mechanism of therapeutic change can be interpreted as follows: the skills taught through this program reduce automatic behavioral responses and enhance the child's capacity for self-regulation, thereby increasing frustration tolerance. Consequently, the child learns to attend to emotions, use alternative interpretations, and consider available solutions in order to select more adaptive responses in challenging situations.

Therefore, the reduction in externalizing behavior problems cannot be solely attributed to decreased emotional intensity but may also result from the development of cognitive processing skills and the use of strategies such as flexible thinking, identifying cognitive traps, and problem-solving. These skills enable children to reinterpret emotional situations and respond in less aggressive and more adaptive ways. In this regard, Hosokawa et al. (2024) also emphasized the role of mechanisms such as cognitive restructuring and problem-solving in reducing externalizing behavior problems. They demonstrated that training children to identify and challenge negative or maladaptive thoughts and replace them with more adaptive strategies leads to improved emotion regulation and reduced impulsive reactions.

It is noteworthy that the findings of this study provide preliminary evidence for the program's effectiveness; however, as a proof-of-concept study, further research with broader samples is needed. The homogeneity of participants in terms of gender and mothers' education limits the generalizability of results to boys or children from different socio-economic backgrounds. Additionally, since only participating mothers completed the questionnaires, response biases such as social desirability or expectancy effects may have occurred. Future

studies are encouraged to include more diverse samples and use multiple information sources (e.g., teacher reports or independent observations) to improve data accuracy and validity.

Therefore, the results of this study should be interpreted with consideration of its limitations. The intervention was conducted in a preschool setting, where certain contextual factors such as staff movements, concurrent activities, and the presence of other children, sometimes disrupted the focus and order of the sessions. Additionally, only mothers participated in the treatment, while the role of fathers in family interactions and behavioral reinforcement was not examined. Moreover, the study utilized a single-subject design with only three child participants, which limits the generalizability of the findings to other children or age groups. Broader studies with larger samples are needed for more robust conclusions.

Considering these limitations, several suggestions are proposed for future research. Involving both parents in the therapeutic process could increase the intervention's effectiveness and more comprehensively modify family maladaptive reinforcement cycles. Conducting the sessions in a suitable and controlled environment could minimize potential distractions and enhance session quality. Also, due to the limited generalizability of the results, implementing this program using controlled experimental designs, larger sample sizes, and long-term follow-ups could provide more accurate evidence of the program's effectiveness. Finally, although this study focused on externalizing behavior problems, examining both internalizing and externalizing symptoms in future research could offer a more comprehensive understanding of the program's effectiveness.

In conclusion, this study demonstrated that implementing a cognitive and emotional self-regulation intervention based on transdiagnostic treatment among preschool-aged children can effectively reduce externalizing behavior problems, enhance emotional self-regulation abilities, and improve relationships between the child, parents, and peers. These findings may serve as a foundation for developing early, targeted interventions for young children with emotional and behavioral difficulties, thereby contributing to the prevention of persistent disorders in later developmental stages

Declarations

Author Contributions

All authors equally contributed to the conception, design, data collection, analysis, and writing of this research.

Data Availability Statement

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

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Ethical considerations

All procedures of this study were conducted in accordance with the ethical principles outlined in international research guidelines. Informed consent was obtained from the parents of all participants, and confidentiality of their information was maintained throughout all stages of

the research. This study was approved by the Research Ethics Committee of the University of Tehran under the code IR.UT.PSYEDU.REC.1403.075 on August, 2024.

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Conflict of interest

The authors declare that there were no conflicts of interest in conducting this research.

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Unshackled Mastery: How Outcome-Freedom Preserves Working Memory and Protects Skill Automaticity in High-Pressure Performance

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ABSTRACT

High-pressure environments place heavy demands on working memory and executive control. This paper presents a theoretical integration of flow theory and Outcome Freedom (psychological detachment from results) to explain sustainable mastery under pressure. Drawing on evidence from attentional control theory, reinvestment research, working-memory studies, flow psychology, and the nonattachment literature, we develop the Unshackled Mastery model. The model proposes that optimal performance requires two interdependent elements: deep task absorption (flow) and psychological detachment from outcome-expectations (Outcome Freedom). Together, these processes preserve cognitive resources, maintain attentional flexibility, and protect skill automaticity even in high-stakes situations. Research in attentional control theory and reinvestment theory consistently shows that outcome-pressure disrupts cognitive control: anxiety consumes working-memory resources and reduces processing efficiency ((Eysenck & Calvo, 1992; Eysenck et al., 2007), while pressure triggers conscious monitoring of automated skills, undermining fluent execution (Masters & Maxwell, 2008). Evidence from nonattachment research further demonstrates that psychological detachment supports emotional stability, cognitive flexibility, and adaptive performance (Ho et al., 2022; Sahdra et al., 2010). These findings collectively underpin the Unshackled Mastery model. The framework predicts measurable differences in working-memory capacity, attentional flexibility, and neural activation patterns between outcome-attached and outcome-free performance states. We also outline how this model can be tested through psychometric development, neuroimaging studies, and randomised controlled trials across clinical, occupational, and athletic settings. This theoretical integration addresses a key gap: current models of burnout and performance optimisation treat flow, stress reactivity, and outcome-attachment as separate issues, lacking a unified framework that explains how they interact.

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Introduction

Across high-pressure environments operating theatres, sports arenas, classrooms, crisis negotiations the same pattern appears. People who perform well under pressure are absorbed yet steady: focused without strain, committed without desperation. Their effort is deliberate, but not driven by panic.

This pattern emerges across domains: the marathon runner who finds rhythm when their body should be breaking down, the clinician who remains grounded in the middle of an ICU crisis, the negotiator who succeeds precisely because they are not gripping the outcome. In each case, mastery depends less on sheer intensity and more on how freely a person can stay engaged.

The wider picture is less stable. Burnout rises not because people have become weaker, but because their sense of worth has become entangled with results. The World Health Organisation lists burnout as an occupational phenomenon, with mental-health–related productivity losses reaching twelve billion workdays a year (World Health Organisation, 2024). Global rates of anxiety and depression rose by roughly twenty-five per cent after recent societal upheavals (World Health Organisation, 2022).

This paper addresses a critical gap in current models of performance and burnout. The problem is not high effort, but what happens when outcomes dominate the mind. Once Identity–Outcome Fusion takes hold—when personal worth becomes tied to results—attention narrows, working memory crowds with threat, and automatic skills destabilise. Current approaches treat these as separate problems: flow research examines peak absorption without addressing outcome-driven desperation; mindfulness interventions reduce stress reactivity but don't target outcome-attachment; clinical burnout models describe symptoms without explaining the cognitive mechanisms by which chronic outcome-pressure depletes resources.

We present Unshackled Mastery: a theoretical integration that synthesises flow and Outcome Freedom to explain how sustainable high performance arises from the combination of deep engagement with psychological steadiness.

1.1 The Cognitive Problem: Why Outcome Attachment Syndrome Undermines Performance High-pressure performance environments demand peak cognitive functioning precisely when psychological pressure makes it hardest to deliver. Research in attentional control theory demonstrates that anxiety consumes working-memory resources, reducing cognitive efficiency even when performance outcomes remain intact (Eysenck & Calvo, 1992; Eysenck et al., 2007). Similarly, reinvestment theory shows that pressure triggers conscious monitoring of automated skills, disrupting fluent execution and leading to choking under pressure (Masters & Maxwell, 2008).

Despite advances in understanding performance breakdown, we lack a unified framework that explains why Outcome Attachment Syndrome (OAS) specifically undermines both cognitive control and skill automaticity and what psychological mechanism protects against this degradation.

1.2 The Existing Landscape: Where Current Models Fall Short Existing approaches to performance optimisation and burnout prevention treat these as separate problems. Flow research examines peak absorption but rarely addresses what happens when flow becomes tied to desperate outcome-seeking (Csikszentmihalyi, 1990) (Nakamura & Csikszentmihalyi, 2002). Mindfulness interventions reduce stress reactivity but don't directly target the outcome-attachment that drives performance anxiety (Keng et al., 2011). Clinical models of burnout describe symptom profiles without explaining the cognitive mechanisms by which chronic outcome-pressure depletes mental resources (Maslach & Leiter, 2016). This paper addresses this gap by presenting an integrated model.

1.3 Research Aims and Model Overview This paper presents the Unshackled Mastery model: a theoretical integration of flow and Outcome Freedom to explain sustainable mastery under

pressure. The model proposes that optimal performance requires two interdependent components: deep task absorption (flow) full engagement with minimal self-referential processing and psychological detachment from outcome-expectations (Outcome Freedom) cognitive and emotional disengagement from outcome-contingency.

When combined, these components preserve working-memory capacity, maintain attentional flexibility, and protect automated skill execution even in high-stakes environments. This paper presents the theoretical foundations, proposed mechanisms, and validation pathways for the Unshackled Mastery model.

Method

Systematic Theoretical Integration

This paper employs a systematic theoretical integration methodology. Rather than conducting empirical research with new participant samples, we synthesise evidence across five major research domains to develop a unified explanatory framework. Theoretical integration is an established approach for advancing knowledge in psychology and cognitive science.

2.1 Integration Approach and Rationale The theoretical integration process involved three iterative phases: (1) mapping recurring cognitive mechanisms across major theories, (2) identifying conceptual overlap and critical gaps in existing models, and (3) specifying the propositions and testable predictions of the integrated model.

2.2 Literature Selection Strategy Literature was gathered through systematic searches of PubMed, PsycINFO, Scopus, and Google Scholar using combined search terms: flow, automaticity, reinvestment, working memory, outcome attachment, pressure, cognitive control, and nonattachment. Priority was given to peer-reviewed studies published within the past seven years, alongside foundational work where key constructs were first established. This approach identified three consistent patterns across all theoretical domains: (1) Working-memory strain under outcome-pressure (attentional control theory) (2) Disruption of automaticity through threat-focused monitoring (reinvestment theory) (3) Cognitive resource preservation through psychological detachment (nonattachment and acceptance-based research). The literature synthesis identified these convergent findings across independent research streams, suggesting they represent robust mechanisms rather than domain-specific effects.

2.3 Scope and Limitations of the Integration Method This theoretical integration synthesizes existing empirical literature but does not present new quantitative data. The validity of the integrated model depends on the quality and relevance of the source literatures. We prioritized peer-reviewed, empirically-grounded work while recognizing that the specific mechanisms of the integrated model require direct empirical testing (see Section 4.5: Future Research Directions).

2.4 Key Concepts and Definitions The model integrates both established constructs and new terms introduced in this theoretical framework. Core constructs such as flow, mindfulness, and nonattachment are grounded in existing empirical literature. New terms are defined below:

Outcome Freedom: The ability to stay fully engaged in a task while not tying self-worth to the result. Effort remains committed, but the outcome is not taken as a personal judgement.

Outcome Attachment Syndrome: A pattern where effort becomes driven by the need for a particular result, creating pressure, narrowing attention, and reducing cognitive flexibility.

Identity–Outcome Fusion is when a result begins to feel like a verdict on who you are. It tends to show up in three ways: (1) a global self-judgement triggered by a single performance moment, (2) your sense of worth rising or falling with the outcome, and (3) attention narrowing toward any hint of failure or judgement. This isn't the same as perfectionism, performance anxiety, or ego-involvement. Those can feed into it, but Fusion is the specific collapse of *"how*

I did" into *"who I am."* Outcome Freedom targets that collapse directly, separating personal worth from the outcome so a performance moment no longer becomes a verdict on the self.
Sustainable Flow: A form of flow supported by Outcome Freedom, allowing deep absorption to be maintained without overreaching, emotional volatility, or post-performance crash.
To reduce conceptual blurring, Table 1 outlines how Flow, Mindfulness, Nonattachment, Psychological Flexibility, and Outcome Freedom differ within this model.

Table 1. Conceptual distinctions between core constructs relevant to the Unshackled Mastery model

Construct	Primary focus	Relation to outcomes	Distinctive feature in this model
Flow	Deep task absorption and effortless involvement	Outcomes background/implicit	Emphasizes absorption; says little about identity stakes.
Mindfulness	Present-moment, non-judgmental awareness	Outcomes noticed but not central	Builds awareness; doesn't remove outcome-dependent self-worth.
Nonattachment	Letting go of clinging to experience	Outcomes held lightly	Broad, life-level stance; not performance-specific.
Psychological Flexibility	Values-based action despite discomfort	Outcomes matter but are not the driver	Allows distress; emphasizes values, not identity-outcome separation.
Outcome Freedom	Full engagement without tying worth to results	Outcomes inform learning, not identity	Performance-specific decoupling of worth from outcomes.

Results

The Integrated Model and Supporting Evidence This section presents the theoretical framework that emerged from systematic analysis across flow, attentional control, reinvestment, and nonattachment literatures. The analysis reveals how these previously separate domains interact to produce either performance degradation or sustainable excellence under pressure. Rather than reporting quantitative data, this section presents the integrated propositions and their evidence base from the synthesised literature.

3.1 The Vulnerability of Isolated Flow Analysis of flow literature reveals that flow states are characterised by hypofrontality and heightened dopaminergic activity, supporting automaticity and smooth execution (Csikszentmihalyi, 1990). A recent meta-analysis reported a moderate association between flow and performance (r=.31), accounting for roughly 10% of performance variance (Harris et al., 2023). The relationship is consistent, though the direction of causality remains unresolved.

Flow's limitation is simple: it has no built-in psychological safeguard. Without nonattachment, the same absorption that supports high performance can push individuals past their limits. Under identity outcome fusion, the attentional narrowing of flow begins to carry threat-monitoring with it. The state that should enhance performance starts to drain cognitive resources and leaves the individual depleted afterwards. Flow sharpens attention, but without protection it cannot sustain long-term performance.

Proposition 1: Flow without outcome-detachment is vulnerable to performance degradation and burnout under sustained high-pressure conditions.

3.2 Outcome Freedom: Evidence & Integrating Mechanisms - Analysis of nonattachment and detachment literature demonstrates that psychological disengagement from outcome-contingency directly addresses flow's vulnerability. Outcome Freedom the separation between effort and self-worth draws directly from the research on nonattachment. In practice, it gives flow the stabilising anchor it does not have on its own.

By removing identity-threat from performance errors, Outcome Freedom protects working memory from the threat-focused processing described in Attentional Control Theory (Eysenck et al., 2007). When failure no longer feels catastrophic, the cognitive load tied up in worry returns to the task. This keeps flow from collapsing inward into self-monitoring and reinvestment (Masters & Maxwell, 2008).

The empirical support is consistent. When Sahdra and colleagues developed the Nonattachment Scale (Sahdra et al., 2010), they found that individuals with higher nonattachment were happier, less anxious or depressed, and better at regulating their emotions. They also noted stronger empathy, generosity, and healthier relationships in day-to-day terms, people who aren't tied to outcomes tend to stay steadier emotionally and in their relationships.

A larger meta-analysis across forty-one studies involving more than twenty-four thousand participants showed the same pattern: those who stay engaged without clinging to results are calmer, more balanced, and cope with stress more effectively (Ho et al., 2022). Despite this, nonattachment remains largely absent from mainstream performance models.

Proposition 2: Outcome Freedom (psychological detachment from outcome-contingency) protects working-memory capacity by reducing threat-focused processing and preserves skill automaticity by reducing conscious monitoring.

3.3 The Integrated State: Unshackled Mastery The central finding of this theoretical integration is that Unshackled Mastery arises when high flow (absorption) combines with high nonattachment (Outcome Freedom). This integration resolves the usual tension between deep engagement and psychological steadiness. The result is Sustainable Flow—immersion that remains intense without becoming destabilising.

Flow anchors attention in the task, while nonattachment prevents identity from gripping the result. Together they create a performance state defined by clarity, steadiness, and full access to trained skill. There is no panic, no internal verdict, no collapse of working memory. The individual stays absorbed without turning inwards.

A 2024 meta-analysis of eleven randomised controlled trials involving 582 athletes (Si et al., 2024) found large, reliable effects: mindfulness increased by 1.08 SD, flow by 1.47, performance by 0.92, and anxiety dropped by 0.87. Mindfulness strengthens attention, speeds recovery from pressure, and increases the likelihood of entering flow. It supports the transition, but it does not complete it. Mindfulness builds awareness; flow turns that awareness into action. Unshackled Mastery brings the two together and holds them steady through nonattachment.

This integrated state aligns with findings in mindfulness research but focuses on a different mechanism. Mindfulness develops awareness but does not directly disrupt outcome-attachment or protect automaticity under pressure. Flow provides absorption but lacks psychological safeguard. Nonattachment alone can become passive if it is not paired with full engagement. Unshackled Mastery integrates these elements—absorption held in place by nonattachment producing a performance state that remains durable rather than depleting. Table 2 summarises how this integrated model emerges from evidence across five independent research domains. Each domain contributes a specific cognitive mechanism that, when combined, produces the properties outlined in Proposition 3.

