psychiatry international

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Review

Mental Imagery between Cognition and Emotion: A Narrative Review

Francesco Maria Boccaccio [1], Alessia Pennisi [1], Claudia Savia Guerrera [1], Giuseppe Alessio Platania [1,*], Vittoria Torre [1], Simone Varrasi [1], Venera Francesca Vezzosi [2], Flavia Coco [1], Sabrina Castellano [1,†] and Concetta Pirrone [1,†]

[1] Department of Educational Sciences, University of Catania, 95124 Catania, Italy; francesco.boccaccio@phd.unict.it (F.M.B.); pennisialessia19@gmail.com (A.P.); claudia.guerrera@phd.unict.it (C.S.G.); vittoria.torre@phd.unict.it (V.T.); simone.varrasi@phd.unict.it (S.V.); flavia.coco99@hotmail.it (F.C.); sabrina.castellano@unict.it (S.C.); concetta.pirrone@unict.it (C.P.)
[2] Unità Operativa Complessa di Neuropsichiatria Infantile, Presidio Ospedaliero di Acireale, ASP 3 Catania, 95024 Acireale, Italy; veravezzosi@libero.it
* Correspondence: giuseppe.platania@phd.unict.it
† These authors contributed equally to this work.

Abstract: Mental imagery is a cognitive ability that enables individuals to simulate sensory experiences without external stimuli. This complex process involves generating, manipulating, and experiencing sensory perceptions. Despite longstanding interest, understanding its relationship with other cognitive functions and emotions remains limited. This narrative review aims to address this gap by exploring mental imagery's associations with cognitive and emotional processes. It emphasizes the significant role of mental imagery on different cognitive functions, with a particular focus on learning processes in different contexts, such as school career, motor skill acquisition, and rehabilitation. Moreover, it delves into the intricate connection between mental imagery and emotions, highlighting its implications in psychopathology and therapeutic interventions. The review also proposes a comprehensive psychometric protocol to assess mental imagery's cognitive and emotional dimensions, enabling a thorough evaluation of this complex construct. Through a holistic understanding of mental imagery, integrating cognitive and emotional aspects, researchers can advance comprehension and application in both research and clinical settings.

Keywords: mental imagery; cognition; learning; emotional imagery; psychometric protocol

Citation: Boccaccio, F.M.; Pennisi, A.; Guerrera, C.S.; Platania, G.A.; Torre, V.; Varrasi, S.; Vezzosi, V.F.; Coco, F.; Castellano, S.; Pirrone, C. Mental Imagery between Cognition and Emotion: A Narrative Review. *Psychiatry Int.* **2024**, *5*, 697–717. https://doi.org/10.3390/psychiatryint5040049

Academic Editor: Marco Colizzi

Received: 30 March 2024
Revised: 17 September 2024
Accepted: 27 September 2024
Published: 9 October 2024

1. Introduction

Mental imagery, often referred to as the mind's eye or the internal visualization process, is a powerful cognitive ability that allows one to mentally simulate sensory experiences without external stimuli. It involves creating, manipulating, and experiencing sensory perceptions in the absence of direct sensory input, such as sight, sound, taste, touch, and smell [1–4].

According to Kosslyn's theory, different cognitive stages are required to generate and manipulate mental images [5]. These methods of production encompass image generation, namely the capability to create new mental images or adopt ones that already exist to generate novel representations or ideas; image maintenance, the skill to sustain and hold mental images in working memory over short periods for manipulation or comparison; image inspection, the ability to examine and analyze details within mental images, focusing on specific features or attributes; and image transformation, the skill to mentally rotate, manipulate, or transform visual images to simulate different perspectives or arrangements [6].

Mental imagery functions as a cognitive tool, supporting the brain's ability to navigate daily challenges. It empowers us to engage in essential cognitive tasks, such as memory retention, organization, and the future planning of emotional experiences, facilitating

decision making in everyday life challenges [7]. Additionally, it helps improve our memory skills by promoting the formation of associations and supports the expression of social competencies [8]. In essence, this ability aims to dynamically adapt the human brain's responses to the various contexts encountered by individuals, allowing for the development of tailored responses for each unique situation over time [9]. While this process allows us to visualize and emotionally connect with future challenges, improving our ability to handle them effectively, it involves both intentional strategies and inherent brain functions. It is noteworthy that various events or trigger situations may unintentionally activate these mental images, sometimes leading to automatic responses [10].

Despite the longstanding interest among researchers in mental imagery as a cognitive ability, there is still a significant gap in understanding how it relates to other cognitive functions. Additionally, the role of mental imagery in shaping individual emotions has not been extensively explored. Is mental imagery solely a cognitive process, or should its connection with emotions be given more attention?

To address these questions, it is essential to develop valid, reliable, and efficient psychometric instruments. While there are numerous tools available for assessing mental imagery in the literature, there is a lack of a proposed psychometric protocol capable of comprehensively evaluating its various components, including the emotional aspect.

Thus, while mental imagery has been explored extensively in cognitive research, its emotional impact and inter-relationship with cognitive processes remain under-explored. So, this review aims to bridge this gap by examining both the cognitive and emotional aspects of mental imagery. Understanding how mental imagery can be utilized has the potential to greatly influence different aspects of health and well-being. In this context, Health Psychology is crucial for identifying risky behaviors, supporting both primary and secondary prevention, and evaluating treatment outcomes. Consequently, assessment tools are essential resources for health professionals [11].

Given the interdisciplinary nature of mental imagery research, a narrative review has been chosen for this study. The narrative approach offers the flexibility needed to explore and synthesize a broad range of theories, methodologies, and findings. This method allows for a comprehensive and critical overview of the existing literature, helping to identify key trends and gaps without the limitations that a systematic review might impose [12]. Considering the breadth and variability of the field, a narrative review is especially suitable for enhancing our conceptual understanding of mental imagery and laying the groundwork for more focused, future research endeavors.

