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Review

A systematic review and narrative synthesis of mental imagery tasks in people with an intellectual disability: Implications for psychological therapies

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ABSTRACT

Mental imagery is recognised for its role in both psychological distress and wellbeing, with mental imagery techniques increasingly being incorporated into psychological interventions. In this systematic review and narrative synthesis (PROSPERO 2021: CRD42021240930), we identify and evaluate the evidence base for the phenomenon and phenomenology of mental imagery in people with intellectual disabilities, to ascertain the applicability of such interventions for this population. Electronic searches of nine databases and grey literature identified relevant publications. Two reviewers independently assessed titles and abstracts of retrieved records (n = 8609) and full-text articles (n = 101) against eligibility criteria. Data were extracted and quality appraised. Forty-onepapers met our eligibility criteria. The quality and designs were variable. Mental imagery was facilitated through ensuring participants understood tasks, providing opportunity to rehearse tasks (including using concrete prompts) and using scaffolding to help participants elaborate their responses. People with intellectual disabilities can engage with mental imagery, with appropriate adaptations, although the associated phenomenology has not been thoroughly investigated. Mental imagery interventions may be useful for people with intellectual disabilities with appropriate modifications.

Mental imagery interventions are a core component of Cognitive Behavioural Therapy (CBT) (Saulsman, Ji, & McEvoy, 2019). They are included in treatment protocols for treatment resistant psychological disorders where 'standard' psychological interventions have previously had limited effects, including depression (Wheatley et al., 2007) and Obsessive Compulsive Disorder (Maloney, Koh, Roberts, & Pittenger, 2019), and to address transdiagnostic psychological issues (Landkroon et al., 2021; Morina, Lancee, & Arntz, 2017). Such interventions are powerful, as mental imagery has a greater effect on emotion than verbal thoughts of a similar content (Holmes & Mathews, 2005) through several pathways (Holmes & Mathews, 2010), and thus has a role both in maintaining psychological disorders and in psychological treatments. However, whilst adapted CBT is a recommended psychological intervention for various disorders in people with intellectual disabilities, many interventions described as CBT in this population may actually be behavioural interventions (Sturmey, 2004). Mental imagery interventions do not require the cognitive and verbal skills of some traditional CBT interventions such as challenging cognitions or creating alternative cognitive appraisals, potentially making them more accessible for this population. Therefore, incorporating mental imagery interventions into psychological treatments for people with intellectual disabilities may be clinically important. However, a review and synthesis of any differences in the ability of people with intellectual disabilities to engage with mental imagery is first required.

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1. Mental imagery

Mental images include a range of experiences from sudden, intrusive memories of past events to deliberately constructed daydreams (Holmes & Mathews, 2010), and have been described as occurring when perceptual information is accessed from memory giving "rise to the experience of 'seeing with the mind's eye', 'hearing with the mind's ear' and so on" (Kosslyn, Ganis, & Thompson, 2001). Mental imagery can occur in any of the five senses, but often include a visual image, or picture. By contrast, perception occurs when information is directly registered from the senses. Mental images can involve several sensory modalities and represent complex scenarios which can alter over time. They can be fleeting and fragmentary and can incorporate previously perceived events and objects in novel and innovative ways.

Mental imagery can be considered from various angles, including from a cognitive perspective (examining the different operations involved in mental imagery), through exploring the phenomenology of mental imagery, and by considering the links between mental imagery and psychopathology.

1.1. *Kosslyn's cognitive stages model of mental imagery*

Kosslyn's (1980, 1994) computational model of mental imagery aims to establish which cognitive systems are associated with the generation and manipulation of mental images and the processing subsystems that underlie the functioning of mental imagery in the brain. It is based on perceptual anticipation theories. This centres on the idea that mental images are experienced when one so strongly anticipates seeing an object that a depictive representation of the object is created in the topographically organised visual cortex (Kosslyn, Thompson, & Ganis, 2006). This model has shaped research within both experimental cognitive psychology, and neuropsychology (Pearson, Deeprose, Wallace-Hadrill, Heyes, & Holmes, 2013).

Kosslyn's model encompasses four components of mental imagery: imagery generation, inspection, maintenance, and transformation (Kosslyn et al., 2006), with transformation having been expanded to include image manipulation (Pearson et al., 2013). In addition to these four aspects, Pearson et al. (2013) highlight the phenomenology, or subjective experience of mental imagery. These components are not independent, in that more than one aspect of mental imagery is often employed within the experience of having mental images. These components of mental imagery have been studied extensively within experimental psychology and are well understood within the general population. However, they have not been systematically evaluated within a population with intellectual disabilities.