TABLE 2. Theoretical Integration: How Five Research Domains Support the Unshackled Mastery Model

Research Domain	Core Finding	Contribution to Unshackled Mastery
Attentional Control Theory	Anxiety consumes working memory through threat-focused processing (Eysenck et al., 2007)	Outcome Freedom reduces threat-processing, preserving cognitive capacity for task focus
Reinvestment Theory	Pressure triggers conscious monitoring of automatic skills, causing choking (Masters & Maxwell, 2008)	Outcome Freedom prevents identity-threat from triggering reinvestment; automaticity remains protected
Flow Psychology	Flow enables absorption and performance (r=.31) but lacks safeguard against burnout (Harris et al., 2023)	Outcome Freedom provides the psychological stabilizer flow needs for sustainability
Nonattachment Research	Psychological detachment reduces anxiety and supports emotional regulation (Sahdra et al., 2010)	Core mechanism protecting cognitive resources and enabling steady performance under pressure
Working Memory Studies	Cognitive load under pressure reduces processing efficiency (Eysenck & Calvo, 1992)	Combined flow + nonattachment preserves available working-memory bandwidth

Proposition 3: High Flow combined with high Outcome Freedom produces a distinct state Unshackled Mastery characterised by preserved automaticity, stable working memory, and reduced psychological cost under pressure. Distinguishing Outcome Freedom from apathy. Outcome Freedom does not imply indifference to results. Standards and effort remain high; what changes is the meaning of the outcome.

Performance still matters, but the result is no longer treated as a verdict on personal worth.

Apathy lowers effort. Outcome Freedom preserves full engagement while removing identity threat. The model therefore predicts sustained task engagement not withdrawal when Outcome Freedom is present.

Discussion and Conclusion

4.1 Cognitive Mechanisms Supporting Unshackled Mastery

The integration reveals six cognitive mechanisms through which Outcome Freedom supports sustainable high performance:

4.1.1 Working Memory Preservation

Eysenck and Calvo's attentional control theory shows that anxiety consumes working-memory resources by pulling attention towards threat-monitoring rather than the task itself (Eysenck & Calvo, 1992). People may still perform adequately, but every action feels heavier because part of their cognitive capacity is tied up in forecasting potential failure. When outcome-pressure is high, this background threat-processing quietly drains bandwidth. When failure becomes psychologically survivable—when it no longer feels like a threat to self-worth—those resources return to the task. Research on psychological detachment points in the same direction: individuals who learn to mentally separate from work demands tend to be calmer, healthier, and more stable across wellbeing markers, even during periods of widespread stress (Blake et al., 2025). This is the first way Outcome Freedom restores cognitive efficiency.

4.1.2 Protecting Automaticity Reinvestment theory describes how pressure disrupts automatic skills by triggering conscious monitoring of movements that normally run smoothly (Masters & Maxwell, 2008). Within Unshackled Mastery, Outcome Freedom acts as the protective layer. When performance errors no longer feel like threats to identity, the urge to monitor each component of execution drops away. Automaticity is preserved. Skills express themselves as trained rather than being interrupted by self-evaluation in real time.

4.1.3 Maintaining Cognitive Flexibility Identity–Outcome Fusion narrows attention around a single plan. Instead of adjusting to changing conditions, the mind becomes fixated on forcing the original route, even when it clearly isn't working. Outcome Freedom prevents this constriction. It supports cognitive flexibility the ability to update strategies, shift focus, and respond to what is actually happening (Zainal & Newman, 2024). When outcomes are held lightly, attention remains open and adaptive instead of collapsing into rigidity.

4.1.4 Autonomic Balance The autonomic system reacts to pressure in the same way it reacts to threat. A certain degree of sympathetic activation is useful it sharpens focus and gets the system engaged but once activation pushes past the optimal point, performance starts to slip. The Yerkes–Dodson curve captures this clearly: performance peaks at moderate arousal and falls away when activation is either too low or too high (Yerkes & Dodson, 1908).

Acceptance-based research shows physiological calming lower cortisol, steadier HRV when people relate differently to internal pressure (Lindsay et al., 2018). Outcome Freedom reframes arousal not as danger but as readiness. This allows a person to stay alert enough to perform without tipping into the tension that undermines fine motor control and decision-making.

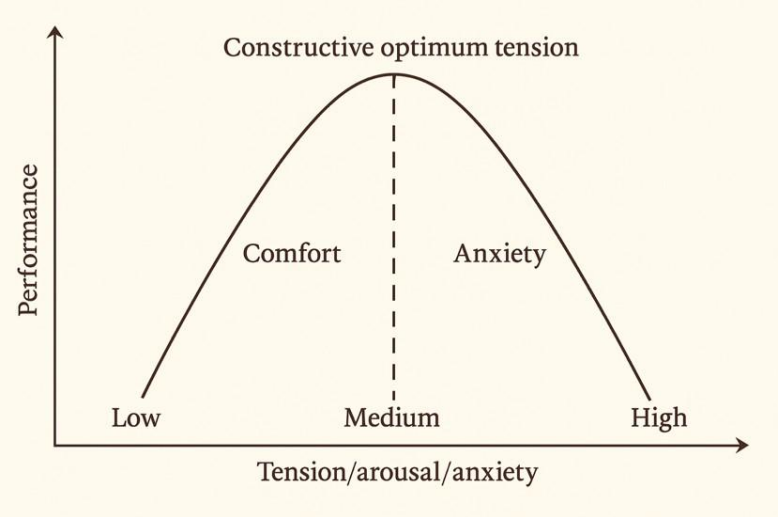

Figure 1. The Yerkes–Dodson "Sweet Spot" Curve.
Note. Performance rises with moderate activation, peaks at optimal arousal, and declines with under- or over-activation. Adapted by the author (Dr R. Shonpal, 2025), based on Yerkes & Dodson, 1908.

4.1.5 Intrinsic Motivation Sustained Self-Determination Theory highlights the three foundations of intrinsic motivation: autonomy, competence, and relatedness (Ryan & Deci, 2000). When outcomes become fused with identity, these foundations erode. Autonomy weakens when behaviour is driven by approval. Competence becomes fragile when self-worth rises and falls with results. Relatedness deteriorates when colleagues turn into comparisons. Outcome Freedom protects intrinsic motivation by keeping effort anchored in genuine interest rather than self-protection or external validation.

4.1.6 Accelerated Recovery Setbacks become heavier when they are interpreted as judgements of identity rather than simple events. Under Identity–Outcome Fusion, recovery involves dealing with shame as well as adjusting strategy. Outcome Freedom shifts the frame: failures remain information, not verdicts. This shortens recovery time and strengthens resilience. Research on psychological detachment shows that people who can mentally step back from outcome-pressure recover faster and maintain more stable wellbeing over time (Jin et al., 2025).

4.2 Relation to Existing Frameworks

Outcome Freedom our model's application of nonattachment to performance draws from mindfulness, non-attachment, and acceptance-based approaches, particularly Acceptance and Commitment Therapy's (ACT) concept of psychological flexibility. Where mindfulness builds present-moment awareness, Outcome Freedom trains how we hold the future learning to release the grip on results whilst staying fully invested in the process. Non-attachment eases craving; Outcome Freedom channels that steadiness into adaptive effort under pressure through a mechanism we term "Decoupling." ACT teaches people to work with distress whilst pursuing their values; Outcome Freedom aims to prevent that distress from arising by separating self-worth from results before the moment of strain, creating what might be called Neutral Excellence.

Unshackled Mastery grows from these foundations but carries them further. It turns equanimity from a meditative state into a practical resource for high performance completing the shift from awareness to resilient, embodied action. It brings together flow's energy and equanimity's steadiness into one state: full engagement with inner freedom intact.

The field has fragmented insights into flow, mindfulness, burnout, and equanimity, but has lacked a unified cognitive model explaining how these elements interact to produce either performance degradation or sustainable excellence under pressure. Unshackled Mastery provides this integration.

4.3 Applications across Domains

The model predicts measurable benefits in any high-pressure environment where sustained performance and psychological steadiness must coexist.

Healthcare offers the clearest example. Clinicians are expected to care deeply while staying emotionally intact. Mindfulness training in ICU settings produces moderate reductions in burnout (Sukmayanti et al., 2025), but it doesn't address outcome-attachment. Unshackled Mastery targets precisely this gap engaged care with identity protected from outcome-fusion. A testable healthcare intervention is a short Outcome Freedom exercise added to routine training, where clinicians briefly reframe outcome-linked self-judgements before shifts, which should reduce reinvestment and steady working-memory function under pressure.

Education shows a similar pattern. Flow during study predicts stronger academic results ($r \approx .43$; (Zhang & Qi, 2023)), yet grade-driven outcome-fusion remains the strongest driver of avoidance and anxiety. Training both flow and outcome-freedom could support learning and wellbeing simultaneously. A practical testable intervention is a brief pre-exam decoupling task in which students separate grades from self-worth; the model predicts lower test anxiety and reduced cognitive interference during assessment.

In workplaces and sport, mindfulness produces improvements in psychological health ($g \approx 0.6$–0.7; (Bartlett et al., 2019)). Nonattachment-based approaches improve relational functioning ($g \approx 0.21$; (Voldstad et al., 2025). The pattern is consistent: single-component interventions help, but integrated approaches that address the Flow × Outcome Freedom interaction are likely to produce stronger and more durable effects. A testable approach is to pair a flow cue with a short decoupling phrase practised during high-pressure simulations, which the model predicts will produce more consistent performance and slower burnout than flow-only routines.

Across domains, the same picture emerges: sustainable high performance comes not from increasing intensity but from combining deep engagement with freedom from outcome-contingency.

4.4 Strengths & Limitations Strengths of this integration include synthesis across five independent research domains, identification of convergent mechanisms, and clear propositions that generate testable predictions. The framework addresses a recognized gap in existing performance models and offers practical implications for diverse high-pressure contexts. Limitations should be noted:

Construct Validity. Flow and Outcome Freedom may not be as distinct as they appear. Both involve absorption, reduced self-talk, and lower anxiety. Statistical testing may reveal substantial overlap, reframing Unshackled Mastery as a refinement of existing constructs rather than a fully separate state. That would not diminish its practical value, but it would require reconsidering how the model is classified.

Causality. The direction of influence remains uncertain. Outcome Freedom may make entry into flow more reliable, or deep flow may ease outcome-gripping through reduced self-monitoring. The relationship may be bidirectional. Longitudinal and experimental designs are needed to clarify this, with implications for how training programmes are sequenced.

Individual Differences: Temperament, early attachment patterns, trait anxiety, neuroticism, and perfectionism may explain a significant proportion of variance. Some individuals naturally resemble the Unshackled Mastery profile, while others may require structured training to achieve the same balance. Differential responsiveness should be expected.

Cultural Generalisability Unknown: Most research comes from Western, Educated, Industrialised, Rich, Democratic populations (Henrich et al., 2010). In settings where group reputation, hierarchy, or economic risk dominate, the pressures around performance and the meaning of detachment may operate differently. Cross-cultural validation is essential before assuming broad applicability.

Measurement Challenges: Inner states are difficult to measure cleanly. Self-report is prone to misjudgement and social desirability. Proper testing requires multi-method assessment: behavioural indicators, physiological signals such as HRV and cortisol, and, where feasible, neurophysiological measures to verify the proposed working-memory mechanism.

4.5 Future Research Directions Unshackled Mastery integrates well-supported ideas, but the combined model has not yet been empirically tested. The next step is a structured research programme to determine whether it can be measured, trained, and sustained in real-world settings. The pathway below outlines five phases across the next decade.

Phase 1: Measurement Development (Months 1–12): The first phase will develop the Unshackled Mastery Scale (UMS) by adapting and combining existing flow and Outcome Freedom items. Validation will assess distinctiveness from flow, nonattachment, mindfulness, and psychological flexibility, including cross-cultural measurement invariance. Phase 1 will also test whether the Flow × Outcome Freedom interaction explains variance in performance and wellbeing beyond flow or nonattachment alone, and whether it can be distinguished from dissociation or avoidant coping via behavioural and physiological markers.

Phase 2: Mechanism Testing (Months 12–24): This phase empirically verifies the cognitive mechanisms. Studies will employ cognitive tasks under pressure, physiological monitoring (cortisol, HRV), and neuroimaging to identify neural correlates of integrated states. Experience sampling will track within-person fluctuations, testing if the interaction (Flow × Outcome Freedom) predicts unique benefits.

Phase 3: Intervention Development (Months 24–36): A structured Unshackled Mastery training programme will be created, with components compared against flow-only and Outcome Freedom-only interventions. The programme will be piloted, refined, and set instructor standards established for eventual delivery in accessible self-guided formats.

Phase 4: Efficacy Trials (Years 3–5): Large-scale, high-power ($N \geq 500$) Randomized Controlled Trials (RCTs) will compare Unshackled Mastery against established interventions, including Mindfulness-Based Stress Reduction (MBSR), Non-Attachment training, Acceptance and Commitment Therapy (ACT), and standard flow protocols. Trials will utilize objective performance metrics and include 6- and 12-month follow-up assessments.

Phase 5: Real-World Implementation (Years 5–10) Effectiveness will be evaluated across diverse high-pressure settings, focusing on key outcomes and cost-benefit analysis: Healthcare: Clinician burnout and patient outcomes; Education: Student engagement and teacher retention; Workplaces: Productivity, wellbeing, and leadership stability.

5. Conclusion A shift is underway in how high-pressure performance is understood. Many systems continue to chase excellence through escalating intensity—rewarding fatigue, celebrating overextension, and losing skilled individuals to burnout. One way to capture this relationship is to set it out plainly:

$$Flow * Outcome\ Freedom = Unshackled\ Mastery$$

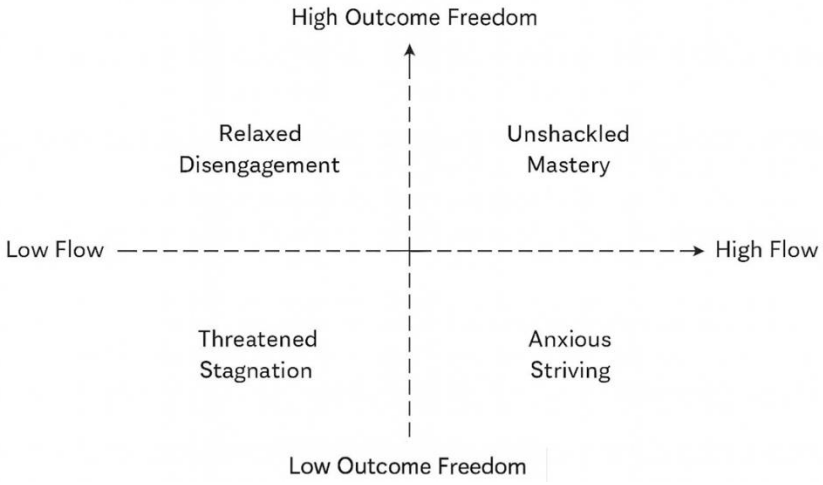

Figure 2. Flow × Outcome Freedom performance matrix.

Note. Horizontal axis = Flow (low → high); vertical axis = Outcome Freedom (low → high). Quadrants: (1) Low Flow × Low Outcome Freedom Threatened Stagnation; (2) High Flow × Low Outcome Freedom Anxious Striving (fragile flow); (3) Low Flow × High Outcome Freedom Relaxed Disengagement; (4) High Flow × High Outcome Freedom Unshackled Mastery. Conceptual schematic created by the author (Dr R. Shonpal, 2025).

Figure 2 shows how Flow and Outcome Freedom interact to produce distinct performance states. The quadrant in which both are high represents Unshackled Mastery: deep absorption held by psychological steadiness, allowing automatic skills to run cleanly under pressure. When outcomes are held too tightly high Flow with low Outcome Freedom performance becomes fragile and prone to collapse. When both are low, thinking narrows and engagement drops; when Flow is low but Outcome Freedom is high, people remain steady but under-engaged. The combination of high Flow and high Outcome Freedom offers the most reliable path to sustainable high performance.

Unshackled Mastery is not an abstract ideal. It describes a practical way of working: full commitment to the task while holding the result lightly. This loosening of identity from outcome reduces cognitive strain, restores working memory, and protects automaticity. The system reorganises itself attention steadies, adaptability returns, and recovery becomes quicker and more complete. Consistency grows from calm, not tension.

The potential applications span every domain where sustained performance under pressure is required. Clinicians who remain compassionate across decades, not years. Classrooms where mastery grows without fear. Organisations where people give their best without burning out. Homes where love is steady because it isn't tangled with performance.

The signs are already visible. When people stop fighting themselves, their best work emerges more naturally. Human performance aligns with human nature instead of battling against it.