Therefore, this narrative review aims to achieve three objectives: firstly, to explore the current understanding of mental imagery as a cognitive ability and its potential associations with other cognitive domains; secondly, to examine the nature and significance of the relationship between mental imagery and emotions; and thirdly, to propose a psychometric protocol that can comprehensively assess the construct of mental imagery across its dimensions.

More in detail, this review aims to provide a holistic synthesis of existing research on mental imagery, focusing on its influence on cognitive and emotional dimensions. By bridging the gap between these domains, we explore how mental imagery influences cognitive processes, as well as its crucial role in emotional regulation. Another key objective is to propose a psychometric protocol that integrates both the cognitive and emotional aspects of mental imagery, facilitating a more comprehensive evaluation of its impact in various domains. Given the interdisciplinary nature of mental imagery research, the narrative review format allows for the synthesis of diverse theoretical perspectives, accommodating a broad exploration of the literature.

2. Materials and Methods

The current narrative review was realized by collecting scientific studies from the main online datasets (Scopus, PubMed, and the Web of Science) on three main topics. The first one was related to the relationship between mental imagery and cognition. The search

terms used were the following: "Mental Imagery" AND "Cogniti*". The filters used were the following: title/abstract; free full text; English; from 1997 to 2023.

An initial pool of 607 studies was detected, and, after screening, 66 studies were used for this section (Figure 1).

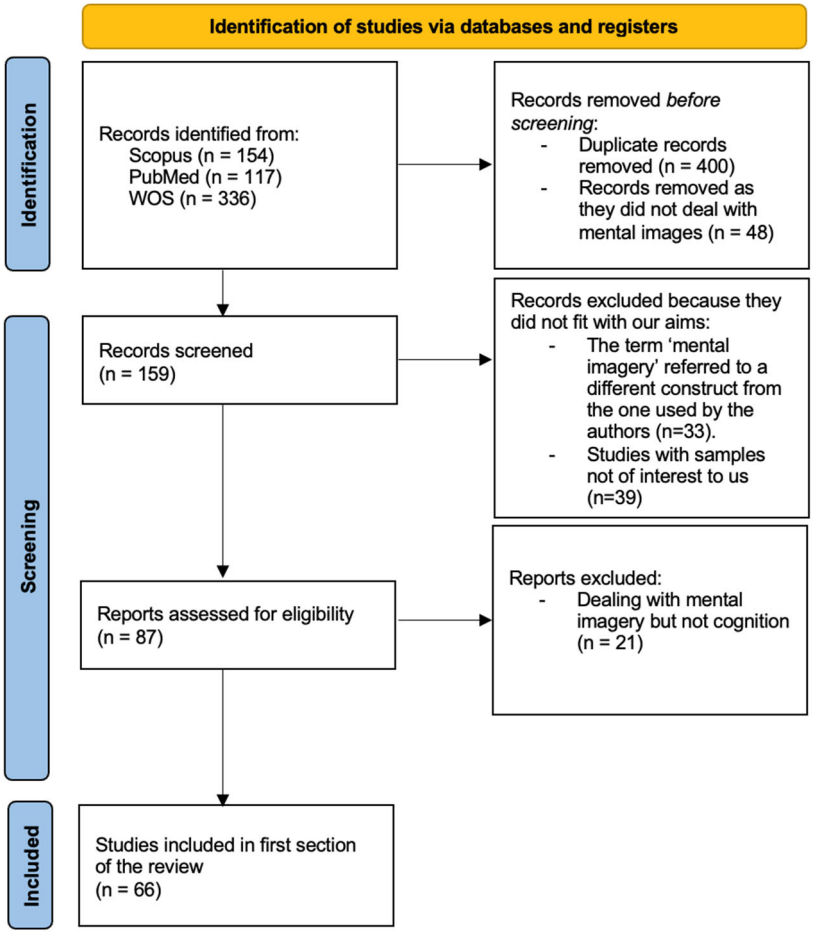

Figure 1. PRISMA flow diagram [13] for papers on mental imagery and cognition.

The second topic focused on the close relationship between mental imagery and emotions. The research terms were the following: "Mental imagery" AND "Emotion*" OR "Emotional Imagery". The filters used were the following: title/abstract; free full text; English; from 1997 to 2023.

An initial pool of 218 studies was detected, and, after screening, 60 studies were used (Figure 2).

The third and last topic was related to psychometric tests useful to assess mental imagery in its all aspects. Research terms were the following: "mental imagery assessment" AND "mental imagery Test*" OR "emotional imagery assessment" AND "emotional imagery test*". The filters used were the following: title/abstract; free full text; English; from 1997 to 2023.

From an initial pool of 742 papers detected, 62 studies were used for this section after screening (Figure 3).

Please note that some of these studies are listed in Supplementary Table S1.

Given the aim and the methodological approach of this work, no ethical permissions were required.