Image Generation. This is the process whereby stored topographical representations of objects are made explicit and accessible within the visual buffer (Kosslyn et al., 2006). Images can be rich and specific or general and low resolution (with these general images taking less time to generate and being less memorable; Cornoldi et al., 2014). Image generation has been reported across different sensory modalities.

Image Maintenance. Images begin to fade as soon as they are generated, lasting only about 250 ms (Kosslyn, 1994). Therefore, for any manipulation or inspection of an image to be conducted, active maintenance of the image is required. Image maintenance is a crucial part of mental imagery, allowing individuals to retain an image to complete additional tasks such as transformation or inspection. Within the model, such maintenance is achieved by the re-activation of visual memory representations in an Object Properties Processing subsystem (Kosslyn, 1980; Kosslyn et al., 2006).

Image Inspection. Within the computational theory, once an image has been generated the image is held within the visual buffer and it can be inspected by shifting the attentional window across it to encode its properties (Kosslyn et al., 2006). The spatial relationships between different parts of the image are encoded as the attentional window moves incrementally across the image (Kosslyn, 1994). Visual scanning tasks are often used to test mental inspection skills. There is significant evidence that the time it takes a participant to scan across an image increases directly with the distance scanned (Denis & Kosslyn, 1999).

Image Transformation. Images can be transformed as if the person themselves is manipulating the object, or as if an external force was to manipulate the object (Kosslyn et al., 2006). Pearson et al. (2013) classify the manipulation of mental images in psychological interventions, such as image restructuring, as a form of image manipulation. Mental synthesis describes a combination of mental rotation and image restructuring, in which parts of an image are transformed and manipulated to produce new information or patterns (Pearson & Logie, 2000), and is linked with image restructuring, as used within Cognitive Behavioural Therapy (Pearson et al., 2013). Image transformation has also been studied in auditory (Zatorre, 2012) and haptic (Miquée et al., 2008) modalities.

1.2. *Phenomenology of imagery*

There appears to be a continuum of experience of mental imagery, with some neurologically intact people reportedly unable to access any mental images (Nelis, Holmes, Griffith, & Raes, 2014), whist others are highly skilled in imagery (Macintyre, Moran, Collet, & Guillot, 2013). The subjective vividness of mental images includes the luminosity and clarity of an image, as well as how similar the subjective imagery experience is to actual perceptual experience (Pearson, De Beni, & Cornoldi, 2001). Other phenomenological imagery characteristics that have been investigated in clinical populations without Intellectual Disability include a sense of 'nowness' (Hales, Deeprose, Goodwin, & Holmes, 2011) and whether the imagery is experienced from a field or observer perspective (Day, Holmes, & Hackmann, 2004).

2. Mental imagery and psychopathology

There is a growing interest in how mental imagery can treat psychopathology (Blackwell, 2019; Holmes & Mathews, 2010). Whilst experimental psychology has explored everyday experiences of mental imagery, clinical psychology has focused on the role of intrusive and distressing images in maintaining psychological disorders (Hackmann, Bennett-Levy, & Holmes, 2011). Several mechanisms through which mental imagery impacts upon emotion have been proposed (Holmes & Mathews, 2010), suggesting implications for psychological interventions. Indeed, a range of mental imagery interventions have been shown to be effective across various populations and disorders (e.g., children and adolescents, Schwarz, Grasmann, Schreiber, & Stangier, 2020; social anxiety disorder; Lee & Kwon, 2013). Mental imagery interventions can promote positive imagery, reduce negative imagery, change the person's relationship with the imagery (through metacognition) or use imagery competing tasks (e.g., Tetris) (Holmes, Arntz, & Smucker, 2007).

3. Mental imagery and intellectual disabilities

People with intellectual disabilities indisputably experience cognitions, and therefore presumably also experience mental imagery, a type of cognition. However, little empirical information exists regarding mental imagery in this population. Within Kosslyn's model (Kosslyn et al., 2006), the four mental imagery components are implemented through the combined action of several more basic, domain-general algorithmic neurocognitive components and processes. Ability to experience mental imagery reflects these components and processes (Heyes, Lau, & Holmes, 2013), which includes information processing speed, general cognitive development, and executive functioning including attentional control, response inhibition, and working memory (Pearson, 2019), all of which are impaired in people with intellectual disabilities (Danielsson, Henry, Messer, & Rönnberg, 2012). Such impairments in these domain-general cognitive skills may impact the experience of mental imagery. However, cognitive impairments exist in clinical populations without intellectual disabilities (e.g., those with PTSD and bipolar disorder), and whilst such clients may require scaffolding to optimally engage with mental imagery interventions (e.g., Holmes, Hales, Young, & Di Simplicio, 2019), their cognitive limitations are not a barrier per se. Understanding how, if at all, mental imagery may differ in people with intellectual disabilities, is an essential precursor to developing a suitable mental imagery intervention for the population.