The work ahead is straightforward, even if it's not simple: build the evidence, refine the training, and bring Unshackled Mastery into the environments that need it most. Measurement development, mechanism studies, intervention design, and real-world trials will take this from concept to practice.

However, the heart of the shift begins one person at a time. A surgeon whose hands stay steady because the outcome no longer defines them. A teacher who leads with presence rather than pressure. An executive whose clarity returns because the grip has eased.

Across high-pressure contexts clinical, educational, professional, or personal Unshackled Mastery offers a measurable shift: full attention without self-monitoring, sustained effort without identity-threat, and engagement without desperation. When flow and Outcome Freedom combine, performance quality increases while psychological cost decreases.

Declarations

Author Contributions

The author developed the model, reviewed the literature, and wrote the manuscript.

Data Availability Statement

No new data were collected. All sources are cited within the paper.

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Ethical considerations

This theoretical article did not require ethics approval or participant consent.

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Conflict of interest

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Developing a Model of Social Anxiety in Students Based on Maladaptive Cognitive Emotion Regulation Strategies with the Mediating Role of Negative Self-Talk

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ABSTRACT

The present study aimed to develop a model of social anxiety in students based on maladaptive cognitive emotion regulation strategies, examining the mediating role of negative self-talk. This descriptive-correlational study (using structural equation modeling) employed an applied research approach. The statistical population consisted of high school students (second period) in Ardabil during the 2023–2024 academic year. Using a cluster random sampling method, 251 students (119 boys and 132 girls) were selected. The data were collected through the Social Phobia Inventory (SPIN), the Cognitive Emotion Regulation Questionnaire (CERQ), and the Calvete Self-Talk Inventory (STI). Data analysis was conducted using SPSS-27 and AMOS-24 software. In this study, maladaptive emotion regulation strategies had a positive and significant effect on negative self-talk ($\beta = 0.804$, $p < 0.001$). Negative self-talk also significantly predicted social anxiety ($\beta = 0.527$, $p < 0.001$), and maladaptive emotion regulation strategies showed a direct and significant effect on social anxiety ($\beta = 0.528$, $p < 0.001$). The bootstrapping results further confirmed the significant mediating role of negative self-talk in this relationship ($\beta = 0.381$, $P<0.02$). The findings highlight the importance of psychological interventions aimed at reducing maladaptive emotion regulation strategies and negative self-talk. Educational programs based on emotion regulation and cognitive restructuring may effectively reduce students' social anxiety.

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Introduction

Social anxiety is one of the most common mental health problems among students and can lead to decreased academic performance, social withdrawal, and other psychological difficulties (Hatami Nejad, Noroozi Homayoon, et al., 2025). This disorder is characterized by an intense fear of social situations and a persistent concern about negative evaluation by others (Sadri Damirchi, Noroozi Homayoon, & Hatami Nejad, 2025a). During adolescence, social anxiety tends to intensify due to developmental and social pressures (Ritz et al., 2024). In Iran, studies have shown a notable prevalence of social anxiety among high school students, underscoring the need to examine its underlying factors. Maladaptive cognitive patterns and experiences may contribute significantly to the onset and persistence of this disorder (Zhao et al., 2024). Social anxiety is defined as an intense and persistent fear of social situations in which an individual may be exposed to judgment or negative evaluation(Salari et al., 2024). According to the cognitive-behavioral model of Clark and Wells (1995), social anxiety results from excessive self-focus, negative predictions about social interactions, and cognitive distortions (Lei et al., 2024). Rapee and Heimberg's (1997) theory similarly emphasizes the role of negative expectations and sensitivity to social evaluation (Rapee et al., 2024). Among students, this disorder is often exacerbated by academic, social, and identity-related pressures typical of adolescence, which can lead to avoidance of social interactions, low self-esteem, and poor academic performance(Brzozowski & Philip Crossey, 2024). Cognitive factors such as negative self-talk and maladaptive emotion regulation strategies play a central role in maintaining and intensifying this disorder.

Maladaptive cognitive emotion regulation strategies refer to dysfunctional cognitive processes for managing emotions, such as self-blame, other-blame, rumination, and catastrophizing(Hatami Nejad, Sadeghi, et al., 2025). According to Garnefski and Kraaij (2007), these strategies tend to intensify rather than alleviate negative emotions(Noroozi Homayoon, Akhavi Samarein, et al., 2025; Noroozi Homayoon, Sadeghi, et al., 2024; Noroozi Homayoon, Sadri Damirchi, et al., 2025; Sadri Damirchi, Noroozi Homayoon, & Hatami Nejad, 2025b). By increasing focus on negative thoughts and reducing psychological flexibility, such strategies contribute to psychological problems including social anxiety(Noroozi Homayoon, Hatami Nejad, et al., 2024). In students, the impact of these maladaptive strategies can be particularly harmful due to developmental and social pressures(Sadri Damirchi, Noroozi Homayoon, Gohari, et al., 2025). Investigating these variables within the context of social anxiety can help identify the cognitive mechanisms involved in this disorder. The findings indicated that maladaptive cognitive emotion regulation strategies are directly and positively associated with social anxiety (Hayatipoor et al., 2024; Wang et al., 2024; Zsido et al., 2021).

Negative self-talk refers to internal, self-critical dialogue characterized by negative thoughts and emotions often associated with anxiety and depression(Brady et al., 2025). According to Calvete et al. (2005), negative self-talk like loneliness stems from maladaptive cognitive patterns and exacerbates social anxiety by reinforcing the fear of negative evaluation and diminishing self-confidence(Calvete & Cardeñoso, 2002; Sadri Damirchi et al., 2024). These internal dialogues may mediate the relationship between maladaptive emotion regulation strategies and social anxiety(Xie & Wang, 2025). The results also showed that negative self-talk is directly and positively associated with social anxiety (Borrajo et al., 2024; Singh & Gautam, 2025; Wheeler et al., 2024). Among students, due to developmental sensitivities, negative self-talk can lead to social withdrawal and poor academic functioning. The growing prevalence of social anxiety among Iranian high school students and the lack of comprehensive domestic studies on the roles of maladaptive cognitive emotion regulation and negative self-talk highlight the necessity of this research (Almasi et al., 2022). The absence of culturally adapted models to explain this phenomenon represents a significant research gap. This study

aims to propose an integrative model to enhance understanding of the underlying mechanisms of social anxiety. In addition, the emergence of artificial intelligence (AI)–based analytical tools has provided new opportunities for examining complex psychological constructs with greater precision and cultural sensitivity (Sadri Damirchi, Abbasi, et al., 2025). The findings of this study can guide the development of effective psychological interventions, such as educational programs focusing on emotion regulation and reducing negative self-talk, and can inform educational and mental health policies, particularly in promoting early interventions and the integration of AI-assisted approaches to mitigate the adverse effects of social anxiety.

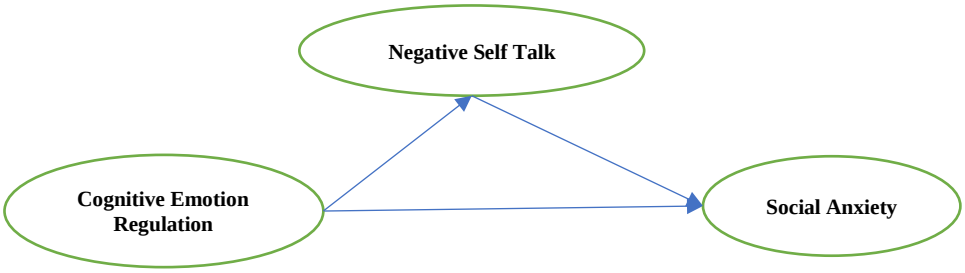

Figure 1. Conceptual Model of the Study

Method

The present study employed a descriptive-correlational design (using structural equation modeling) and was fundamental in nature. In the correlation model, the exogenous variable was *maladaptive cognitive emotion regulation strategies*, the mediating variable was *negative self-talk*, and the endogenous variable was *social anxiety*. The statistical population included all high school students (second period) in Ardabil City during the 2023–2024 academic year. According to the Hair (2015) principle for sample size estimation—considering 10 to 20 participants per observed variable and an additional 10% for potential attrition—the required sample size was determined. Ultimately, 251 students (119 boys and 132 girls) were selected as the study sample. Sampling was conducted using a multistage cluster random method. From among the educational districts of Ardabil, District 1 was randomly selected. Subsequently, ten schools (five boys' and five girls' schools) were randomly chosen from this district, and from each school, two classes from grades 10, 11, and 12 were randomly selected to participate in the study. Inclusion criteria included: being a high school student (grades 10–12), providing informed consent, being aged 16–18 years, having no psychiatric disorders, and responding honestly to the questionnaires. Exclusion criteria were: incomplete questionnaires, unwillingness to participate, not being enrolled as a student, having psychiatric disorders, taking psychiatric medication, and being older than 18 years. Before data collection, participants were informed about the purpose and procedure of the study, confidentiality of their information, their voluntary participation, and their right to withdraw at any time. Questionnaires were then distributed among students. They were assured that their responses would be analyzed anonymously and collectively, in compliance with ethical research principles. At the descriptive level, the mean and standard deviation were used to assess the variables. At the inferential level, relationships between variables were analyzed using Pearson's correlation coefficients and structural equation modeling (SEM). Data analysis was performed using SPSS version 27 and AMOS version 24.

Instruments

Cognitive Social Anxiety Inventory (SPIN)

The Social Phobia Inventory (SPIN) consists of 17 items and was developed by Connor et al. (2000). It includes three subscales: fear, social avoidance, and physiological discomfort (Rai et al., 2022). Each item is scored on a Likert scale from 0 to 4: 0 = *Not at all*, 1 = *A little*, 2 =

somewhat, 3 = *Much*, 4 = *Very much*. A cutoff score of 19 or higher indicates the presence of social anxiety (Rizkia et al., 2024). Connor et al. (2000) reported the inventory's reliability in clinical samples, with Cronbach's alpha ranging from 0.78 to 0.89, and an overall alpha of 0.94. In Iran, the inventory has been translated and standardized (Hatami Nejad, Noroozi Homayoon, et al., 2025). Its convergent validity has been confirmed, with significant correlations ($r = 0.70$, $p < 0.01$) with the General Health Questionnaire (GHQ-28) (Hassanzadeh et al., 1394). Reliability analyses in Iranian samples reported Cronbach's alpha coefficients of 0.94 for the total scale, 0.94 for fear, 0.93 for avoidance, and 0.94 for physiological discomfort. Test-retest correlations over a two-week interval were 0.96 for fear, 0.94 for avoidance, and 0.96 for physiological discomfort, indicating strong reliability and validity in the Iranian population. In international studies, SPIN reliability has been reported as 0.90 (Nay et al., 2022) and 0.94 (Obadji & Vomaallo, 2022). In the present study, Cronbach's alpha was used to assess reliability, yielding an overall alpha of 0.74 for the items.

Cognitive Emotion Regulation Questionnaire (CERQ-18)

This 18-item questionnaire was developed by (Garnefski et al., 2001) to assess emotional regulation strategies. The tool includes two subscales for adaptive strategies (5 subscales) and maladaptive strategies (4 subscales). The subscales include self-blame (items 1 and 2), acceptance (items 3 and 4), rumination (items 5 and 6), positive refocusing (items 7 and 8), planning (items 9 and 10), positive reappraisal (items 11 and 12), perspective taking (items 13 and 14), catastrophizing (items 15 and 16), and other-blame (items 17 and 18). Scores for adaptive strategies are obtained by summing the scores from the subscales of perspective taking, positive refocusing, positive reappraisal, acceptance, and planning, while scores for maladaptive strategies are obtained by summing the scores from the subscales of self-blame, other-blame, rumination, and catastrophizing. The questionnaire is scored on a 5-point Likert scale ranging from never (1) to always (5), with higher scores indicating better emotional regulation. The developers reported overall reliability coefficients of 0.87, with subscale reliabilities ranging from 0.73 to 0.88. In the study by (Ballabrera et al., 2024), Cronbach's alpha for the adaptive strategies subscale was 0.84, and for the maladaptive strategies subscale, it was 0.76. In this study, the Cronbach's alpha for this tool was 0.88. In Iran, in the study conducted by Hosseini Abrishami et al. (2022), the reliability coefficient of the questionnaire, measured by Cronbach's alpha, ranged from 0.75 to 0.83 (Hosseini Abrishami et al., 2022).

Inner Self-Talk Questionnaire: Callot Self-Talk Inventory (STI)

The Callot Self-Talk Inventory (STI), developed by Calvete et al. (2005), is a self-report tool comprising 52 items designed to assess positive and negative self-talk in adults. The instrument includes two scales: Positive Self-Talk and Negative Self-Talk. Reported Cronbach's alpha coefficients are 0.90 for the negative self-talk scale and 0.80 for the positive self-talk scale. In terms of convergent validity, significant correlations have been found between the STI scores and measures of depression, anxiety, and stress (Calvete et al., 2005). To complete the questionnaire, participants are first asked to imagine specific situations and then rate each item on a four-point Likert scale. Calvete et al. (2005) indicated that in clinical populations, negative self-talk scores are typically above 60. The validity and reliability of the STI in Iran have been confirmed by Javahimajidi (2018) and Alavi et al. (2013). Alavi et al. (2013) reported Cronbach's alpha of 0.81 for the negative self-talk scale and 0.72 for the positive self-talk scale. Additionally, negative self-talk was found to have a significant positive correlation with depression and anxiety.

Results

In the present study, the sample consisted of 251 high school students. of these, 119 students (47.4%) were boys and 132 students (52.6%) were girls. Regarding grade levels, 81 students (32.3%) were in the

10th grade, 85 students (33.9%) were in the 11th grade, and 85 students (33.9%) were in the 12th grade. The participants' ages ranged from 16 to 18 years, with a mean age of 16.70 years (SD = 2.89).

Table 1. Descriptive Statistics of the Study Variables

Variable	Mean	SD	Skewness	Kurtosis
Fear	23.38	3.16	-0.551	-0.205
Social Avoidance	26.20	2.996	-0.048	-0.464
Physical Discomfort	5.11	2.089	-0.383	-0.690
Self-Blame	14.73	3.516	-0.134	1.008
Blaming Others	15.51	3.36	-0.288	-0.797
Rumination	14.92	3.307	-0.152	-0.791
Catastrophizing	14.82	3.415	-0.238	-0.710
Maladaptive Strategies	92.33	7.019	-0.709	1.911
Social Anxiety	54.70	6.675	-0.151	-0.524
Cognitive Emotion Dysregulation	60.03	11.583	-0.163	-0.871

Table 1 presents the means and standard deviations of the study variables. The subsequent columns report the skewness and kurtosis indices, which are used to assess the normality of the data. As observed, the skewness and kurtosis values of the observed variables range between -2 and +2, indicating that the distributions of the variables are approximately normal and suitable for structural equation modeling (SEM) analysis. Prior to data analysis, the assumptions of SEM were examined. Accordingly, the normality of the variables was assessed using the Kolmogorov–Smirnov test, and the results indicated that the study variables were normally distributed ($p > 0.05$).

The basis for SEM analysis is the sample correlation matrix, which is presented in Table 2.

Table 2. Correlation Coefficients of the Research Variables

Variable	1	2	3	4	5	6	7	8	9	10
Fear	1									
Maladaptive Emotion Regulation	.65**	1								
Physiological Distress	.34**	.36**	1							
Self-Blame	.68**	.64**	.26**	1						
Blaming Others	.72**	.66**	.27**	.72**	1					
Rumination	.67**	.69**	.31**	.74**	.78**	1				
Catastrophizing	.43**	.46**	.22**	.47**	.55**	.56**	1			
Negative Self-Talk	.80**	.72**	.43**	.67**	.70**	.72**	.47**	1		
Social Anxiety	.87**	.87**	.64**	.69**	.72**	.72**	.48**	.84**	1	
Emotion Regulation	.73**	.73**	.31**	.84**	.90**	.90**	.76**	.75**	.77**	1

*** P< 0.01*

The results of Table 2 indicate that all research variables are significantly correlated with each other. To examine the assumption of no autocorrelation in the residuals, the Durbin–Watson statistic was computed, yielding a value of 1.90. Since this value falls within the acceptable range of 1.5 to 2.5, the assumption of no autocorrelation is considered satisfied. Additionally, multicollinearity for the exogenous variables was assessed using the tolerance and variance inflation factor (VIF). The results indicated that the assumption of no multicollinearity was met, as tolerance values for all variables were close to 1 and VIF values were below the critical threshold of 2.