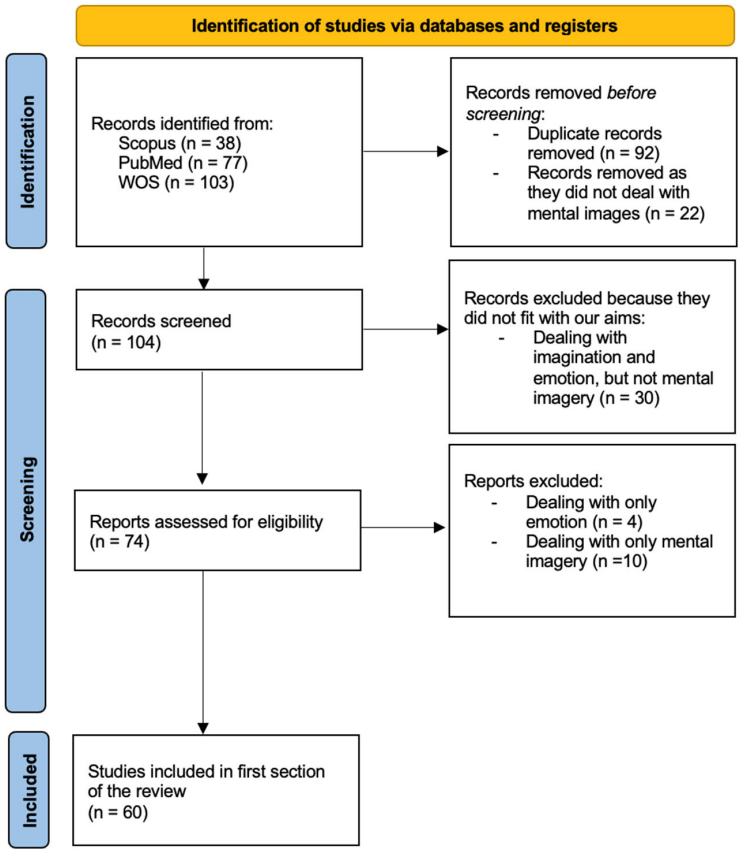

Figure 2. PRISMA flow diagram [13] for papers on mental imagery and emotions.

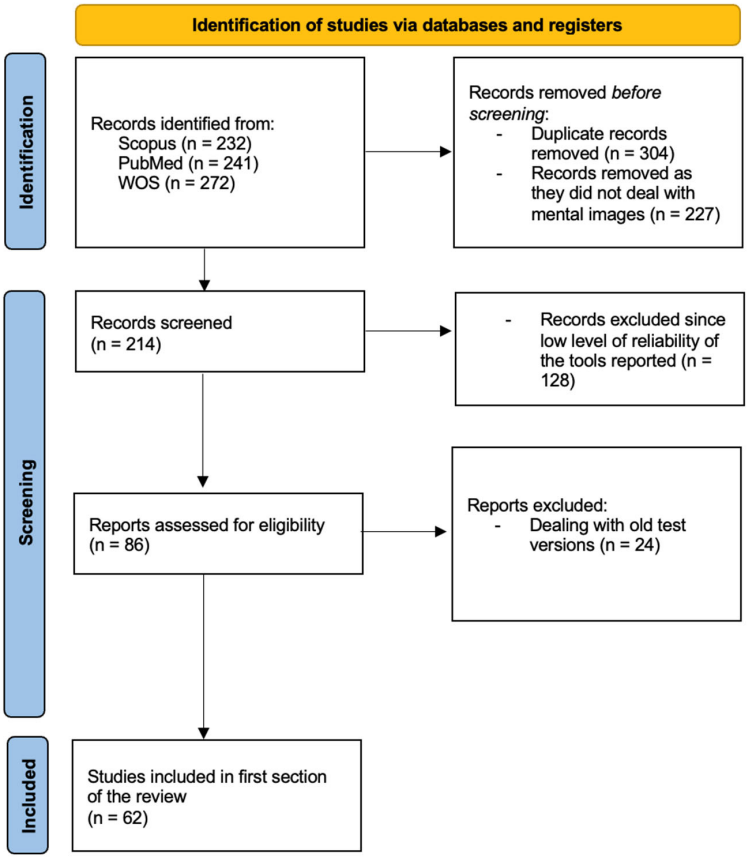

Figure 3. PRISMA flow diagram [13] for papers on mental imagery and psychometric tools.

Our final findings are presented in the following paragraphs. Section 3.1 deals with mental imagery and cognition in general, with a particular focus on learning processes. Section 3.2 collects all the evidence available about mental imagery and emotions. Section 3.3 reports a psychometric protocol proposal.

3. Results

3.1. Mental Imagery and Cognition

3.1.1. General Aspect

As a cognitive ability, mental imagery is closely related to all the other cognitive skills, such as perception, attention, memory, language, reasoning, problem solving, and decision making [14,15]. Mental imagery intersects with these cognitive functions in various ways, influencing how individuals perceive, understand, and interact with the world around them [16].

One fundamental aspect of the relationship between mental imagery and cognitive abilities lies in their role in memory formation and retrieval. Mental imagery can enhance memory by providing a visual or multisensory framework for encoding and organizing information, making it more memorable and easier to recall. For instance, imaging a specific event or location can facilitate the retention of details associated with that experience [9,17,18]. However, the relationship between memory and mental imagery is a key aspect in some psychopathological disorders, in which imaging particular autobiographical scenes could trigger some dysfunctional responses, for example in post-traumatic stress disorder or depression [4].

Furthermore, mental imagery plays an important role in cognitive processes such as problem solving and creative thinking. When faced with a problem or task, individuals often engage in mental imagery to simulate potential solutions, anticipate outcomes, and explore alternative scenarios [10,19–22]. This process enables them to mentally manipulate objects, visualize spatial relationships, and simulate cause-and-effect relationships, facilitating effective problem solving and decision making [23]. Therefore, mental imagery helps us with remembering, organizing and planning future situations, formulating strategies, and recalling past emotional experiences, facilitating decision making in everyday life issues [7].

Moreover, mental imagery contributes to the development and refinement of perceptual and motor skills [24]. Through mental rehearsal and visualization, individuals can improve their performance in various domains, including sports [25], music [26], and surgery [27]. By mentally rehearsing movements, sequences, and strategies, individuals can enhance their motor coordination, precision, and efficiency, translating mental representations into skilled actions [28].

Additionally, mental imagery is closely intertwined with language processing and comprehension. Visual imagery can enrich language comprehension by providing concrete mental representations of abstract concepts and linguistic descriptions [29].