People with intellectual disabilities are at increased risk of developing various mental illnesses (Helps, 2015) and are less able to access accessible, effective psychological interventions (Vereenooghe & Langdon, 2013). To understand how mental imagery psychological interventions need to be adapted to benefit people with intellectual disabilities, a comprehensive review and synthesis of the existing literature was completed.

4. Aim of the review

The aim of this systematic review was to synthesise the literature about mental imagery in people with intellectual disabilities, to understand similarities and differences compared to the general population (in relation to Kosslyn's model of mental imagery), understand how mental imagery is currently used within therapeutic interventions, and appraise the quality of this literature. Through this, gaps in the literature were identified, allowing future research to be targeted to such areas, advancing the understanding of mental imagery in people with intellectual disabilities and potentially driving innovation in clinical intervention.

5. Review questions

1. What do we understand about the abilities of people with intellectual disabilities to engage with mental imagery (the generation, maintenance, inspection, and transformation of mental images)?
2. What do we understand about the phenomenology of mental images in people with intellectual disabilities, compared to the general population?
3. What do we understand about the role of mental imagery within existing psychological interventions for people with intellectual disabilities?

6. Methods

The systematic review is reported in line with current PRISMA-S guidelines (Page et al., 2021; Rethlefsen et al., 2021).

6.1. Eligibility criteria

Studies were included if they: (a) involved the assessment of mental imagery (the generation, maintenance, inspection, and transformation of a mental image) or involved mental imagery as a core component of a reported intervention imagery (interventions deemed to contain a core component of mental imagery included EMDR, Imagery Rehearsal, Imagined Exposure) or report the phenomenology of mental imagery, (b) were conducted with people with intellectual disabilities and (c) were published after 1980 (the year of publication of the Diagnostic Statistical Manual of Mental disorders, 3rd ed.; *American Psychiatric Association*, 1980).

Studies were excluded from the review based on one or more of the following criteria: (a) including data from autistic people or mixed aetiology groups where data for individuals with solely intellectual disabilities were not reported separately, (b) most participants did not meet criteria of intellectual disability (participants did not have a diagnosis of intellectual disability, or an IQ of below 70, or mean group IQ below 75), (c) the paper did not report an empirical research study, (d) mental imagery did not form a core component of a task or intervention (i.e. a mental imagery task used on a one-off basis as part of a broader psychological intervention, or tasks described could be solved using mental imagery or another strategy e.g. Theory of Mind or False Belief task).

6.2. Information sources

Databases. The following electronic databases were searched: AMED (HDAS), BNI (HDAS), CINAHL (HDAS), EMBASE (Ovid Online), MedLine (HDAS), PsychINFO (HDAS) on 25 May 2021. No additional relevant results were identified on re-running searches on 31 August 2021, or 6 March 2022.No search filters were used.

6.2.1. Grey literature and registries

The following sources of the grey literature were initially searched on 24 April 2021, with searches re-run on 31 August 2021 and 6 March 2022, with no new results identified.

Google scholar (https://scholar.google.com/) was searched using the terms (intellectual disability OR learning disability) AND mental imagery. The first 100 results were screened for inclusion, and no new articles were identified as relevant.

Cochrane Library was searched using the terms 'mental imagery' in all text and 'intellectual disability' or 'learning disability' in Title, Abstract, Keywords. Forty-five Cochrane reviews were identified, none of which were relevant. 2394 trials were identified, seven of which were identified as relevant. Of these seven, five were duplicates of results identified through databases, and two did not meet inclusion criteria.

The Cochrane Central Register of Controlled Trials (https://www.cochranelibrary.com/central) was searched to identify ongoing trials using MeSH terms: "Developmental Disabilities", "Intellectual Disability" and "Learning Disabilities". No relevant results were identified.