Table 3. Fit indices of the research model

Fit Index	Acceptable Range	Calculated Value	Fit Status
χ^2 / df (CMIN/DF)	< 3	1.746	Accepted
RMSEA	0.05 – 0.08	0.055	Accepted
PCLOSE	> 0.05	0.037	Accepted
TLI	> 0.90	0.985	Accepted
RFI	> 0.90	0.965	Accepted
IFI	> 0.90	0.961	Accepted
NFI	> 0.90	0.979	Accepted
CFI	> 0.90	0.973	Accepted

As shown in Table 3, all fit indices meet the recommended criteria (Hu & Bentler, 1999), indicating that the research model has a good fit.

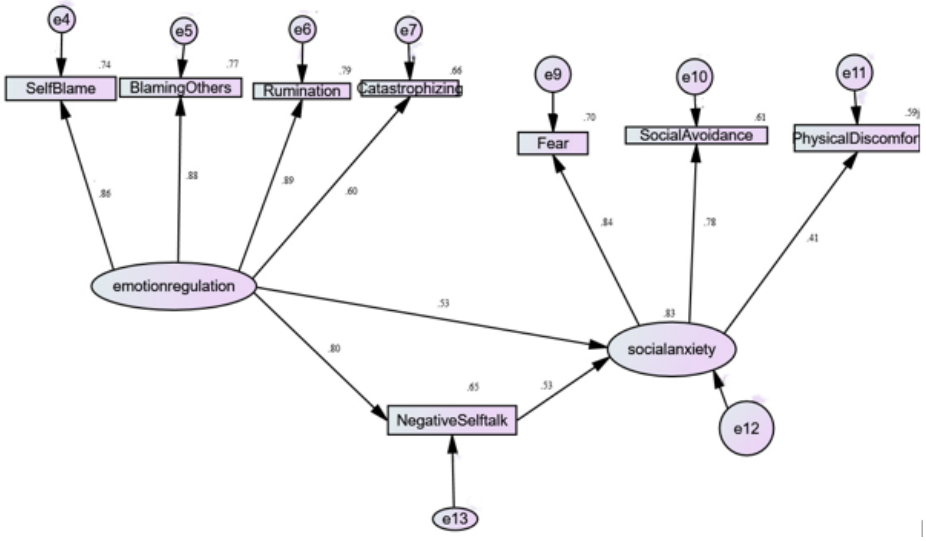

Figure 2. Final Research Model

Table 4. Standardized and Unstandardized Regression Weights of the Study Variables

Dependent Variable	Independent Variable	Unstandardized Estimate (B)	Standardized Estimate (β)	Standard Error (S.E.)	C.R.	p-value	Status
Negative Self-Talk	Emotion Regulation	1.917	0.804	0.122	15.743	***	Accepted
Social Anxiety	Negative Self-Talk	0.199	0.527	0.023	8.486	***	Accepted
Social Anxiety	Emotion Regulation	0.474	0.528	0.060	7.854	***	Accepted

****p<0.01*

As observed in Table 4, the path coefficients representing the effects of the study variables are significant at the 0.05 level.

Table 5. Bootstrapping Results for the Indirect Effect in the Research Model

Indirect Path	Indirect Effect	Lower Bound	Upper Bound	Significance Level
Emotion Regulation → Negative Self-Talk → Social Anxiety	0.381**	0.260	0.503	0.02

Note: ***p < 0.05*

Interpretation: The results of the bootstrapping analysis indicate that negative self-talk significantly mediates the relationship between maladaptive emotion regulation strategies and social anxiety. The 95% confidence interval for the indirect effect (0.260 to 0.503) does not include zero, confirming the significance of the mediation effect.

Discussion and Conclusion

The findings indicated that maladaptive cognitive emotion regulation strategies are directly and positively associated with social anxiety ($\beta = 0.42$, $p < 0.01$). This result is consistent with the studies of Hayatipoor et al. (2024), Wang et al. (2024) and Zsido et al. (2021). In explaining this finding, maladaptive strategies such as self-blame, other-blame, rumination, and catastrophizing increase focus on negative thoughts and emotions, thereby exacerbating social anxiety. According to Garnefski (2007), these strategies amplify negative emotions rather than reducing them and decrease psychological flexibility. In students, this process is intensified due to developmental and social pressures, such as fear of peer judgment and academic expectations. Self-blame creates feelings of guilt and incompetence, reducing self-confidence, which, according to the Clark and Wells model (1995), is a key factor in social anxiety. Rumination reinforces anxiety cycles through persistent focus on negative thoughts. Catastrophizing magnifies potential social consequences, increasing fear of social situations. These strategies, by reducing coping ability, reinforce avoidant behaviors, leading to social isolation and decreased academic performance. During adolescence, sensitivity to social evaluation amplifies these effects. The lack of adaptive emotion regulation skills, such as reappraisal, perpetuates this cycle. Cognitive-behavioral interventions (CBT) can reduce social anxiety by teaching adaptive strategies, such as cognitive restructuring, tailored to the developmental and social characteristics of students. These findings emphasize the importance of identifying and modifying maladaptive strategies to prevent social anxiety.

The results also showed that negative self-talk is directly and positively associated with social anxiety ($\beta = 0.37$, $p < 0.01$), in line with the findings of Borrajo et al. (2024), Wheeler et al. (2024) and Singh and Gautam (2025). Negative self-talk, as critical internal dialogue, intensifies social anxiety by reinforcing fear of negative evaluation and reducing self-confidence. According to Callot (2005), negative self-talk strengthens anxiety cycles through focus on social failures and anticipation of negative outcomes. In students, these thoughts are exacerbated by peer pressure and social expectations. Examples of such self-talk include statements like "I cannot speak in public" or "Everyone is judging me," which lead to avoidant behaviors. Raphi and Himberg (1997) show that these self-statements increase sensitivity to social evaluation. During adolescence, when social identity formation is critical, negative self-talk can result in social isolation and decreased self-esteem. Lack of cognitive skills to manage these thoughts sustains the anxiety cycle. Cognitive restructuring interventions that replace negative self-talk with positive statements can reduce anxiety and should be adapted to students' developmental and social needs. These findings highlight the key role of negative self-talk in exacerbating social anxiety.

Furthermore, negative self-talk played a significant mediating role in the relationship between maladaptive cognitive emotion regulation strategies and social anxiety ($\beta = 0.31$, $p < 0.01$). This aligns with the studies of Borrajo et al. (2024), Wheeler et al. (2024) and Singh and Gautam (2025). Maladaptive strategies, such as self-blame and rumination, create negative cognitive patterns that lead to negative self-talk, which in turn exacerbates social anxiety.

According to Garnefski (2007), these strategies promote focus on negative emotions, laying the groundwork for critical self-talk. For example, self-blame may lead to self-statements such as "I always fail," increasing fear of judgment. Rumination reinforces these negative self-talk patterns. Clark and Wells (1995) demonstrate that these statements heighten sensitivity to social evaluation and intensify avoidant behaviors. In students, social and academic pressures amplify this process. Negative self-talk thus acts as a mediating mechanism, transmitting the effects of maladaptive strategies to social anxiety. Cognitive-behavioral and mindfulness interventions can reduce these self-talk patterns and teach adaptive strategies, thereby decreasing anxiety. Interventions should be tailored to the developmental needs of students. These findings underscore the importance of targeted interventions to reduce negative self-talk. Limitations of this study include: first, the use of cluster random sampling focused on a single educational district in Ardabil may limit the generalizability of the findings; second, focusing on students aged 16–18 restricts examination of broader age differences; third, self-report instruments may be influenced by biases such as shame or lack of honesty, particularly given the sensitivity of social anxiety; fourth, not accounting for subcultural and socio-economic diversity may overlook environmental influences; and fifth, the absence of longitudinal data prevents assessment of long-term changes in social anxiety. Research Recommendations: Future studies should use broader random sampling across multiple regions to increase generalizability. Including both genders and a wider age range can clarify developmental and gender differences. Mixed-method approaches, such as in-depth interviews, can provide a deeper understanding of students' experiences. The role of subcultures and socio-economic factors should be examined. Longitudinal studies are recommended to evaluate long-term changes and the effectiveness of interventions. Practical Recommendations: Implement school-based programs focused on emotion regulation and cognitive restructuring. Establish specialized counseling centers providing safe spaces for students with social anxiety. Conduct parent and teacher workshops to raise awareness of social anxiety signs and coping strategies for early identification. Develop group programs to enhance social skills and reduce negative self-talk. Policy initiatives should integrate mental health services into the educational system, collaborate with local organizations, and establish crisis helplines to improve access and intervention effectiveness.

Declarations

Author Contributions

All authors contributed actively to the conception, design, and execution of the research.

Data Availability Statement

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

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Ethical considerations

This study was conducted in accordance with ethical standards for research involving human participants and was approved by the Ethics Committee of the University of Mohaghegh

Ardabili (Ethics Code: IR.UMA.REC.1403.079). All participants were fully informed about the purpose and procedures of the study and provided informed consent prior to participation. Participation was voluntary, confidentiality was assured, and participants were free to withdraw from the study at any time without any consequences. All data were collected anonymously and used solely for research purposes.

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Neurocognitive Differences in Attention, Memory, and Executive Functions Between People with Epilepsy and Healthy Controls: Evidence from Shiraz, Iran

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ABSTRACT

This study investigated neurocognitive profiles in attention, memory, and executive functions among individuals with epilepsy compared to healthy controls in Shiraz, Iran. In a cross-sectional design, 121 participants (61 with epilepsy, 60 controls) aged 18–45 years were assessed using a standardized neuropsychological battery, including the Digit Span Test, Rey Auditory Verbal Learning Test (RAVLT), Stroop Color-Word Test, and Wisconsin Card Sorting Test (WCST). Data were analyzed using non-parametric Mann–Whitney U tests due to non-normal distributions. Results revealed that individuals with epilepsy exhibited significantly greater cognitive impairments across all domains: attention ($U=171.5$, $p < .001$), memory ($U = 135.5$, $p < .001$), and executive functioning ($U= 49.5$, $p < .001$). The findings underscore substantial neurocognitive dysfunction associated with epilepsy, highlighting the need for integrated cognitive screening and tailored interventions within clinical care in the Iranian context. This study contributes to the growing cross-cultural evidence on epilepsy-related cognitive deficits and supports the adoption of holistic management approaches that address both seizure control and cognitive rehabilitation.

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Introduction

Epilepsy is a chronic neurological disorder characterized by recurrent, unprovoked seizures, affecting approximately 50 million people globally, with a disproportionately high burden in developing regions (Gerina et al., 2025). Beyond the primary clinical manifestations, epilepsy is increasingly recognized for its significant comorbidity with neurocognitive impairments (Gupta et al, 2022). The intricate relationship between epileptic activity, underlying neuropathology, antiepileptic drugs (AEDs), and cognitive function poses a substantial challenge to patients' quality of life, affecting educational attainment, vocational success, and psychosocial well-being (Baker & Butler, 2024).

Cognitive domains most frequently implicated in epilepsy include attention, memory, and executive functions core processes essential for daily adaptive functioning. Attentional deficits, often exacerbated by AED side effects and seizure frequency, can undermine information processing speed and concentration (Hasegawa & Annaka, 2023). Memory disturbances, particularly in verbal and episodic memory, are commonly reported and are frequently associated with temporal lobe involvement and duration of illness (Mukaino, 2024). Executive dysfunction, encompassing abilities such as planning, cognitive flexibility, and inhibitory control, is often linked to frontal lobe pathology and has profound implications for problem-solving and behavioral regulation (Soleymani et al., 2025).

Extant literature from diverse cultural and clinical settings, consistently documents significant cognitive disparities between individuals with epilepsy and healthy controls (Van Patten et al., 2024). However, the generalizability of these findings can be influenced by genetic, environmental, socioeconomic, and healthcare access variables specific to different populations. In Iran, despite a reported epilepsy prevalence comparable to global estimates, there remains a relative paucity of focused, comprehensive neuropsychological profiling comparing patients with epilepsy to demographically matched healthy controls using standardized assessments. Most local studies have either been clinically descriptive or limited to specific epilepsy subtypes, leaving a gap in population-based cognitive characterization. Furthermore, while the adverse cognitive effects of certain AEDs and the role of seizure burden are acknowledged, the interactive contribution of illness duration, treatment adherence, and psychosocial factors within the Iranian context is not well-documented. Addressing this gap is crucial for developing tailored cognitive rehabilitation strategies and optimizing holistic patient care.

Therefore, this study aims to investigate the neurocognitive profile of individuals with epilepsy in Shiraz, Iran, specifically focusing on attention, memory, and executive functions, in comparison with a group of healthy controls. We hypothesize that (1) individuals with epilepsy will demonstrate significantly poorer performance on measures of attention, memory, and executive functioning compared to healthy controls, and (2) within the epilepsy group, longer illness duration will correlate with greater cognitive impairment. The findings intend to contribute empirical evidence from the Iranian population to the international neuropsychological literature on epilepsy and inform clinical practices aimed at early cognitive screening and intervention.

Method

Participants

This cross-sectional, case-control study recruited a total of 120 participants, divided into two groups: a clinical group of 60 individuals diagnosed with epilepsy and a control group of 60 neurologically healthy individuals. Participants in the epilepsy group were consecutively recruited from the outpatient neurology clinics of major teaching hospitals affiliated with Shiraz University of Medical Sciences. Diagnosis was confirmed by a board-certified neurologist

based on clinical history and standard diagnostic criteria, including electroencephalography (EEG) and/or neuroimaging (MRI/CT) where indicated. All patients in the clinical group were on a stable regimen of antiepileptic drugs (AEDs) for at least six months prior to assessment.

The control group was recruited from the local community through advertisements and were screened for any history of neurological or major psychiatric disorders, head injury with loss of consciousness, or substance abuse. Both groups were matched at the group level on key demographic variables: age (range 18-45 years) and years of education (minimum 8 years).

Inclusion criteria for the epilepsy group were: (1) age between 18 and 45 years; (2) confirmed diagnosis of epilepsy for at least one year; (3) proficiency in Persian. Exclusion criteria for both groups included: (1) presence of comorbid major psychiatric disorders (e.g., psychosis, major depressive disorder) as per clinical interview; (2) intellectual disability (IQ < 70); (3) significant sensory or motor impairments preventing test completion; (4) history of other major neurological conditions (e.g., stroke, tumor).

Materials and Measures

Neurocognitive functioning was assessed using a battery of standardized and psychometrically validated instruments.

1. **Attention and Working Memory:**

Digit Span Tes: The Digit Span Test from the Wechsler Adult Intelligence Scale–Revised (WAIS-R) was used to assess attention and verbal working memory. This widely utilized neuropsychological measure requires participants to orally reproduce sequences of digits that are presented auditorily by the examiner (Ostrosky-Solís & Lozano, 2006). The test was administered in two conditions: Forward Digit Span (FDS) and Backward Digit Span (BDS). In the forward condition, participants were instructed to repeat the digits in the same order as presented, whereas in the backward condition they were required to recall the digits in reverse order. Digit sequences were delivered at a fixed rate of one digit per second, using a constant vocal pitch to minimize the use of chunking strategies that could artificially enhance performance. Repetition of digit sequences was not permitted; participants were informed that each sequence would be presented only once and were encouraged to provide their best possible response. The task began with two-digit sequences, which served as practice trials and were excluded from scoring. Sequence length increased progressively up to a maximum of nine digits. Each span length from three to nine digits was presented three times using different digit combinations. One point was awarded for each correctly recalled sequence. After three trials at each span length, task difficulty was increased regardless of performance. For data analysis, the percentage of correctly recalled trials was calculated for each participant. As scoring was based on sequences ranging from three to nine digits, the maximum attainable score in each condition (forward and backward) was 21.

2. **Verbal Memory:**

Rey Auditory Verbal Learning Test (RAVLT): Verbal learning and memory were assessed using the Rey Auditory Verbal Learning Test (RAVLT), a widely used and well-validated neuropsychological measure of episodic verbal memory. The original one-trial version of the test was first introduced by Claparède in the early twentieth century, and subsequently expanded by Rey into a five-trial learning paradigm followed by delayed recall and recognition trials (Strauss et al., 2006). The contemporary form of the RAVLT incorporates minor methodological refinements while preserving its core structure. In its current standardized version, the RAVLT consists of three semantically unrelated word lists. Lists A and B each include 15 words and are designed to assess free recall, whereas the third list comprises 50 words (20 novel distractor words and 30 words drawn from Lists A and B) and is used to evaluate recognition memory. During administration, List A is orally presented across five

consecutive trials, and after each presentation participants are instructed to recall as many words as possible in any order, providing indices of immediate memory and learning across trials. Subsequently, List B is presented once to induce proactive interference, and participants are asked to recall the words from this list. Immediately thereafter, without re-presenting List A, short-delay free recall of List A is assessed. Following a delay interval of approximately 20–30 minutes, long-delay free recall is obtained. Finally, a recognition trial is administered in which participants are required to identify words from List A among distractor items. The RAVLT yields multiple quantitative indices reflecting learning, recall, interference, and recognition processes. These include the First Trial Score (FTS), as an index of immediate verbal memory; the Seventh Trial Score (STS), reflecting delayed recall; the Proactive Interference Score (PIS), indicating the extent to which previously learned information interferes with new learning; and the Retroactive Interference Score (RIS), capturing the disruptive effect of newly learned material on prior learning. Additional indices comprise the Forgetting Rate Score (FRS), representing memory decay over time; the Final Acquisition Learning Score (FALS), defined as the maximum number of words recalled across the five learning trials; the Total Learning Score (TLS), calculated as the sum of words recalled across Trials 1–5; and the Learning Over Trials Score (LOTS), reflecting learning gains beyond initial recall. Recognition memory is assessed using the Net Positive Score (NPS), derived from correct minus incorrect recognitions, and the Recognition Over Recall Score (RORS), which contrasts recognition performance with delayed free recall (Lezak, 2004; Sisakhti et al., 2023). Collectively, these indices provide a comprehensive assessment of verbal learning and memory functioning.