In addition to this evidence, the scientific literature highlights that a fundamental cognitive function associated with mental imagery is learning in its various forms.

3.1.2. Mental Imagery in Different Learning Domains

Different scientific evidence has emphasized that mental images can often totally replace perceptual stimuli during different types of learning [30]. An example is classical conditioning, which can also occur by replacing perceptual stimuli with specific, voluntarily structured visual images [31].

It is precisely within this context that the concept of perceptual learning is presented, which refers to the phenomenon whereby training and practicing specific perceptual tasks promotes improved performance related to these perceptual abilities [32]. However, it has been shown that imaging the crucial components of a task, rather than performing them, also significantly improves task performance [33]. The evidence, therefore, indicates precisely that mental imagery acts like perception within the learning process [34],

as the power of mental imagery is inter-related with the subjective descriptions of the observer [35].

Mental imagery, therefore, appears to be a process akin to perceptual imagery, since both play interchangeable roles within associative learning [31], even showing similarities from a neurological point of view [36]. In this regard, Lewis and colleagues (2014) have proven that it is possible to carry out associative learning through voluntary mental imagery in the same way as it is possible to do so with classical sensory perception. Specifically, it appears that mental imagery drives associative learning, thus providing a mechanistic explanation that is useful in clinical practice for managing the treatment of psychopathologies, such as anxiety [31].

The most recent research investigates the close relationship between mental imagery and learning within various and, at the same time, important everyday human contexts.

One of these is certainly the school environment, in which learning appears to play a key role. Indeed, several studies have shown that students' performance is significantly better when they are involved in imaginative tasks or mental practice than in traditional study conditions [37]. Specifically, students who are asked to imagine a procedure or concept to complete a scientific, mathematical, and, in general, academic task seem to show better results than those who are asked to study the same material traditionally [38,39]. It has even been shown that the use of mental imagery as a teaching technique positively influences school learning outcomes [40].

The relationship between school learning skills and mental imagery has been investigated as early as the pre-school age of children. For example, several studies have proven how children can represent words and non-words orthographically and phonologically, a fundamental prerequisite in learning to read [41,42].

Even in the case of school-age students from primary schools, several studies highlight the close relationship between reading competence and the ability to represent and use mental images [43]. This is because reading ability requires the acquisition of specific competence, namely that of the phonological and orthographic representation of words [44], a relationship also present in research conducted with dyslexic and dysgraphic children [45]. In mathematics learning, on the other hand, spatial and visuospatial representations are used [46], as children tend to make use of schematic representations (which encode the spatial relationships present in exercises and problems) and pictorial representations (which interpret the visual aspects described in problems) [47].

Similarly, research conducted with high-school students emphasizes the importance of the link between mental images and school learning. For example, Leopold and Mayer [40] demonstrated that students who used an imagery condition showed excellent learning about the respiratory system compared to their peers in the control condition, reporting high scores on both delayed and immediate tests. Or again, students involved in the imaginative representation of a scientific text on water molecules showed better understanding and learning than peers who approached the study of the text content only [48].

Another context within which mental images play a key role is certainly sport and motor learning. It has been established that the use of imagery within these contexts contributes to improving athletic performance, for example by increasing self-efficacy and motivation, and helps athletes deal with injuries through pain, arousal, and stress management [49–51].

The concept of motor imagery, therefore, appears to have some relevance within the world of sport, as it refers to the mental representation of movement in terms of cognitive repetition, in the absence of actual concrete physical movement [52]. Mental training is widely used among athletes, as in this way they try to learn and memorize movements done well, thus contributing to increased self-confidence [53]. Indeed, the ability to imagine movements is implicated not only in the performance of motor tasks but also, and above all, in the cognitive function of learning [54]. This competence appears to be present from the earliest years of a child's life [55]. Various studies have shown that from the age of six, children develop a mental rotation ability in motor tasks, in which their reaction times are

similar to those of adults [56]. However, other authors have proven that although children learn specific movements through mental imagery, they can reproduce these movements with around 50% accuracy compared to adults [57]. In fact, it appears that the accuracy of motor tasks related to mental rotation develops with age, as a true similarity with adult performance occurs from the age of eleven [58].

Several studies have analyzed the relationship between motor imagery and motor skill learning, showing improved performance after training with mental imagery [59,60]. It appears that motor imagery is implicated in the refinement of movement accuracy, speed [61], muscle strength [62], and motor recovery [63].

There are also several models in the literature that detail the fundamental components involved in motor imagery. One of these is the PETTLEP model [64], which aims to design motor learning interventions more simply, taking into account seven important characteristics: physical, environment, task, time, learning, emotion, and perspective. Studies using this model have reported a positive effect of motor imagery on performance [65,66].

Other research, however, has focused on identifying strategies to enhance motor learning through mental imagery. Hermeans et al. [67] analyzed the efficacy of eye movements in motor imagery practice in tasks that measured speed and accuracy, concluding that eye movements during such practice significantly impacted the representation of coordinated movement [68].

In addition to the effectiveness of mental imagery within the context of motor learning, evidence has also been gathered to test the effectiveness of motor imagery in rehabilitation. It appears that it has been used as a rehabilitation therapy to enable the recovery of specific functions that had been impaired due to brain injury [69,70].

Therapy involving motor imagery, as well as approaches based on physical practice, can facilitate the brain plasticity necessary for the improvement of motor functions [71]. In this regard, studies suggest that kinaesthetic representations appear to be significantly effective in therapeutic interventions, as they influence the activation of motor regions [72,73]. Thus, it appears that motor imagery is particularly suitable for neurological rehabilitation, as it can be integrated with physical activity-related interventions to increase the overall effectiveness of therapy [69]. Indeed, for patients who are unable to take part in physical therapies, motor imagery may be useful in stimulating brain plasticity to ensure the patient's overall functional improvement [69].

The influence of mental imagery on learning is not only related to school or motor and sports. Several trials have shown that the characteristics of mental images are implicated within different disciplines, such as psychology, education, music, aviation, and medicine [27,74].

Particularly regarding medicine, mental imagery has been used as a methodology to improve the speed and quality of surgical training [27], although there are few studies on this. For example, Hall precisely noted how important the use of mental imagery is in surgical work, so much so that he proposed the use of imagery in preoperative preparation, to also develop a calm and peaceful environment [75]. In this regard, a study by Ibrahim and colleagues found that surgeons' interactions with colleagues and materials during preoperative activities stimulate mental imagery, through which it is possible to construct strategies and procedures that, in turn, stimulate other preoperative interactions [76]. Similarly, Souiki and colleagues proved that surgical trainees who benefited from a mental imagery rehearsal exercise before physical practice showed better evaluation than the control group, concluding that even if mental imagery cannot replace traditional surgical learning, it is still a valuable approach to improve the acquisition of technical skills and shorten the time required for physical learning [27].

Mental images are also involved in learning new spatial paths, especially with older people. As is well known, the assimilation of environmental information allows one to mentally represent cognitive maps outlining arrangements and landmarks [77], but this capacity tends to diminish with advancing age [78]. The use of strategies based on mental imagery, however, seems to have proved very valuable not only for solving spatial tasks

but also for stimulating the learning of new paths, both with young people and adults [79]. Similarly, it was also found to be useful for improving spatial recall tasks, such as drawing a map of a specific place [80] or identifying one's location or landmark [81]. For example, Carbone and colleagues conducted a study in which mental imagery was found to be crucial for older people in spatial learning, particularly about spatial recall tasks requiring, for example, the use of landmarks [82].

In conclusion, it can be pointed out that mental imagery helps individuals, whether young or old, to learn strategies through which they can manage the space of a specific environment, encoding information that will facilitate mental representations of maps and paths [83].

Ultimately, mental imagery is implicated in various cognitive functions, particularly learning. However, it would be remiss to conclude the discussion solely at this juncture, as researchers often overlook the emotional aspect when examining mental imagery within cognitive functions. Therefore, this narrative review endeavors to explore the contemporary understanding of the intimate connection between mental imagery and emotions, highlighting the significance of this relationship and underscoring the imperative of its inclusion in discussions surrounding mental imagery.

3.2. Mental Imagery and Emotions

As widely discussed, mental imagery has been the topic of much experimental work in general psychology, with a focus on the cognitive dimension. Despite often being described as "seeing with the mind's eye", mental imagery represents a complex and multifaceted construct, encompassing bodily sensations, feelings, and emotions [84,85]. In this paper, we define emotional imagery as mental imagery that is either accompanied by an emotional response or can induce such a response. This type of imagery is characterized by the emotional content it evokes, rather than merely imagining an emotional state. Images can powerfully evoke emotional states, and there are several reasons why images have a particularly powerful affective impact and several mechanisms that provide links between imagery and emotion [84]. It could be possible to summarize them into three key points: (1) imagery, psychophysiology, and basic emotional systems in the brain; (2) imagery and perception; (3) imagery and autobiographical memory.

3.2.1. Imagery, Psychophysiology, and Basic Emotional Systems in the Brain: Their Role in Psychopathology

The first reason is represented by psychophysiology and basic emotional systems in the brain. These aspects and the links between mental imagery and emotions were already central in Lang's bio-informational theory of emotional imagery. According to this view, images are supposed to be particularly effective in provoking emotions when they include information about the associated autonomous or behavioral response [86]. This author hypothesized that the mental representation of an emotionally charged stimulus (e.g., fearful stimulus) activates an associative network of stored information that overlaps with that activated during the experience of the stimulus [87]. In this regard, some scientific evidence points out that during emotional mental imagery and emotional real experience, the activation of the same emotion-processing regions (i.e., the prefrontal cortex, anterior cingulate cortex, and amygdala) has been observed [88]. More in detail, imaging aversive events enhances functional brain activity in a network of cortical and subcortical regions that include the medial prefrontal cortex, the posteromedial prefrontal cortex, as well as regions in the medial temporal lobe, including the anterior hippocampus [89]. These regions have long been noted as active in the "default mode network" (DMN) and involved in a variety of different internally oriented cognitive processes, including imaging novel situations that draw on information from both episodic and semantic memory [90]. In light of this evidence, it seems likely that the emotional systems of the brain are particularly responsive to images. Additionally, mental images are mainly sensory–perceptual representations, so they may activate the brain systems underlying emotions more directly than

symbolic representations that do not use sensory codes [84]. Sensory stimuli can elicit rapid responses from the brain areas implicated in emotion, such as the amygdala, bypassing the need for higher-level processing by other cortical areas, thus operating outside of awareness [91]. So, based on Lang's theory and the related evidence, powerful emotional imagery is involved in various mental health conditions, such as anxiety disorders and, in particular, post-traumatic stress disorder (PTSD), depressive disorders [4,88,92], and borderline personality disorder [93], acting as "amplifiers" on an emotional level [94]. Concerning anxiety disorders, distressing mental images are common and have been found to have an important role in the maintenance of anxiety problems [95]. For example, in social anxiety disorder (SAD) there might be an anxious mental image of someone looking at you [96]. In fact, in these patients, negative self-imagery is linked to greater emotional distress, is more vivid, and, thus, is more often perceived through an observer-perspective [97,98]. Furthermore, current cognitive models of SAD in children, adolescents, and adults indicate that negative self-images play a pivotal role in maintaining the disorder [99]. Additionally, in agoraphobia, there may be images of the inability to cope with an impending physical or mental catastrophe [95]. Other evidence shows that in agoraphobic patients, most of the images involve different sensory modalities and, in most cases, seemed to be related to unpleasant memories of events experienced many years earlier [100–102]. Emotional imagery is also involved in health anxiety, in which negative images of the self, illness, and death may be present [95]. Aversive mental images of contracting or having a severe disease are assumed to contribute to the development and maintenance of health anxiety [103]. The images tend to be future-oriented and fall into four themes: receiving the "bad news" of a serious/life-threatening illness, suffering from the illness, experiencing death and dying from the illness, and the impact of one's death or serious illness on loved ones [104]. In PTSD, individuals may experience a vivid re-emergence of emotions through "flashbacks," wherein they react as though the traumatic event is unfolding anew. This reaction manifests in various ways, including expressions of terror, physiological responses like sweating, and even instinctive behaviors such as flinching as if anticipating harm [84]. Furthermore, a recent meta-analysis, conducted by Thome et al. (2020), reveals that in patients with PTSD, the act of imaging trauma-related events amplifies activation within the emotional memory network, mirroring the pattern observed in healthy individuals when they envision unpleasant events [105].