3. **Executive Functions:**

Stroop Color-Word Test: Selective attention, cognitive control, and inhibitory processing were assessed using a computerized version of the Stroop Color and Word Test (SCWT), a well-established and reliable measure of executive functioning. The assessment was administered in a controlled environment with moderate ambient lighting. Participants were seated approximately 40 cm from a 13-inch monitor, and standardized instructions were provided prior to test administration. Stimuli consisted of the color words yellow, red, blue, and green, which were presented randomly at a rate of 60 frames per minute, with each stimulus displayed for approximately 1 second. All stimuli were presented in Adobe Erbic font with a font size of 65. Before the main task, participants completed a familiarization phase comprising 47 practice trials to become accustomed to the spatial location of the response keys corresponding to blue, green, yellow, and red, which were marked with colored bars on the keyboard. Following this phase, the main task was administered across four experimental conditions, consisting of 110 randomized stimulus presentations. In the first condition, the color words were presented in white font, and participants were required to respond based on the semantic meaning of the word. In the second condition, the words were displayed in congruent colors, such that the ink color matched the semantic meaning of the word. In the third condition, the words were presented in incongruent colors, and participants were instructed to respond according to the word's meaning. In the final condition, the words were also presented in incongruent colors; however, participants were required to respond based on the ink color while inhibiting the semantic content of the word. To examine the effects of learning and repetition, the SCWT was re-administered after a 10-minute interval. For each condition, performance indices included the number of correct and incorrect responses as well as reaction time for correct responses. The computerized SCWT was implemented using Python software. Consistent with prior research, despite variations in stimulus characteristics and administration formats, the fundamental Stroop paradigm underlying the SCWT remains stable and

demonstrates satisfactory reliability as a measure of attentional control and cognitive inhibition (Van der Elst, et al., 2006; Sobhani et al., 2022).

Wisconsin Card Sorting Test: Cognitive flexibility and set-shifting ability were assessed using the Wisconsin Card Sorting Test (WCST), a well-established neuropsychological measure of executive functioning (Heaton, 1981; Dann et al., 2023). The computerized version of the task was administered via Inquisit 6 software (2021)[1]. In this task, participants were required to sort a series of response cards by matching each card to one of four reference stimulus cards. The stimulus cards varied along three perceptual dimensions: color, shape, and number. Participants were not explicitly informed of the correct sorting rule and were required to infer the rule based on feedback provided after each response. The sorting criterion changed automatically after 10 consecutive correct responses, thereby requiring participants to inhibit previously learned rules and shift to a new sorting strategy. The task continued until participants successfully completed sorting according to each of the three dimensions twice, or until all 128 response cards had been presented. Performance on the WCST was indexed by the percentage of perseverative errors, calculated in accordance with the standardized scoring procedures described by Heaton et al. (1981; Dann et al., 2023), which reflects difficulties in cognitive flexibility and resistance to set-shifting.

All tests have demonstrated acceptable reliability and validity in Persian-speaking populations. A demographic and clinical questionnaire was used to collect information on age, gender, education, epilepsy type, duration of illness, and current AED regimen.

Design and Procedure

The study employed a between-subjects design with one independent variable, Group, with two levels (Epilepsy vs. Healthy Control). The dependent variables were scores on the neuropsychological tests measuring the three core cognitive domains: Attention/Working Memory, Verbal Memory, and Executive Functions.

Following ethical approval and participant recruitment, each participant underwent a single assessment session lasting approximately 90 minutes. Sessions were conducted in a quiet, well-lit room at the Chamran hospital's neuropsychology lab in Shiraz. After providing written informed consent, participants completed the demographic/clinical questionnaire.

A trained clinical psychologist, blinded to the group status of control participants, administered the neuropsychological test battery in a standardized manner following published protocols. The order of tests was: Digit Span, RAVLT (immediate trials), Stroop Test, WCST, followed by the RAVLT delayed recall and recognition trials. Short breaks were offered to minimize fatigue.

Data Analysis

Data were analyzed using IBM SPSS Statistics, version 26. Prior to conducting inferential analyses, the dataset was screened for accuracy, missing values, and outliers. Descriptive statistics, including means, standard deviations, and skewness coefficients, were computed for all cognitive variables (attention, memory, and executive functioning) separately for the epilepsy and control groups.

The assumption of normality was assessed using both graphical inspection and the Shapiro–Wilk test, which is recommended for small to moderate sample sizes. Results of the Shapiro Wilk test indicated significant deviations from normality for all cognitive variables in both groups (all $p < .001$). In addition, skewness values exceeded acceptable thresholds (±1), further confirming non-normal distributions.

Given the violation of normality assumptions, non-parametric statistical procedures were employed. Group differences between individuals with epilepsy and healthy controls on

[1] https://www.millisecond.com

measures of attention, memory, and executive functioning were examined using the Mann–Whitney U test. This test was selected due to its robustness in comparing independent groups when data are ordinal or non-normally distributed.

For each comparison, Mann–Whitney U values, standardized *Z* statistics, and exact significance levels (*p*-values) were reported. Rank-based descriptive indices, including mean ranks and sum of ranks, were also calculated to facilitate interpretation of group differences. All statistical tests were two-tailed, and the level of statistical significance was set at $p < .05$

Results

Descriptive Statistics and Assessment of Normality

Descriptive statistics for attention, memory, and executive functioning scores in individuals with epilepsy and healthy controls are presented in Table 1.

Table 1 Descriptive Statistics for Attention, Memory, and Executive Functioning in Individuals with and Without Epilepsy

Variable	Group	M	SD	Skewness
Attention	Control	2.78	.39	1.17
	Epilepsy	9.56	.24	-.20
Memory	Control	1.73	.38	1.64
	Epilepsy	9.48	.18	-5.30
Executive Functioning	Control	1.02	.28	2.30
	Epilepsy	8.72	.16	-6.39

Note. Higher scores indicate greater cognitive difficulties.

As shown, participants with epilepsy exhibited substantially higher mean scores across all three cognitive domains, indicating greater cognitive difficulties compared to controls. The skewness values for all variables exceeded acceptable thresholds for normal distribution, suggesting deviations from normality in both groups.

To formally assess the assumption of normality, the Shapiro–Wilk test was conducted separately for each group (Table 2).

Table 2 Shapiro–Wilk Test of Normality for Cognitive Variables

Variable	Control	p	Epilepsy W	p
Attention	**.776**	<.001	**.391**	<.001
Memory	**.653**	<.001	**.365**	<.001
Executive	**.531**	<.001	**.475**	<.001

As reported in Table 2, the results indicated that attention, memory, and executive functioning scores were significantly non-normally distributed in both individuals with epilepsy and controls (all $p < .001$). Consequently, non-parametric statistical procedures were deemed appropriate for subsequent analyses.

Group Comparisons on Cognitive Functioning

Mann–Whitney U tests were employed to compare individuals with epilepsy and healthy controls on attention, memory, and executive functioning. Rank-based descriptive statistics are displayed in Table 3. Across all three domains, participants with epilepsy demonstrated consistently higher mean rank scores, reflecting greater cognitive difficulties relative to controls.

Table 3 Mean Rank Scores for Attention, Memory, and Executive Functioning

Variable	Group	Mean Rank	Sum of Ranks
Attention	Control	33.36	2001.50
	Epilepsy	88.19	5379.50
Memory	Control	32.76	1965.50
	Epilepsy	88.78	5415.50
Executive functioning	Control	31.33	1879.50
	Epilepsy	90.19	5501.50

Inferential statistics revealed statistically significant group differences across all cognitive domains (see Table 4). Individuals with epilepsy reported significantly greater attention-related problems compared to controls ($U = 171.50$, $Z = -8.84$, $p < .001$). Similarly, memory impairments were significantly more pronounced in the epilepsy group ($U = 135.50$, $Z = -9.22$, $p < .001$).

Moreover, executive functioning deficits were markedly higher among individuals with epilepsy relative to healthy controls ($U = 49.50$, $Z = -9.96$, $p < .001$), indicating substantial impairments in higher-order cognitive processes.

Table 4 Mann–Whitney U Test Results for Group Comparisons

Variable	U	Z	P
Attention	171.5	-8.84	<.001
Memory	135.5	-9.22	<.001
Executive Functioning	49.5	-9.96	<.001

Overall, the findings provide strong empirical support for the presence of significant deficits in attention, memory, and executive functioning among individuals with epilepsy compared to non-epileptic controls.

Discussion and Conclusion

The present study investigated neurocognitive differences in attention, memory, and executive functions between individuals with epilepsy and healthy controls in Shiraz, Iran. Consistent with the study hypotheses, individuals with epilepsy demonstrated significantly poorer performance across all three cognitive domains, with large effect sizes indicating clinically meaningful impairments relative to neurologically healthy participants. These findings extend a growing body of international evidence demonstrating that epilepsy is frequently accompanied by broad neurocognitive dysfunction, even beyond overt seizure activity (Helmstaedter et al., 2021; Van Patten et al., 2024).

Attentional deficits observed in the epilepsy group may reflect the cumulative impact of recurrent epileptiform discharges on fronto-parietal attention networks, as well as the cognitive side effects associated with antiepileptic drug (AED) treatment and the presence of subclinical seizure activity (Loring & Meador, 2016; Hasegawa & Annaka, 2023). Impairments in verbal learning and memory, particularly on the Rey Auditory Verbal Learning Test (RAVLT), are consistent with the well-documented vulnerability of medial temporal lobe structures in epilepsy. Both ictal and interictal neural activity have been shown to disrupt hippocampal functioning, thereby compromising memory encoding and consolidation processes (Baxendale et al., 2017; Mukaino, 2024).

Executive functioning emerged as the most affected cognitive domain, as evidenced by pronounced group differences on the Stroop Test and Wisconsin Card Sorting Test (WCST). This pattern aligns with contemporary models emphasizing the sensitivity of prefrontal cortical systems and large-scale cognitive control networks to the diffuse neural disruptions characteristic of epilepsy (Upton & Thompson, 2020; Soleymani et al., 2025). Although the study demonstrated clear group-level cognitive differences, the absence of within-group analyses examining illness duration or seizure-related variables limits conclusions regarding the specific clinical correlates of executive dysfunction, warranting further investigation.

Overall, the present findings are consistent with prior international research, supporting the cross-cultural and transdiagnostic nature of cognitive comorbidity in epilepsy (Jaffri et al., 2022; Van Patten et al., 2024). Importantly, they also converge with emerging evidence from Iranian samples, which has begun to characterize cognitive vulnerabilities in neurological populations (Sisakhti et al., 2023; Sobhani et al., 2022). The relatively large magnitude of cognitive differences observed in this study may be partially attributable to contextual factors, including illness severity, AED polytherapy, and psychosocial stressors such as limited access

to specialized neuropsychological services. These factors, which may vary across healthcare systems, could exacerbate cognitive burden in individuals with epilepsy (Gerina et al., 2025).

From a clinical perspective, these findings underscore the necessity of integrating routine neurocognitive screening into standard epilepsy care in Iran, rather than focusing exclusively on seizure control. Early identification of attentional, memory, and executive deficits can inform individualized treatment planning, patient education, and vocational or educational accommodations (Helmstaedter et al., 2021). Moreover, the development and implementation of culturally adapted cognitive rehabilitation programs for Persian-speaking patients may offer a viable pathway to improving daily functioning, autonomy, and quality of life (Baker & Butler, 2024). Enhancing awareness among patients and families regarding the cognitive dimensions of epilepsy may also help reduce stigma and promote adaptive coping strategies.

Several limitations should be acknowledged. The cross-sectional design limits causal inference regarding the progression of cognitive impairments over time. Additionally, recruitment from a single clinical center may restrict the generalizability of findings to the broader Iranian epilepsy population. While a standardized neuropsychological battery was employed, future studies would benefit from a more comprehensive assessment encompassing processing speed, social cognition, emotional functioning, and subjective cognitive complaints. Potential confounding variables, including mood symptoms, sleep disturbances, and specific AED regimens, were not statistically controlled and may have influenced cognitive performance (Thompson & Duncan, 2005). Furthermore, the inclusion of neuroimaging or electrophysiological measures could strengthen inferences regarding the neural mechanisms underlying observed deficits.

Future research should prioritize longitudinal and multi-center designs to examine cognitive trajectories in epilepsy and to identify clinical, pharmacological, and psychosocial predictors of cognitive outcomes. Randomized controlled trials evaluating culturally tailored cognitive rehabilitation interventions are particularly warranted. Additionally, investigations into protective factors such as cognitive reserve may offer valuable insights for mitigating cognitive decline. Integrative approaches combining neuropsychological, neuroimaging, and genetic data may ultimately facilitate more personalized and comprehensive models of epilepsy care.

In conclusion, this study provides compelling evidence of significant impairments in attention, memory, and executive functioning among individuals with epilepsy in Iran. These neurocognitive difficulties have important implications for everyday functioning and overall quality of life, highlighting the need for a more holistic, cognitively informed approach to epilepsy management within clinical practice.

Declarations

Author Contributions

All responsibilities for the article rest with the author.

Data Availability Statement

This study's data can be requested from the author upon request. The data is not available publicly due to ethical or privacy concerns.

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Ethical considerations

The research study was approved by the ethics committee at University of Shiraz. Participants' consent was obtained based on completing the survey after receiving all relevant information about the research, including research objectives, anonymity, voluntary participation, and

having the opportunity to ask questions. They were free to withdraw from the research at any time without mentioning the reason and without any cost or consequences.

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Conflict of interest

The author declares that there is no conflict of interest.

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Design Features of Educational Games to Foster Metacognitive Skills: A Systematic Review

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ABSTRACT

This systematic review sought to identify and synthesize the key features of educational games that effectively promoted metacognitive skills. Given the pivotal role of metacognitive skills in self-regulated learning and academic achievement, understanding the game features that can enhance these skills is particularly significant. A comprehensive search was conducted across Iranian and international databases including Scopus, Web of Science, ScienceDirect, Google Scholar, IranDoc, and NoorMags for studies published between 2015 and 2025. Following PRISMA-based screening procedures, 15 eligible empirical studies were included. A qualitative content analysis approach was employed, and the methodological quality of the studies was evaluated using the MMAT (2018 version). The synthesis of findings revealed several core themes that collectively contributed to the activation of metacognitive skills such as planning, monitoring, evaluation, reflection, and self-regulation. These themes encompassed the platform and mode of gameplay, game objectives, game mechanics, game dynamics, aesthetic elements, scaffolding strategies, and the types of feedback embedded within the games. The results indicated that the most effective metacognitive games were those offering an optimal level of challenge, providing immediate and socially mediated feedback, fostering interaction and collaborative dialogue, and balancing excitement, cognitive engagement, and aesthetic appeal—while simultaneously granting learners autonomy and control over their learning experience. Nonetheless, methodological limitations such as heterogeneity in game types, small sample sizes, and reliance on self-reported measures were noted across the reviewed studies. The findings offer practical insights for designers and researchers developing game-based interventions aimed at enhancing metacognitive skills.

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Introduction

In today's educational environments, merely acquiring knowledge is no longer sufficient for success because learners face an overwhelming volume of information and increasingly complex tasks. For many learners, the main challenge does not lie in a lack of knowledge but in their inability to manage their own learning processes, plan effectively, maintain attention, and evaluate their performance (Azevedo & Cromley, 2004). These challenges are particularly pronounced in open and self-directed learning environments, where they impose a higher cognitive load and require the simultaneous engagement of both cognitive and metacognitive skills (Azevedo & Witherspoon, 2009).

In recent decades, however, games have evolved beyond mere entertainment to become a powerful tool for fostering active and meaningful learning. Unlike traditional educational settings, which rely on the passive transmission of knowledge, game-based environments emphasize learning through experience, receiving feedback, and continuously refining performance (Garris et al., 2002). By providing opportunities for interaction, exposure to incremental challenges, and ongoing decision-making, these environments actively engage learners in the learning process and enhance their intrinsic motivation for exploration and critical thinking (del Moral Pérez et al., 2018).