Although there is evidence of the role played by mental images in maintaining and worsening anxiety symptoms, imaginal exposure seems to be one of the most effective treatments [106,107]. For example, mental imagery could represent a valid ally to effectively treat PTSD symptoms. Trauma-focused, imagery-based interventions, such as imagery rescripting (ImRs), which consists of a set of therapeutic procedures applied to change the content of pre-existing unpleasant memories into more benign images or to use new positive images to rewrite negative schematic beliefs [108], and imaginal exposure (ImE), that involves "revisiting" the most currently distressing traumatic memory and providing a detailed verbal account of the traumatic memory that includes sensory information and the thoughts, feelings, and reactions experienced [109], are effective in reducing involuntary re-experiencing in PTSD [110–119]. Furthermore, other evidence suggests that imagery rescripting could serve as a suitable approach to address the symptoms associated with health anxiety, including anxiety, intrusive thoughts, and avoidance or safety-seeking behaviors [120].

As already stated, emotional imagery is involved also in depression. At least two types of intrusive negative imagery have been described in depression: the imagery of past negative events and the suicidal imagery of the future [97,121,122]. Increasing evidence from observational studies suggests that depression correlates with a proclivity to recollect memories from an observer's viewpoint, potentially linked to reduced levels of emotional content [123–125]. Additionally, some evidence suggests that depression is associated with more basic problems in mental imagery generation and manipulation [126,127]. However, imagery rescripting showed a medium to large effect size for depression treatment [108].

As briefly introduced above, emotional mental imagery is involved in borderline personality disorder. Current research on borderline patients reports a bidirectional association between emotionally dysregulated behaviors and the intrusive mental imagery of future episodes of self-harm [128]. Moreover, it is crucial to acknowledge that heightened levels of mental imagery correlate with suicidal ideation and self-harming tendencies in individuals with borderline personality disorder [129]. Numerous studies highlight that imagery rescripting is effective in reducing borderline symptoms, in terms of emotional dysregulation and negative effects [93,128,130].

3.2.2. Emotional Imagery and Perception

A second way in which imagery can impact emotion is via its link to directly perceiving the world. There is a certain degree of competition between mental imagery and perception processes when they share the same sensory modality [84]. This evidence is underlined by the results of several scientific studies that, on the one hand, show that keeping a mental image in mind interferes with the perceptual processes of other stimuli, and, on the other, that imagery vividness is reduced when performing simultaneously on the same sensory pathway [131–133]. This offers confirmation that imagery and perceptual processes use the same cognitive resources. Different evidence has showed that visual mental imagery can activate areas in the early visual cortex [4,134–136]. Zvyagintsev et al., identified three distinct brain networks during mental imagery tasks: a supramodal network, independent of the imagery type, and two modality-specific networks for auditory and visual imagery. The supramodal network encompassed brain regions associated with attention, memory retrieval, motor preparation, semantic processing, default-mode networking, and multisensory integration. The modality-specific networks included areas specialized in processing sensory information unique to each modality. Notably, engaging in auditory imagery resulted in reduced activity within visual imagery areas, and vice versa. Moreover, both auditory and visual mental imagery prominently suppressed activity in the primary sensory and motor regions [137]. Despite the fact that mental imagery has been studied in its visual and auditory form, it occurs also in other sensory modalities [135]. Moreover, facial emotion perception is also involved in emotional imagery. For example, imaging facial expressions of negative emotions activates the same brain areas involved in processing facial expressions visually, in particular the amygdala [84,138]. Furthermore, simulating others' affective facial expressions through imagination in social situations allows us to enact vivid affective responses [139]. Other evidence suggests that parkinsonian and Alzheimer patients not only may be impaired at expressing emotional faces and perceiving an emotional facial affect, but also on emotional facial imagery [140–144].

3.2.3. Emotional Imagery and Autobiographic Memory

A third link between imagery and its impact on emotion relates to autobiographical memory. Episodic or autobiographical memory functions as a repository for the retention of commonplace events over the long term, facilitating the construction of a coherent temporal narrative for the self [145]. More specifically, autobiographical memory enables the encoding, storage, and retrieval of personally lived experiences alongside their spatial and temporal attributes [146].