Beyond purely cognitive aspects, games can create an environment in which learners not only practice skills like problem-solving and decision-making but also regulate and monitor their own mental processes a phenomenon known as metacognition, which refers to the awareness and conscious control of one’s own thought processes (Flavell, 1979). Research suggests that key features of educational games, such as complex scenarios, immediate feedback systems, and opportunities for constructive failure, could offer a fertile ground for practicing metacognitive components including planning, monitoring progress, and evaluating and refining strategies (Plass et al., 2015).

The advancement of digital technologies has further facilitated the creation of self-directed learning environments. These environments help learners monitor and improve their metacognitive skills through mechanisms such as self-explanation and personal reflection. By separating metacognitive instruction from purely educational content, these tools shift active control of the learning process to the learner (Braad et al., 2022).

However, differences in game design including learning objectives, types of interaction, feedback methods, and challenge levels can result in divergent learning outcomes. Some existing gamification frameworks have limited game elements to specific contexts, and a comprehensive, standardized definition that clearly explains how these elements influence different learner behaviors has yet to be established (Baniamerian & Esmaeeli, 2022).

This gap highlights the need to identify and compare the design features of educational games to determine the most effective combinations of game elements for developing metacognitive skills. Consequently, a systematic review of the existing literature is warranted. Such a review would identify and analyze the key design elements of games that enhance metacognitive skills, thereby facilitating the design and implementation of theory-based, game-driven educational interventions.

Metacognition and Its Impact on Learning

The significance of metacognition is well-documented in the literature. The concept of metacognition was first introduced by Flavell (1979) and refers to an individual's knowledge and awareness of their own cognitive processes, as well as their ability to monitor and control them. This framework of metacognition generally encompasses two main dimensions:

1. Metacognitive knowledge: knowledge about mental processes, learning strategies, and the conditions under which learning occurs.
2. Metacognitive regulation: processes such as planning, monitoring, and evaluating performance

during learning.

Research has shown that learners with stronger metacognitive skills tend to perform more effectively, flexibly, and deeply in their learning processes (Braad et al., 2022). These skills play a key role in self-regulated learning, problem-solving, and the transfer of knowledge to new situations (Dignath et al., 2008). Furthermore, previous studies indicated that metacognitive awareness serve as a predictive factor for academic success (Özçakmak et al., 2021). Therefore, metacognitive training is increasingly recognized as an effective approach to enhancing the quality of learning.

Educational Games as a Platform for Developing Metacognitive Skills

In recent years, researchers in the fields of education and learning technologies have argued that educational games offer a suitable platform for practicing and developing metacognitive skills (Kim et al., 2009). Games often present dynamic, problem-based situations in which players must plan, make decisions, adjust their strategies, and evaluate the outcomes of their choices. This cycle closely mirrors the processes of metacognition within an interactive environment (Gee, 2003).

In classical literature, game is defined as an activity in which individuals strive to achieve specific goals but proceed only along paths defined by the rules of the game, with acceptance of these constraints being a prerequisite for the activity to qualify as game (Suits, 1967). More recent sources describe games as structured systems of rules, goals, and player interaction, ranging from highly rule-bound to free-form and improvisational experiences (Fernández-Vara, 2019).

An educational game is an interactive, rule-based environment that actively engages learners in the learning process by purposefully integrating game elements and learning objectives (Plass et al., 2020). According to Plass et al. (2015), the design of educational games is based on several key components, including game mechanics, visual aesthetic design, narrative, motivational systems, music, and educational content. These elements collectively shape the learning experience, with each playing a distinct role in engaging the learner. According to the *Game-Based Learning Handbook* (Plass et al., 2020), in educational games, game mechanics (repetitive actions performed by the learner) are intentionally aligned with learning mechanics (activities designed to achieve educational objectives).

Based on the theoretical framework of Plass et al. (2020), as applied by Dever et al. (2024), "game mechanics" refer to the rules and mechanisms that shape the learner's repeated interactions with the game environment. These mechanics essentially represent the intersection between "instructional methods," which aim to facilitate learning, and "game design elements," which are intended to enhance engagement. When explicitly aligned with metacognitive objectives, such as planning, monitoring, and reflection, they allow for the observation and assessment of learners' metacognitive skills (Braad et al., 2020).

In contrast, "game dynamics" refer to the behavioral patterns and experiences that emerge when players interact with the mechanics, such as collaboration, competition, and peer feedback (Hofbauer & Sigmund, 2003). These dynamics provide the context for the actual activation of metacognitive skills. For instance, group discussion and collective decision-making can foster collaborative planning and reflection (Braad et al., 2020). Consequently, effective game design must create not only well-defined mechanics but also purposeful dynamics that reinforce feedback, inquiry, and reflection (Braad et al., 2020). Mechanics can be seen as the architectural blueprint of the game, while dynamics constitute the actual behavior and life within that structure. Effective game design ensures that players receive immediate feedback throughout their learning journey, enabling them to monitor and adjust their strategies. The narrative and story elements of a game can foster emotional and cognitive engagement, directing players' attention to their own thought processes (McGonigal, 2011).

However, despite the remarkable growth of research on educational games, evidence

suggests that most studies have focused on the overall effectiveness of games on academic performance, while paying less attention to design features that specifically target metacognitive skills (Zirawaga et al., 2017).

Furthermore, many studies have focused on the overall effectiveness of games rather than on how to design them effectively (Clark et al., 2016; Mayer, 2014). However, it remains unclear which specific game design elements such as the degree of player agency, the presence of social interaction, the provision of immediate feedback, difficulty levels, or competitive structures are more effective in fostering metacognitive components.

The qualitative review by Braad et al. (2020) is considered one of the first efforts to provide a comprehensive picture of the role of metacognition in game-based learning. By analyzing 24 studies, they identified nine types of metacognitive interventions in digital game environments and argued that educational game design should be developed with explicit consideration of these interventions and the extent to which they are integrated into gameplay. However, their review was limited to digital environments and did not examine the game design features that could enhance metacognition across both digital and non-digital contexts. Moreover, the review was conducted qualitatively and lacked a systematic structure for source selection and evaluation.

Other limited reviews, such as the study by Wouters et al. (2013), have examined the use of games for teaching cognitive skills; however, reviews specifically focusing on the design features of games that enhance metacognition remain scarce. Furthermore, in the Iranian research landscape, most studies including the systematic review by Baniamerian and Esmaeeli (2021) have addressed the general impact of educational games on learning, with limited attention to metacognitive mechanisms. This situation indicate that a comprehensive and systematic understanding of the design features influencing metacognition is still lacking.

Therefore, the present review was conducted systematically, based on standard systematic review guidelines, with the aim of updating previous findings and examining the design features of games that promote metacognition. A systematic review approach was employed to extract and categorize common components in the design of both physical and digital games through the analysis and comparison of empirical research findings. The main research question is formulated as follows:

What are the key features and elements of games that are effective in enhancing metacognitive skills?

Method

Search Strategy

For this systematic review, a comprehensive search of both international and domestic databases was conducted to identify all relevant empirical studies on educational game design and metacognitive skills. The databases searched included Scopus, ScienceDirect, Google Scholar, Web of Science, IranDoc, and NoorMags. The systematic search was carried out between September 18 and September 24, 2025. An updated search was also conducted on October 1, 2025, to ensure the inclusion of the most recent studies published up to that date. The search strategy was designed using a combination of Boolean operators (AND/OR) and a set of English and Persian keywords to ensure that the search process remained both comprehensive and precise. The English keywords included the following phrases, which are presented in Table 1. Persian equivalents were also used in searches of domestic databases.

Table 1. List of Keywords and Boolean Combinations Used in the Search.

OR		OR		OR
game mechanic game dynamics game feature game design game element game component	**AND**	game digital game serious game educational game board game card game	**AND**	metacognition metacognitive skills metacognitive awareness

The search terms were combined using Boolean operators to identify studies that directly addressed the role of games in the development of metacognitive skills. For example, the following combinations were used:

("game design" OR "game mechanics" OR "game elements") AND ("metacognition" OR "metacognitive skills")

The search also was limited to the period from 2015 to 2025 to focus on the most recent research over the past decade. Furthermore, only empirical studies and open-access articles were included to ensure that the data were fully analyzed.

Eligibility Criteria

For this systematic review, only studies meeting the following criteria listed in Table 2 were included in the analysis.

Table 2. Inclusion and exclusion criteria for studies in this systematic review.

Inclusion Criteria	Exclusion Criteria
Empirical studies involving an intervention, the implementation of a game, or measurement of a game's effect on cognitive or metacognitive skills.	Theoretical or review studies without empirical data or insufficient methodological data.
Published between 2015 and 2025.	Published before 2015.
Focused on development of metacognitive skills or related components.	Focused only on general learning or motivation without metacognitive components
Published in Persian or English.	Published in languages other than Persian or English.
Not limited to specific clinical populations	Focused on specific clinical populations.
Open-access.	Unavailable full text.

Study Selection and Screening

During the full-text screening phase, 32 initially eligible studies were thoroughly assessed. Of these, 17 were excluded due to insufficient empirical data, a lack of direct focus on metacognition, or unavailability of the full text. Consequently, 15 studies were selected as the final corpus for analysis. EndNote 20 was used to manage references and organize the included articles.

This process was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The study selection followed the PRISMA protocol across four stages: identification, screening, eligibility assessment, and final inclusion (Page et al., 2021).

During the initial identification stage, a total of 4,700 records were retrieved from the Scopus, ScienceDirect, Web of Science, Google Scholar, IranDoc, and NoorMags databases. After removing duplicates, the titles of the remaining articles were screened for relevance to the research question.

In the second stage (preliminary screening), 4,538 records were excluded due to irrelevance to the topics of metacognition and games. During the subsequent abstract review, an additional 130 articles were set aside as they did not focus on metacognitive skills or game design.

In the third stage (full-text review), the full texts of 32 potentially eligible studies were thoroughly assessed. Of these, 17 were excluded due to insufficient empirical data, lack of direct focus on metacognition, or unavailability of the full text.

Ultimately, 15 studies were selected as the final corpus for analysis. These articles originated from various countries and encompassed a range of approaches involving digital, card-based, and physical (in-person) games. A flowchart detailing the study selection process is presented in Figure 1.

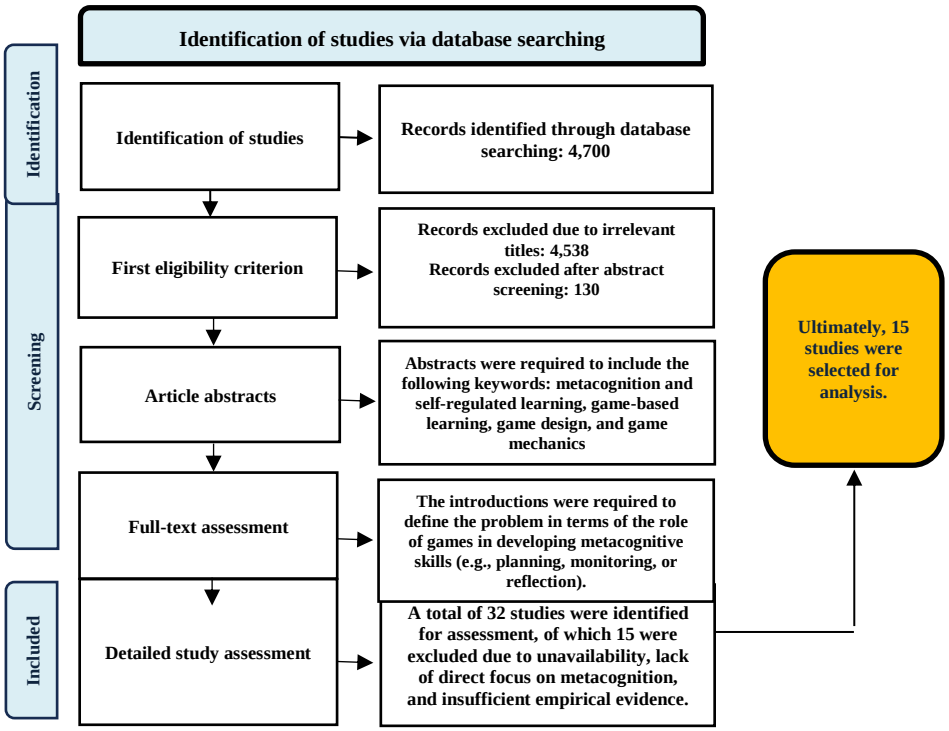

Figure 1. PRISMA flow diagram of the study selection process.

Data Extraction

For the content analysis of the selected studies, key information from each article was first summarized in a table. This table included the author(s) and year of publication, country, sample size, game type and implementation mode, game design features, and findings related to metacognitive skills. It served as the basis for coding and identifying common patterns across the studies.

The coding process was conducted using a qualitative content analysis approach. In the initial stage, a preliminary framework for data categorization was developed based on theoretical concepts of metacognition, such as planning, monitoring, evaluation, self-reflection, and strategy adjustment. Subsequently, while reviewing the study findings, new codes that emerged directly from the data—such as progressive challenge, immediate feedback, or group interaction—were added in an open manner to ensure comprehensive analysis.

In the next stage, similar codes were grouped into conceptual categories. Specifically, the data were analyzed along a main axis focusing on the design features of the games, including challenge structure, type of feedback, degree of player autonomy and decision-making, social interaction, narrative elements, reward systems, and implementation mode (individual or group-based).

To enhance the credibility of the analysis, the data were reviewed and compared iteratively to ensure consistency in coding and coherence across categories. Finally, common patterns across games and metacognitive skills were extracted as key themes. In the results section, these themes and their relationships with metacognitive components are reported in detail.

Quality Assessment

To assess the methodological quality of the studies included in the systematic review, the Mixed Methods Appraisal Tool (MMAT 2018) was used (Hong et al., 2018). This version is specifically designed for reviews encompassing a combination of qualitative, quantitative, and mixed-methods studies, facilitating coherent comparison and analysis of research quality. The MMAT 2018 includes two initial screening questions and five methodological criteria specific to each study design. In this study, to ensure a comprehensive appraisal, all criteria were applied to every study. Thus, the two screening questions (pertaining to the clarity of the research questions and

the appropriateness of the methodology), along with the five design-specific criteria (for qualitative, quantitative, or mixed-methods designs), were considered.

The MMAT scores were used solely to describe the methodological quality of the studies and to facilitate accurate interpretation of the evidence, rather than to exclude or weight studies. In line with the MMAT authors' recommendations (Hong et al., 2018), the final discussion focused on a qualitative analysis of each study's methodological strengths and weaknesses, considering limitations such as inadequate reporting of sampling or data analysis. The details of each study's scoring according to the MMAT criteria are provided in Tables 5–9 in the appendix.

Results

To describe the general characteristics of the studies included in the systematic review, Table 3 presents information on the authors, year of publication, country, sample size, research method, source of publication and methodological quality score based on the MMAT 2018 tool.

Table 3. General characteristics and methodological quality of the studies included in the systematic review.

Authors & Year	Country	Sample size	Journal	Study Design	MMAT Score
Chatzipanteli et al. 2015	Greece	71	American Journal of Educational Research	Mixed-methods	80%
Snow et al. 2015	USA	76	Proceedings of the 7th International Conference on Educational Data Mining	Quantitative – Descriptive	60%
Braad et al. 2019	Netherlands	7	Proceedings of the 13th International Conference on Game Based Learning (ECGBL 2019)	Mixed-methods	60%
Safay Honarvari & Moshkbid Haghighi 2019	Iran	30	Quarterly Journal of Child Mental Health	Quantitative – Non-randomized	60%
Fishovitz et al. 2020	USA	89	Journal of Chemical Education	Mixed-methods	60%
van Heereveld 2020	Netherlands	35	MSc Thesis, University of Groningen	Mixed-methods	60%
Toh & Kirschner 2020	Singapore	6	Computers & Education	Qualitative	100%
Stephanou & Karamountzos 2020	Greece	41	Research in Psychology and Behavioral Sciences	Quantitative – Non-randomized	70%
Beik 2020	Iran	30	MAc Thesis in Physical Education, Urmia University	Quantitative – Randomized Controlled Trial	80%
von Gillern & Stufft 2022	USA	31	Literacy	Qualitative	100%
Takada et al. 2023	Japan	20	JASAL Journal	Mixed-methods	60%
Wilson et al. 2023	Malaysia	25	Asian Journal of University Education (AJUE)	Qualitative	100%
Shaheen & Fotaris 2024	United Kingdom	210	The Proceedings of the 19th European Conference on Games Based Learning	Mixed-methods	70%
Çiftci & Yıldız 2024	Turkey	40	International Journal of Computers in Education	Quantitative – Non-randomized	80%
Raees Dehghan 2024	Iran	120	MAc Thesis in Educational Science, Farhangian University	Quantitative – Non randomized	80%

A systematic analysis of the studies included in this review revealed that, although the examined games differed in nature, platform (digital vs. physical), and target audience, they all employed a common set of design principles aimed at supporting learning and enhancing metacognitive skills. Coding and comparative analysis of the studies led to the identification of several key interrelated dimensions, each playing a distinct role in activating metacognitive skills. These dimensions included game platform and procedure, objectives, mechanics, dynamics, aesthetic elements, pacing patterns, and feedback mechanisms (Figure 2).