Despite the fact that studies of autobiographical memory do not usually focus on emotion per se, if imagery generation takes information from autobiographical memory, then, as far as the memories accessed include feelings experienced during previous episodes, the constructed image is likely to restore the same emotion [84]. In this regard, while Conway and Pleydell-Pearce suggest that autobiographical memory for emotional events may be stored in a form resembling images [147], the predominant view in cognitive science is that long-term memories are stored as symbolic structures. Kosslyn et al. propose that these symbolic representations can be converted into mental images during recall, allowing individuals to visualize past experiences or imagine future scenarios [3]. Similarly, Pylyshyn argues that the brain encodes information using symbolic codes, which generate image-like

experiences when activated [148]. This aligns with the perspective of Schacter and Addis, who emphasize that memory is reconstructive, forming mental simulations dynamically from these symbolic elements [149]. These perspectives suggest that while mental imagery can produce vivid and detailed visualizations, the actual storage of memories relies on symbolic representations rather than stored images. This concept is particularly important when considering emotional imagery. Emotional responses can be evoked by recalling past events or imagining future scenarios, which underscores the significance of symbolic representations. When these representations of emotionally charged experiences are activated, they can generate vivid mental images with a substantial emotional impact. Importantly, this does not mean the images themselves are stored; instead, it is the symbolic and semantic elements of the experiences that are encoded in the memory. The emotional content associated with these symbols can enhance the vividness and the emotional power of the generated imagery, consistent with Schacter and Addis's (2007) view on the constructive nature of memory [149]. This process enables individuals to connect with emotionally significant past events or envision future emotional scenarios, highlighting the role of mental imagery in emotional regulation and overall cognitive functioning.

Additionally, the nature of autobiographical memories makes them particularly suitable for emotional regulation, as these memories can be reconstructed to emphasize positive or negative details [150]. Research suggests that utilizing images linked to specific positive autobiographical memories can effectively induce mood changes. Engaging with these emotionally charged images allows individuals to actively reshape their emotional experiences, which could make this approach a valuable tool in interventions aimed at enhancing emotional regulation and reducing the symptoms of depression [151].

To sum up, it is evident that emotions play a pivotal role in mental imagery; this relationship, as previously stated, is also evident in the manifestations of various psychopathological conditions, such as anxiety and depression. Given this, the significance of delving deeper into the role of the emotional domain in mental imagery becomes significant, particularly if its implications in clinical psychopathology could pave the way for novel therapeutic interventions alongside existing ones. Unfortunately, our review indicates that the pertinent literature has not sufficiently explored this specific interplay. We hypothesize that a primary reason for this could be attributed to the lack of clarity regarding a specific psychometric protocol, which, if appropriately utilized, could undoubtedly contribute to further elucidating not only the involvement of cognitive functions in mental imagery but also the ensuing emotional investment. Only through this comprehensive approach can the functionality associated with mental imagery be comprehensively understood. To address the gap in the scientific literature, it is imperative to propose a comprehensive psychometric protocol encompassing all the facets of mental imagery, considering the previously mentioned construct in its entirety. Only by embracing such a holistic methodology can we enhance our comprehension of mental imagery and its impact on the daily lives of individuals, harnessing its potential to greater effect in both scientific inquiry and clinical practice.

3.3. Mental Imagery and Psychometric Evaluation

Is mental imagery solely a cognitive process or should its connection with emotions be given more attention? These fundamental questions underpin the narrative review at hand. Upon analysis of the available scientific evidence, it becomes evident that mental imagery intersects both cognition and emotions. Nevertheless, to delve into this intricate and multifaceted construct, an equally wide range of evaluation tools is indispensable. The extensive body of experimental psychology research addressing mental imagery encompasses a wide array of measures (see Supplementary Table S1) [6]. Given the complexity of mental imagery, this narrative review seeks to propose a comprehensive psychometric protocol capable of thoroughly assessing the construct across its various dimensions, considering both cognitive and emotional aspects (Table 1). However, with the plethora of tests available to assess the different facets of mental imagery, only those deemed most comprehensive

and consistent have been selected for inclusion in the proposed psychometric protocol. The selection of measures was guided by several key criteria to ensure comprehensiveness, reliability, and relevance. We prioritized tools with a Cronbach's alpha of greater than 0.70 to ensure acceptable internal consistency and reliability. This standard helps guarantee that the tools provide reliable results in assessing mental imagery [152]. Additionally, when different versions of the same tool were available, we selected the most recent version to incorporate the latest updates and improvements in psychometric evaluation. Lastly, we aimed to include measures that assess a broad range of cognitive and emotional abilities, ensuring that various aspects of mental imagery, such as image generation, maintenance, transformation, and emotional vividness, are thoroughly evaluated. These criteria were implemented to ensure that the selected tools offer a comprehensive and reliable assessment of the construct under investigation. Applying this protocol, it is possible to obtain a comprehensive evaluation of mental imagery abilities in all the domains considered.

Table 1. Proposed psychometric protocol to assess mental imagery.

Domain Assessed	Psychometric Tool	Type of Skills Assessed	Description	Charateristics of the Sample
Motor imagery ability	Movement Imagery Questionnaire-3 (MIQ-3) [153]	External visual imagery, internal visual imagery, and kinesthetic imagery.	Twelve-item self-reported questionnaire, latest version of MIQ. MIQ-3's predictive validity reveals the relationships between imagery ability and observational learning use. (α = 0.88 for the visual subscale and α = 0.82 for the kinesthetic subscale.)	A sample of 370 healthy student athletes (male = 185; female = 185) with a mean age of 20.29 years (SD = 2.25).
General mental imagery ability	Vividness of Visual Imagery Questionnaire—2 (VVIQ-2) [154]	Self-reported vividness of visual imagery.	Sixteen-item self-reported questionnaire, to be completed twice. The first session with eyes open and the second with eyes shut. (α = 0.91)	A sample of 279 s-year undergraduate psychology students (162 women, 117 men) participated. The mean age was 20.1 yr. (SD = 1.9; range = 19 to 24).
	Spontaneous Use of Imagery Scale (SUIS) [155]	Spontaneous use of mental imagery in daily life, visual imagery, quality, and vividness of mental images.	Participants use a 5-point scale to rate the level to which each item is appropriate for them. (α = 0.76)	491 first-year psychology students partecipated. The mean age was 18.6 yr. (SD = 1.8; range = 17 to 36).
	Mental Imagery Test (MIT) [156]	Generation, maintenance, inspection, and manipulation of different categories of images.	Battery of 8 subtests involving different tasks, presenting different levels of complexity depending on the components of imagery involved. (α = 0.75)	A sample composed of 565 children was selected (male = 236; female = 268). The mean age was 9.75 yr. (SD = 1.62; range = 8 to 13).
Emotional mental imagery	Measure of Spontaneous Emotional Imagery (E-SUIS) [157]	Use of emotional imagery in day-to-day life.	Sixteen-item, self-reported data measuring use of spontaneous emotional imagery use in daily life. Unidimensional factor structure and excellent reliability (α = 0.87). The scale includes items referring to both past, present, and future imagery. Assessment requires additional imagery measures or interviews to determine discriminant validity of the E-SUIS, according to the authors.	One hundred and fifty-one participants (73 men, 77 women, 2 other) aged 18–25 (M = 22.79, SD = 1.81).
	Four-Factor Imagination Scale (FFIS) [158]	Imaginative process.	Self-reported data measuring four distinct features of imagination: (1) frequency, (2) complexity, (3) emotional valence, and (4) directedness in terms of individual differences. (α = 0.76–0.93)	Participants were 10,410 individuals who completed an online survey. Self-reported ages ranged from 13 to 82 with a mean of 23.8 years and a median of 20 years (SD = 9.9).

4. Conclusions

In conclusion, mental imagery represents a multifaceted cognitive ability with profound implications for various aspects of human cognition, emotion, and behavior. Through the exploration of its relationship with cognition, learning processes, emotions, and psychopathology, this narrative review has shed light on the intricate interplay between mental imagery and other cognitive and emotional functions.

The examination of mental imagery in relation to cognition has revealed its integral role in memory formation, problem solving, creative thinking, perceptual and motor skills development, language processing, and comprehension. Furthermore, mental imagery has been shown to significantly impact various learning processes across different contexts, including academic learning, motor skill acquisition, and rehabilitation.

Furthermore, although the bulk of research has focused on mental imagery as a cognitive function, the exploration of the link between mental imagery and emotions has highlighted its profound impact on emotional experiences and psychopathological conditions. Emotional imagery has been implicated in the amplification of emotional responses, as well as in the maintenance and exacerbation of anxiety disorders, depressive disorders, and borderline personality disorder. However, it has also been recognized as a valuable tool in therapeutic interventions, such as imagery rescripting, for the treatment of these conditions.

Additionally, the proposed psychometric protocol aims to comprehensively assess mental imagery across its cognitive and emotional dimensions, providing a valuable tool for researchers and clinicians to better understand and evaluate this complex cognitive ability.

In essence, mental imagery emerges as a fundamental aspect of human cognition, intricately intertwined with both cognitive processes and emotional experiences. As our understanding of mental imagery continues to evolve, so too will our ability to harness its potential in enhancing cognitive functioning, promoting learning, and addressing emotional well-being. By recognizing the significance of mental imagery in shaping human cognition and emotion, we pave the way for further advancements in both research and clinical practice, ultimately contributing to the holistic understanding of the human mind.

5. Limitations

However, it is important to acknowledge certain limitations in the current understanding of mental imagery between cognition and emotions. Firstly, much of the existing research tends to focus on specific aspects of mental imagery or isolated emotional responses, potentially overlooking the complexity of their interaction. Moreover, the investigation into mental imagery and emotions has predominantly centered on clinical populations or specific psychological disorders, limiting the generalizability of the findings to broader populations. This narrow focus may obscure the full spectrum of emotional phenomena and their interplay with mental imagery across diverse contexts. Additionally, as this paper adopts a narrative review approach, it inherently lacks the systematic rigor of a quantitative meta-analysis or a systematic review. The potential for a selection bias in the choice of studies and the subjective interpretation of findings cannot be entirely ruled out. Additionally, the narrative review format may not offer the comprehensive coverage or replicability that more structured reviews provide. We recognize that without strict inclusion criteria and a formal synthesis of data, there is a risk of emphasizing certain studies or perspectives over others. However, given the broad and interdisciplinary scope of mental imagery research, this approach allows for the integration of a wide range of findings that would otherwise be difficult to consolidate within a more rigid framework. While this review does not claim to provide a definitive or exhaustive analysis, it aims to offer a holistic perspective that highlights existing gaps and provides a foundation for more systematic future investigations into the emotional and cognitive aspects of mental imagery.

Furthermore, the role of individual differences in shaping the relationship between mental imagery and emotions remains relatively under-studied. Factors such as personality traits, cultural backgrounds, and developmental experiences could significantly influence

how individuals perceive and respond to emotional imagery, yet these variables are often overlooked in empirical investigations. Future research should aim to conduct systematic reviews and meta-analyses to provide more robust and generalizable insights.

Further research employing the proposed psychometric protocol is essential to address these limitations. This is critical for advancing our comprehension of the intricate interplay between mental imagery and emotions, informing both the theoretical models and practical interventions aimed at enhancing emotional well-being.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/psychiatryint5040049/s1. Supplementary Table S1 lists all the tests available in the literature to evaluate several mental imagery components. Except references appear in the main text, all the references in Supplementary Materials are listed in [159–212].

Author Contributions: Conceptualization, F.M.B. and G.A.P.; methodology, F.M.B., G.A.P., V.T. and C.S.G.; data curation, F.M.B. and G.A.P.; writing—original draft preparation, F.M.B., G.A.P., F.C., V.T., C.S.G., V.F.V. and A.P.; writing—review and editing, S.V., S.C. and C.P.; supervision, S.C. and C.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Conflicts of Interest: The authors declare no conflicts of interest.

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