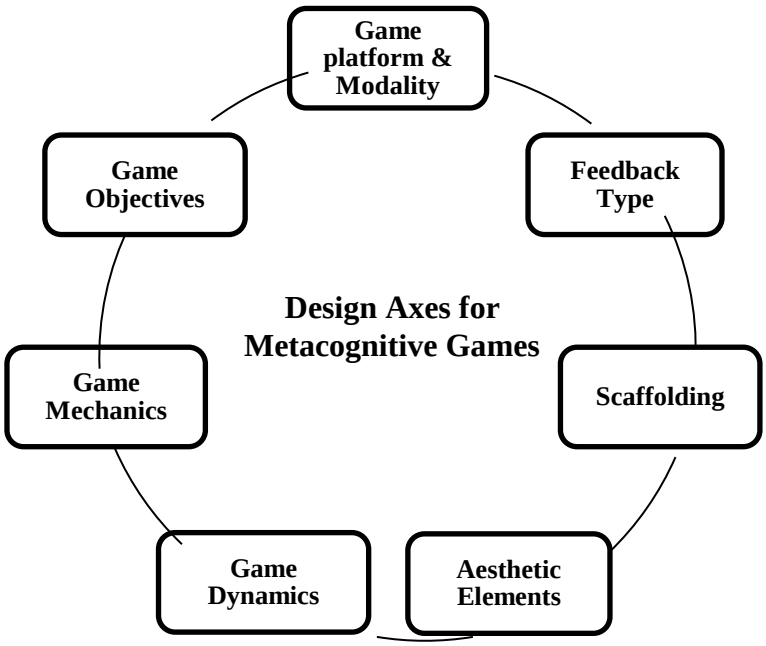

Figure 2. Core design axes identified across metacognition-enhancing educational games.

Game Platform and Modality

Analysis of the studies indicate that metacognitive games are implemented in two main settings group and individual—across both physical and digital platforms, promoting distinct mechanisms for enhancing metacognition.

1. Group-Based Games

This category leverages direct social interaction to foster collective reflection, articulation of reasoning, and evaluation of diverse perspectives. Card games such as *Guided Heads-Up* and *Smarties* are implemented in classroom settings with small groups and the need to provide clues, engage in discussion, and persuade teammates directly promotes self-evaluation and reflective thinking (Fishovitz et al., 2020; Takada et al., 2023).

In sports environments, interventions based on the Teaching Games for Understanding (TGfU) approach in basketball (Stephanou & Karamontzos, 2020; Chatzipanteli et al., 2015) and futsal (Beik, 2020) employ group-based game design emphasizing tactical problem-solving, leading to improved planning and decision-making. Teacher questioning in these contexts plays a pivotal role in activating metacognitive Skills.

Digital games such as *Minecraft* (von Gillern & Stufft, 2022) and *The Sims 4* (Wilson et al., 2023) are also played in multi-person groups. Interaction within these virtual environments facilitates collective reflection on the learning process and the development of conditional metacognitive knowledge knowing why and when to use a particular strategy.

2. Individual-Based Games

These games are predominantly digital and provide a safe space for practicing self-regulation, personal planning, and self-monitoring. Games such as *MeCo* (Braad et al., 2019) and *The Mend* (Shaheen & Fotaris, 2024) are played individually on web or mobile platforms. By simulating the self-regulated learning cycle and incorporating planned reflective pauses, these games enhance emotional self-awareness and planning skills.

The *Learn2Conquer* application (van Heereveld, 2020) and the Scratch programming environment (Çiftçi & Yıldız, 2024) serve as individual platforms that require users to predict, test, debug, and iterate. This process constitutes a rich metacognitive activity that directly contributes to increased metacognitive awareness and skills.

Game Objectives

Analysis of the selected studies reveal that games designed to enhance metacognition have

highly specific objectives compared to purely entertainment-focused games. These objectives can be categorized as follows:

1. Explicitly Promoting Reflective Thinking and Self-Assessment

Many games explicitly list reflective thinking, self-assessment of knowledge, and self-awareness as primary goals. For instance, *Guided Heads-Up* is designed to promote metacognition and self-assessment of learning (Fishovitz et al., 2020). Similarly, *The Mend*, which employs the Reflective Game Design (RGD) framework, aims to enhance emotional resilience, self-awareness, and critical thinking (Shaheen & Fotaris, 2024). The card game *Smarties* is also developed to enhance reflective thinking about language learning strategies (Takada et al., 2023).

2. Direct Practice of Metacognitive Skills and Strategies

Some games focus on practicing and implementing the metacognitive cycle (planning, monitoring, and evaluation). For example, *Learn2Conquer* is designed to increase motivation and repeatedly practice metacognitive skills through goal design, planning, activity execution, reflection, and reward (van Heereveld, 2020). The digital game *MeCo* similarly aims to increase metacognitive awareness through exploratory missions (Braad et al., 2019). Çiftçi and Yıldız (2024) also emphasize practicing metacognitive strategies through Scratch-based game design to enhance metacognitive awareness and mathematics achievement.

3. Creating Problem-Solving Environments to Elicit Metacognition

Games in this category simulate complex, non-routine situations whose resolution requires metacognitive engagement. For instance, in the TGfU approach in physical education, basketball and futsal games aim not merely to score points but to solve tactical problems during gameplay, compelling students to plan, monitor, and evaluate their strategies (Stephanou & Karamountzos, 2020; Chatzipanteli et al., 2015). Similarly, *The Sims 4*, with its retail store management goal, provides an environment for eliciting planning, monitoring, and evaluation (Wilson et al., 2023).

4. Enhancing Foundational Executive and Metacognitive Skills

Studies involving younger children focus on strengthening foundational metacognitive skills. For example, Safay Honarvari and Moshkbid Haghighi (2019) use rhythmic games to enhance planning, organization, and metacognition in preschoolers. Raees Dehghan (2024) also aims to strengthen metacognitive skills (self-awareness, goal-setting, self-regulation, problem-solving) through elementary school games.

5. Facilitating Self-Directed and Exploratory Learning

Some games create open, rich environments that foster self-directed learning. Toh and Kirschner (2020) show that narrative-exploration games like *The Last of Us* and *Mass Effect* provide an environment for self-directed learning and reflection, naturally challenging players' metacognition.

6. Stealth Assessment of Metacognitive Skills

Finally, some studies focus on the indirect and hidden assessment of metacognition. Snow et al. (2015), analyzing behavioral patterns in the game-based environment *iSTART-2*, seek to stealthily assess learner agency and self-regulation through metrics such as entropy, representing a novel approach to evaluating metacognition.

Game Mechanics

Analysis of the data obtained from coding the studies revealed that a variety of game mechanics were employed in the reviewed games, each of which contribute to the enhancement of metacognitive components in distinct ways. These mechanics can be classified into several broad categories:

1. Dialogue-, Choice-, and Reasoning-Based Mechanics

In *Guided Heads-Up*, mechanics such as providing clues from general to specific using technical language and correcting mistakes by teammates compel participants to actively evaluate and revise their knowledge, thereby strengthening self-assessment and error correction (Fishovitz et al., 2020). In *Smarties*, mechanics such as selecting a strategy from a set of cards for a learning

situation and subsequently explaining the reasoning for their choice within the group prompt players to select appropriate strategies and reflect on their own learning processes (Takeda et al., 2023). In *MeCo*, the binary choice mechanic, implemented via dragging cards left or right within a dynamic narrative, engages players in the cycle of planning, execution, and evaluation (Braad et al., 2019).

2. Design-, Construction-, and Problem-Solving Mechanics

Çiftçi and Yıldız (2024) demonstrate that fundamental block-based programming mechanics in Scratch, such as movement control, using conditional statements (if…then), and implementing mathematical calculations, naturally immerse students in the processes of prediction, planning, monitoring, and debugging, all of which are key components of metacognition. In the video games reviewed by Toh and Kirschner (2020), mechanics such as solving puzzles, interacting with the environment to find resources, and learning from failure facilitate the emergence of metacognitive strategies, including trial-and-error, reflection, and adaptation.

3. Simulation and Managerial Decision-Making Mechanics

In *The Sims 4: Get to Work*, mechanics such as making decisions regarding store location, pricing, and staff management require students to plan, monitor performance (e.g., sales reports), and evaluate their business strategies, thereby contributing to the enhancement of conditional knowledge (i.e., knowing when and why to use a particular strategy) (Wilson et al., 2023).

4. Gamification Mechanics for Structured Metacognitive Practice

This category of mechanics directly implements metacognitive frameworks within game elements. In the *Learn2Conquer* application, mechanics such as goal setting, using a timer to monitor time, and receiving rewards (gold) for engaging in reflection provide a structured framework for practicing planning, monitoring, and evaluation skills (van Heereveld, 2020).

5. Physical and Kinesthetic Mechanics in Non-Digital Environments

In the TGFU model, mechanics such as modifying rules (e.g., requiring two passes before a shot), reducing the number of players, and defining a tactical problem as the primary objective encourage players to continuously think about the game, find solutions, and evaluate their performance rather than merely executing skills. This leads to improvements in declarative, procedural, and conditional knowledge (Chatzipanteli et al., 2015; Stephanou & Karamountzos, 2020). Rhythmic games, through mechanics such as following the coach's instructions and motor coordination with rhythm, contribute to the enhancement of executive functions and metacognition in children by improving motor planning and organization (Safay Honarvari & Moshkbid Haghighi, 2019).

6. Agency and Choice Mechanics

Some games promote players' monitoring of their own behavior and planning of their learning path by granting them agency. In the *iSTART-2* system, the free choice mechanic, allowing selection of activities from a main menu, enables researchers to measure users' behavioral entropy as a hidden indicator of self-regulation. Findings indicate that orderly interaction (lower entropy), regardless of the activity type, is associated with higher-quality metacognitive outputs (e.g., self-explanations) (Snow et al., 2015).

Game Dynamics

Furthermore, various dynamics are identified in the games from the selected studies, which can be categorized into three groups:

1. Social Interaction and Strategic Dialogue

This dynamic is evident in both in-person and digital group games. In games such as *Guided Heads-Up* (Fishovitz et al., 2020) and *Smarties* (Takada et al., 2023), discussions and exchanges aimed at selecting the best strategy or clue, as well as in TGfU environments in physical education (Stephanou & Karamountzos, 2020; Chatzipanteli et al., 2015), where dialogues about tactics occur, compel players to revise knowledge, reason, and evaluate others' perspectives. This directly strengthens metacognitive reflection and evaluation skills.

2. Action–Feedback–Adjustment Cycle

This fundamental cycle is observed in design-based learning environments (such as Scratch; Çiftçi & Yıldız, 2024) and digital games (such as *iSTART-2*; Snow et al., 2015, and *Learn2Conquer*; van Heereveld, 2020). In this model, through mechanisms such as trial and error, debugging, receiving immediate feedback (points, rewards, game status), and subsequently adjusting their strategies, players are continuously engaged in monitoring their progress and evaluating the effectiveness of their performance.

3. Reflective Pauses and Self-Regulation

Some games, such as *The Mend* (Shaheen & Fotaris, 2024), incorporate planned pauses for reflection (e.g., journaling or answering metacognitive questions), and rhythmic games (Honarvari & Moshkbid Haghighi, 2019) require coordination, attention, and response inhibition. Both approaches directly target self-awareness, inhibition, and self-regulation. Overall, these dynamics create challenging, interactive, and adaptive environments that provide a natural context for the frequent activation and reinforcement of key metacognitive components.

Aesthetic Elements

Analysis of the studies indicates that the aesthetic elements of the games can be categorized into several general patterns, each contributing to the enhancement of metacognitive components. These patterns are:

1. Simplicity and Minimalism for Content Focus and Interaction

These games utilize simple designs, devoid of complex elements, to fully direct the player's attention toward the targeted cognitive and metacognitive skills. *Guided Heads-Up* (Fishovitz et al., 2020), with simple printed cards, and *The Mend* (Shaheen & Fotaris, 2024), with a minimalist user interface, minimize distractions and provide a space for deep thinking and reflection. Similarly, the *Learn2Conquer* application (van Heereveld, 2020) features a simple, color-coded interface designed primarily to reduce extraneous cognitive load and focus attention on planning and reflection.

2. Simulation and Visual Metaphors for Visualizing Abstract Concepts

These games employ visual metaphors to concretize and facilitate understanding of internal mental processes such as emotion regulation, problem-solving, and planning. *The Mend* (Shaheen & Fotaris, 2024) uses the visual metaphor of home renovation to represent the restructuring of emotions and critical thinking. In *The Sims 4* (Toh & Kirschner, 2020), realistic simulated graphics and visual cues (e.g., employee wellness status) allow students to observe the consequences of their decisions in a safe, concrete environment, which strengthens their metacognitive conditional knowledge (i.e., knowing when and why a strategy is effective).

3. Storytelling and Emotional Immersion for Creating Deep Engagement

The games examined by Toh and Kirschner (2020), including *The Last of Us* and *BioShock*, leverage strong narratives, realistic and emotional environments, and music to evoke profound cognitive and emotional responses in players. This engagement encourages players to think critically, engage in moral reasoning, and reflect on their choices. *MeCo* (Braad et al., 2019) similarly uses a sci-fi setting and humorous narrative to create an engaging space for metacognitive exploration.

Scaffolding

Based on evidence from the studies included in this review, scaffolding patterns in metacognition-enhancing games can be classified into four main categories:

1. Hierarchical Pattern

This pattern is characterized by a gradual increase in complexity and the step-by-step presentation of content. For example, in the TGFU approach, games progress from simple to more complex situations (Chatzipanteli et al., 2015; Stephanou & Karamountzos, 2020). Similarly, rhythmic game sessions are designed hierarchically (Honarvari & Moshkbid Haghighi, 2019).

2. Cyclical Pattern

This pattern is organized around cycles of action and reflection. *MeCo* utilizes a three-stage cycle comprising forethought, performance, and reflection (Braad et al., 2019). Likewise, *The*

Mend incorporates planned reflective pauses to support iterative thinking (Shaheen & Fotaris, 2024).

3. Structured Pattern

This pattern relies on a pre-defined sequence to guide thinking. In *Guided Heads-Up*, clues are provided from general to specific (Fishovitz et al., 2020). In the Scratch environment, teacher guidance and peer feedback are incorporated to provide additional structure (Çiftçi & Yıldız, 2024).

4. Free-Form Pattern

This pattern emphasizes learner agency and freedom in choosing activities. In the *iSTART-2* system, players are able to freely select the sequence of activities (Snow et al., 2015). In narrative games, branching choices enable personalized sequencing tailored to individual players (Toh & Kirschner, 2020).

Feedback Patterns

Based on analyses of the selected studies, feedback patterns in games designed to enhance metacognitive components are divided into two main categories:

1. Social Feedback

One of the most frequently used types of feedback in metacognitive games, social feedback typically occurs through interpersonal interactions in group settings. Examples include peer feedback during discussions and exchanges aimed at selecting the best strategy in *Guided Heads-Up* (Fishovitz et al., 2020) and the card game *Smarties* (Takada et al., 2023), as well as teacher facilitation during the feedback process (Fishovitz et al., 2020). Another form of social feedback involves the use of leaderboards to create competitive motivation (van Heereveld, 2020).

2. In-Game Feedback

This type of feedback is provided immediately during the player's interaction with the game environment. Examples include visual, auditory, and animated cues in *The Mend* (Shaheen & Fotaris, 2024), controller vibration in video games (von Gillern & Stufft, 2022), and reward-based feedback such as points, leveling up, or achievements in the *Learn2Conquer* application (van Heereveld, 2020)

To identify common patterns between game design and metacognitive components, key characteristics of each study including the game's name and type, implementation method, design elements, targeted metacognitive components, and main results—are summarized in Table 4. This table serves as the basis for qualitative analysis and the development of main themes in the findings section.

Table 4. Summary of key study features related to game design and metacognitive components.

Authors & Year	Game Title and Mode of Play	Key Game Features	Targeted Metacognitive Skills	Main Metacognition-Related Findings
Chatzipanteli et al. 2015	Basketball (TGFU) In-person – Group	Reducing player numbers/ smaller play area/ focus on tactical objectives/ interaction with coach.	Declarative knowledge, procedural knowledge, conditional knowledge	The experimental group scored higher on the metacognition questionnaire, with qualitative analysis showing enhanced tactical problem-solving, analysis, monitoring, and evaluation.
Snow et al. 2015	iSTART-2 Digital – Individual	Personalized responses to content/ identifying instructional strategies/ customizable interface/ progress tracking/ self-directed learning.	Self-regulation, behavioral monitoring and planning, behavioral control in choices, monitoring and evaluation	Lower behavioral entropy in the game environment indicating better self-regulation was linked to metacognitive success.

Braad et al. 2019	MeCo Digital – Individual	Humorous, dynamic narrative/ selectable learning goals/ self-regulated learning cycle/ sci-fi with cartoon characters.	Planning, monitoring, self-regulation, and evaluation of learning	The game was engaging but did not increase metacognitive awareness or transfer skills to real-world contexts.
Safay Honarvari & Moshkbid Yazdi	Rhythmic Games In-person – Group	Rhythmic, synchronized movements/ group coordination/ responding to auditory and visual stimuli.	Planning, organizing	Rhythmic games significantly improved children's metacognitive skills (planning and organizing) and related executive functions.
Fishovitz et al. 2020	Guided Heads-Up In-person – Group	Sequential clues/ use of technical language/ general-to-specific & high-to-low thinking/ collaboration/ peer error correction.	Self-assessment of knowledge, error correction, reflection, prioritization of information, awareness of learning processes	The game supported self-knowledge assessment and increased student engagement and understanding.
van Heereveld 2020	Learn2Conquer (L2C) Digital – Individual	Reward system/ equipment upgrades/ learning strategies via victories/ leaderboard/ timer/ gradual difficulty.	Planning, monitoring, evaluation	The game did not significantly enhance metacognitive awareness but fostered initial motivation.
Toh & Kirschner 2020	The Last of Us Mass Effect The Walking Dead Bioshock Digital – Individual	Exploration for resources, hidden paths, and clues/ dialogue with NPCs/ moral decisions/ puzzles/ learning from feedback/ free decision-making.	Planning, evaluation, and strategy adjustment	Players employed metacognitive strategies (planning, evaluation, strategy adjustment) and emotional regulation for self-directed learning during challenges.
Stephanou & Karamountzos 2020	Basketball (TGFU) In-person – Group	Simplified rules / focus on passing, dribbling, shooting/ group cooperation/ tactical problem-solving/ teacher feedback.	Metacognitive knowledge (declarative, procedural, conditional, information management) and metacognitive regulation (planning, monitoring, problem-solving, evaluation, mental visualization)	The TGFU approach enhanced metacognitive knowledge and regulation abilities.
Beik 2020	Futsal Game Practice (TGFU) In-person – Group	Modifying player numbers/ rule and scoring adjustments/ individual constraints for balance.	Planning, self-monitoring, performance evaluation, information management	The experimental group showed significant improvements in metacognitive behavior, performance, decision-making speed, and accuracy.
von Gillern & Stufft 2022	Minecraft, Story Mode LEGO Worlds Zoo Tycoon Digital – Group	Building and resource gathering/ combat and survival/ group collaboration/ symbol-based decisions/ open-world exploration/ dynamic events.	Self-regulation, planning, comprehension monitoring, metacognitive reflection	Games clearly promoted metacognition; students demonstrated self-reflective behaviors.
Takada et al. 2023	Smarties In-person – Group	Strategy cards for hypothetical scenarios/ reveal and justify reasoning/ group discussion/ persuading others.	Selecting appropriate strategies, monitoring and evaluation, self-regulation	Games strengthened reflective thinking at multiple levels, including linking to real learning, gaining new perspectives, and reflecting on prior knowledge.
Wilson et al. 2023	The Sims 4: Get to Work Digital – Group	Marketing strategies/ financial management/ sales analysis/ customer & employee interaction/ responding to market trends.	Declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, evaluation, information management strategies, debugging strategies	Students exhibited 3 types of metacognitive knowledge (declarative, procedural, conditional) and ۵ regulatory processes (planning, information management, comprehension monitoring, error correction, evaluation).

Shaheen & Fotaris 2024	The Mend Digital – Individual	Puzzle solving/ narrative choices/ breathing exercises/ memory logging/ emotion tracking/ character interaction/ reflective pauses/ ethical decisions.	Emotional self-awareness, emotional regulation	The RGD version increased critical thinking, personal reflection, and emotional awareness.
Çiftci & Yıldız 2024	Scratch-Designed Games Digital – Individual	Scratch programming / game rule design / calculations / immediate feedback / interactive scenarios / trial-and-error / debugging / predicting outcomes.	Planning, monitoring, evaluation	The game design process significantly increased metacognitive awareness (mean scores from 31.25 to 65.45) and improved math performance.
Raees Dehghan 2024	Elementary School Games In-person – Group	Physical, imitative, symbolic, imaginative, and rule-based mechanics / cooperation / self-expression / role-play / rule negotiation / exploration.	Self-awareness, self-regulation, problem-solving, behavioral monitoring and evaluation	Elementary school games positively impacted all metacognitive skill components (self-awareness, goal-setting, self-regulation, problem-solving, monitoring, and evaluation).

Discussion and Conclusion

This systematic review was conducted to identify, analyze, and categorize the key design features of educational games both digital and non-digital that were effective in enhancing metacognitive skills. To address the primary research question, "What are the key features and elements of games that effectively enhance metacognitive skills?" empirical studies published between 2015 and 2025 were examined and analyzed, providing a systematic and up-to-date overview of the most effective design elements in this domain.

Analysis of the studies included in this review indicate that in collaborative games, metacognition often manifest in a social form. A key mechanism is "dialogue-driven reflection" a process in which collective decision-making, articulating reasoning, and observing others' strategies enhance cognitive self-awareness (Iiskala et al., 2011). As also shown in other studies, including Iiskala et al. (2015), the findings of this review confirm that requiring players to defend their decisions or evaluate alternative solutions develops their metacognitive skills. Studies such as Chatzipanteli et al. (2015) and Takada et al. (2023) further indicate that group interaction serve as a starting point for cognitive self-evaluation, with gameplay providing a natural context for this social process to occur.

However, a different pathway is observed in individual digital games. Findings from MeCo (Braad et al., 2019) and iSTART-2 (Snow et al., 2015) indicate that a gradual progression of challenges, coupled with continuous feedback, fosters the internalization of skills such as prediction, monitoring, and error correction. In these games, the individual engages in a dialogue with the self a process described by Vygotsky (1978) as inner speech, which plays a crucial role in cognitive self-regulation. From this perspective, digital games can serve as laboratories for practicing cognitive self-regulation, provided their feedback structures are not merely rewarding but also reflective and explanatory.

A central theme that emerges across all studies is the importance of scaffolding and progression in metacognitive development. According to Vygotsky (1978), optimal learning occurs within an individual's zone of proximal development—the gap between what a learner can accomplish independently and what they can achieve with guidance and collaboration. Game designs that progressively increase difficulty create precisely these conditions, enabling

learners to tackle more complex challenges by relying on structured support (van Heereveld, 2020; Stephanou & Karamontzus, 2020; Chatzipanteli et al., 2015; Beik, 2020).

Qualitative analysis of the studies reveals that emotions and aesthetic elements in educational games do not merely serve a decorative or motivational role; rather, they function as an integral part of the learning process. In games with strong narratives, metaphors, or artistic design—such as The Mend (Shaheen & Fotaris, 2024)—the creation of meaningful emotional situations contributes to increased cognitive engagement, reflective thinking, and higher-level processing. This approach aligns with neuroscientific evidence on the functional integration of emotion and cognition, particularly the interaction between the prefrontal cortex and the amygdala, which play key roles in regulating attention, decision-making, and learning (Pessoa, 2008).

Another important finding relates to the dynamic interplay between competition and cooperation in the metacognitive experience. Healthy competition, by activating intrinsic motivation and cognitive focus, drives individuals to analyze their errors and strategies more meticulously, whereas cooperation provides opportunities to review situations from others' perspectives and compare different mental models. Integrating both competition and cooperation in games, therefore, can enhance reflection from both internal and external standpoints. This dynamic reflects the patterns observed in studies by Chatzipanteli et al. (2015) and Fishovitz et al. (2020), and can be regarded as a complementary mechanism for fostering both intrapersonal and interpersonal reflection.

An important factor that warrants closer attention is the influence of cultural and contextual variables on both game design and metacognitive outcomes. Educational games are not culturally neutral; learners' perceptions of challenge, feedback, collaboration, competition, and autonomy are shaped by sociocultural norms, educational traditions, and classroom practices (Ordin et al., 2024). For instance, in collectivist cultures, game designs emphasizing collaboration, peer dialogue, and shared problem-solving may more effectively activate socially shared metacognition, whereas in individualistic contexts, autonomy-focused mechanics and self-paced reflection may better support individual metacognitive regulation (Hadwin, Järvelä, & Miller, 2011; Ordin et al., 2024).

The integration of metacognitive features within games is not context-independent but is strongly mediated by the surrounding educational ecosystem. As Dichev and Dicheva (2017) highlight in their critical review of gamification in education, factors such as curriculum constraints, prevailing assessment cultures, teacher readiness and roles, and learners' familiarity with game-based learning fundamentally shape how these features are perceived, adopted, and utilized. Consequently, the effectiveness of metacognitive game design features should be interpreted within the specific cultural and educational contexts in which they are implemented, rather than assumed to be universally transferable .

Despite the documented benefits of metacognition-oriented game design, several practical challenges may constrain the successful implementation of these features in real educational settings. A key challenge lies in the time and resource demands associated with designing, facilitating, and integrating games that incorporate reflective pauses, adaptive feedback, and scaffolding mechanisms within already crowded curricula. Teachers may require additional training to effectively guide metacognitive dialogue, support reflection, and balance gameplay with instructional objectives.

The integration of digital games into formal educational assessment is further complicated by both technological and methodological constraints. Technologically, uneven access to devices, variable software stability, and inconsistent technical infrastructure across educational institutions can impede reliable and equitable implementation (Udeozor et al., 2024). Methodologically, designing and deploying game-based assessments is complex; aligning in-game tasks with specific learning outcomes, extracting meaningful data from player

interactions, and interpreting these data to infer competency levels present significant challenges for educators (Udeozor et al., 2024). These difficulties highlight the need for assessment frameworks that are not only pedagogically robust but also pragmatically feasible across diverse classroom contexts .

Finally, the present review indicates that an educational game reaches its highest effectiveness when it focuses not solely on content but on the process of thinking in action. Successful design places the learner in situations where action and reflection are continuously intertwined.

Overall, the analysis of findings reveals that the most effective game designs are those that integrate phased scaffolding with progressively increasing levels of challenge, allowing learners to move gradually from guided engagement toward self-regulation. Effective designs also incorporate immediate, social, or in-game feedback that supports ongoing monitoring and self-evaluation. In addition, games that create opportunities for interaction, reflective dialogue, and collaborative decision-making tend to strengthen metacognitive engagement.

Another important feature is achieving a balance among emotional appeal, cognitive involvement, and aesthetic design, which ensures that the game remains both engaging and purposeful. Finally, providing learners with meaningful choice and agency enhances personalization and encourages deeper strategic thinking.

From a practical standpoint, the results of this review can serve as a valuable guide for instructional designers and cognitive science researchers. By integrating the core components of challenge, feedback, reflection, and scaffolding, they can create games that not only convey knowledge but also cultivate the process of “thinking about thinking” in learners.

Limitation

This systematic review, like any study, has several limitations. First, the search was limited to studies published in Persian and English, which may have introduced language bias and led to the exclusion of valuable research in other languages. Second, the omission of certain studies due to lack of open access may have influenced the final findings. Third, the considerable diversity in game types (digital, physical, card-based) and metacognitive assessment tools made it unfeasible to conduct a quantitative analysis or direct numerical comparison across studies. Finally, due to reporting limitations in some of the included articles, details regarding game design or implementation were not always clear, which affected the transparency of the design element classification. Therefore, the findings of this review should be interpreted in light of these limitations.

Recommendation

Based on the findings of this review, it is recommended that future research employ more rigorous and longitudinal designs to better determine the long-term stability of metacognitive effects fostered by gameplay. More transparent reporting of intervention details, along with the use of multi-method assessment tools—combining self-report measures, observation, and functional performance metrics—would substantially enhance the quality of the evidence. Furthermore, investigating the specific impact of different game mechanics, social dynamics, and scaffolding patterns on distinct components of metacognition (such as planning, monitoring, and evaluation) could contribute to the development of more precise frameworks for educational game design. From a practical perspective, collaboration among game designers, cognitive scientists, and educators is essential to create games that are not only engaging but also intentionally and effectively strengthen metacognitive skills.

Declarations

Author Contributions

The conception and design of the study were developed by M.G and R.A. The database search, data extraction, and qualitative synthesis were conducted by M.G. Supervision, validation, and

critical revision of the manuscript were carried out by R.A. Both authors contributed to drafting and revising the manuscript and approved the final version.

Data Availability Statement

The datasets analysed in this review consist entirely of previously published studies, all cited and summarized in the article. Additional information is available from the corresponding author upon request.

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Ethical considerations

As this study is a systematic review of existing literature, it did not involve any direct interaction with human or animal subjects. All original publications have been appropriately cited, and no ethical approval was required for this study.

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Conflict of interest

The authors hereby state that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The entire research process was conducted with a commitment to integrity and objectivity.

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Appendix

Tables 5–9 illustrate the scoring of studies based on the MMAT tool.

Table 5. The scoring of mixed-methods studies according to the MMAT tool.

Authors & Year	Design	Divergences between qualitative and quantitative results are addressed.	Each component adheres to its respective quality criteria.	Interpretation of combined results is coherent and justified.	Qualitative and quantitative components are effectively integrated.	The rationale for using a mixed methods design is clearly justified.	MMT Score
Chatzipanteli et al. (2015)	Mixed Methods	✕	✓	✓	✓	✓	80%
Braad et al. (2019)	Mixed Methods	✓	✕	✓	✕	✓	60%
Fishovitz et al. (2020)	Mixed Methods	✕	✕	✓	✓	✓	60%
van Heereveld (2020)	Mixed Methods	✕	✓	✓	✓	✕	60%
Takada et al. (2023).	Mixed Methods	✕	✓	✓	✓	✕	60%
Shaheen et al. (2024)	Mixed Methods	?	✕	✓	✓	✓	%70

Table 6. The scoring of Quantitative - Non-randomized studies according to the MMAT tool.

Authors & Year	Design	Interventions are clearly described and consistently applied.	Potential confounders are identified and addressed in design or analysis.	Outcome data are complete for participants.	Measurements are valid, reliable, and appropriate for the study objectives.	Participants are representative of the target population.	MMT Score
Safay Honarvari & Moshkbid Haghighi (2019)	Quantitative - Non-randomized	✓	✕	✓	✓	✕	60%
Stephanou & Karamountzos (2020)	Quantitative - Non-randomized	✓	✓	?	✓	✕	70%
Raees Dehghan (2024)	Quantitative - Non-randomized	✓	✕	✓	✓	✓	80%
Çiftci & Yıldız (2024)	Quantitative - Non-randomized	✓	✕	✓	✓	✓	80%

Table 7. The scoring of Quantitative - Randomized Controlled Trial study according to the MMAT tool

Authors & Year	Design	Outcomes are measured reliably and appropriately	Participants and personnel are blinded to the intervention where possible	Outcome data are complete for all participants	Intervention and control groups are comparable at baseline	Participants are randomly assigned to intervention groups	MMT Score
Beik (2020)	Quantitative - Randomized Controlled Trial	✓	✕	✓	✓	✓	80%

Table 8. The scoring of Quantitative - Descriptive study according to the MMAT tool.

Authors & Year	Design	Statistical analyses are appropriate to answer the research question	Response rate is adequate and accounted for	Measurements are reliable, valid, and appropriate	Sample is representative of the target population	Sampling strategy is relevant to the research question	MMT Score
Snow et al. (2015)	Quantitative - Descriptive	✓	✕	✓	✕	✓	60%

Table 9. The scoring of Qualitative studies according to the MMAT tool.

Authors & Year	Design	There is coherence between data collection, analysis, and interpretation.	Results and interpretations are well substantiated by the data.	Findings are clearly derived from the collected data.	Data collection methods are adequate and suitable for the study objectives.	The study uses an appropriate qualitative approach to address the research question.	MMT Score
Toh & Kirschner (2020)	Qualitative	✓	✓	✓	✓	✓	100%
von Gillern & Stufft (2022)	Qualitative	✓	✓	✓	✓	✓	100%
Wilson et al. (2023)	Qualitative	✓	✓	✓	✓	✓	100%