The British Library EThOS database of dissertations was searched using the search terms ('learning disability' OR 'intellectual disability') AND 'image'. This returned 19 results, one of which was a duplicate of a record identified through databases, and 18 did not meet inclusion criteria.

The Conference Proceedings Index was searched through Web of Science and 41 results were obtained. Three results were duplicates of a result obtained through database searches, and the rest did not meet inclusion criteria. Twenty percent of results were screened by a second rater (NH) and an inter-rater reliability of ($k = 1$) was obtained.

6.2.2. Citation searching

Backward and forward citation searching was undertaken. Reference lists of all included articles were manually screened to identify additional studies. Forward citation searching was conducted by looking up each included article on Google Scholar and manually screening each article which cited that paper. This was initially conducted on 7 June 2021, re-run on 31 August 2021 and 6 March 2022 and identified three additional studies.

6.3. Full search strategy

The reproducible searches for all databases are available at Warwick Research Archive Portal http://wrap.warwick.ac.uk/156431. The search strategies were peer reviewed by two senior academics (PL and CS), and by an experienced librarian (SJ). The search was registered with PROSPERO on 22 April 2021 PROSPERO 2021 CRD42021240930 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021240930

6.4. Selection process

Results were exported into EndNote, and 5583 duplicates were removed using EndNote's duplicate identification strategy. Results were then exported to Rayyan for screening. At this stage an additional 970 duplicate results were identified and removed.

The initial screening of the 8609 titles and/or abstracts of records was conducted by OH, with a random sample of 20% double reviewed by an independent second rater (NH) who was blind to the other researcher's ratings. Three abstracts were translated from French to determine their eligibility. None of these papers were eligible for inclusion. Where data were reported for the same participants across multiple papers (e.g., dissertation thesis and peer reviewed article), the peer reviewed journal article was included in the review and double counting was avoided. One record was not obtainable (Hartley, B. A. (1983). Directed Positive Imagery as Reinforcement of Academic Behaviour in Trainable Mentally Handicapped Students. Florida Educational Research and Development Council Research Bulletin, 17 (3), n3).

The review of title and abstracts was completed using Rayyan software. There was an inter-rater reliability of 97%, $k = 0.82$ at this stage, with 17 disagreements discussed and consensus reached on all results. This resulted in 101 articles requiring full text screening, which was also done through Rayyan software. OH and NH independently read and appraised 100% of these texts, resulting in an inter-rater agreement level of 95%, $k = 0.90$. The five articles which were conflicted decisions at this stage were resolved through discussion, and 100% agreement was reached on all studies. One additional study (Unwin, Tsimopoulou, Kroese, & Azmi, 2016) was excluded at data extraction stage as it became apparent that it did not meet inclusion criteria. Therefore, 41 articles met the full inclusion criteria for this review (see Fig. 1).

6.5. Data extraction

Data were extracted using an amended form based on Cochrane Public Health Group. The data extraction form was piloted by NH and OH on three papers, and several minor amendments were made (reduce information on observational cohorts and include information about facilitators and barriers to mental imagery, and additional quality appraisal tools for cross sectional studies, single case designs and case studies). Data were extracted independently for 30% articles by two members of the research team. The following were extracted: (a) study reference and year, (b) recruitment source and geographical location of study, (c) study aim and design, (d) participant information (number per group, sex and age), (e) diagnosis of intellectual disability and IQ (f) aspect of mental imagery considered and (g) main findings (see Table 1). There was an inter-rater reliability of 97%, $k = 0.94$ for data extraction.

6.6. Quality appraisal

Quality appraisal was assessed using the relevant appraisal tool (the JBI Randomised Controlled Trials Checklist, the JBI Qualitative Studies Checklist, the JBI Checklist for Case Reports, the JBI Checklist for Quasi-Experimental Studies, the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies and the Single Case Design Risk of Bias Tool; Reichow, Barton, & Maggin, 2018).

One additional item 'Were ethical issues considered (e.g., informed consent, approval from appropriate ethics committee, discussion of consent or best interests decisions reported)?' was added to all but the JBI Qualitative Studies Checklist, which already contains an item addressing ethical issues. Each item was rated according to 4 possible responses 'yes', 'no', 'unclear' or 'not applicable'. An overall risk of bias judgement, summarising the overall quality of the paper was made. Papers were given an overall 'good' rating if 75% or more of applicable categories were rated as 'yes', an overall 'mixed' rating if between 75 and 50% of items were rated as 'yes', and an overall 'poor' rating if less than 50% of items were rated as 'yes'.

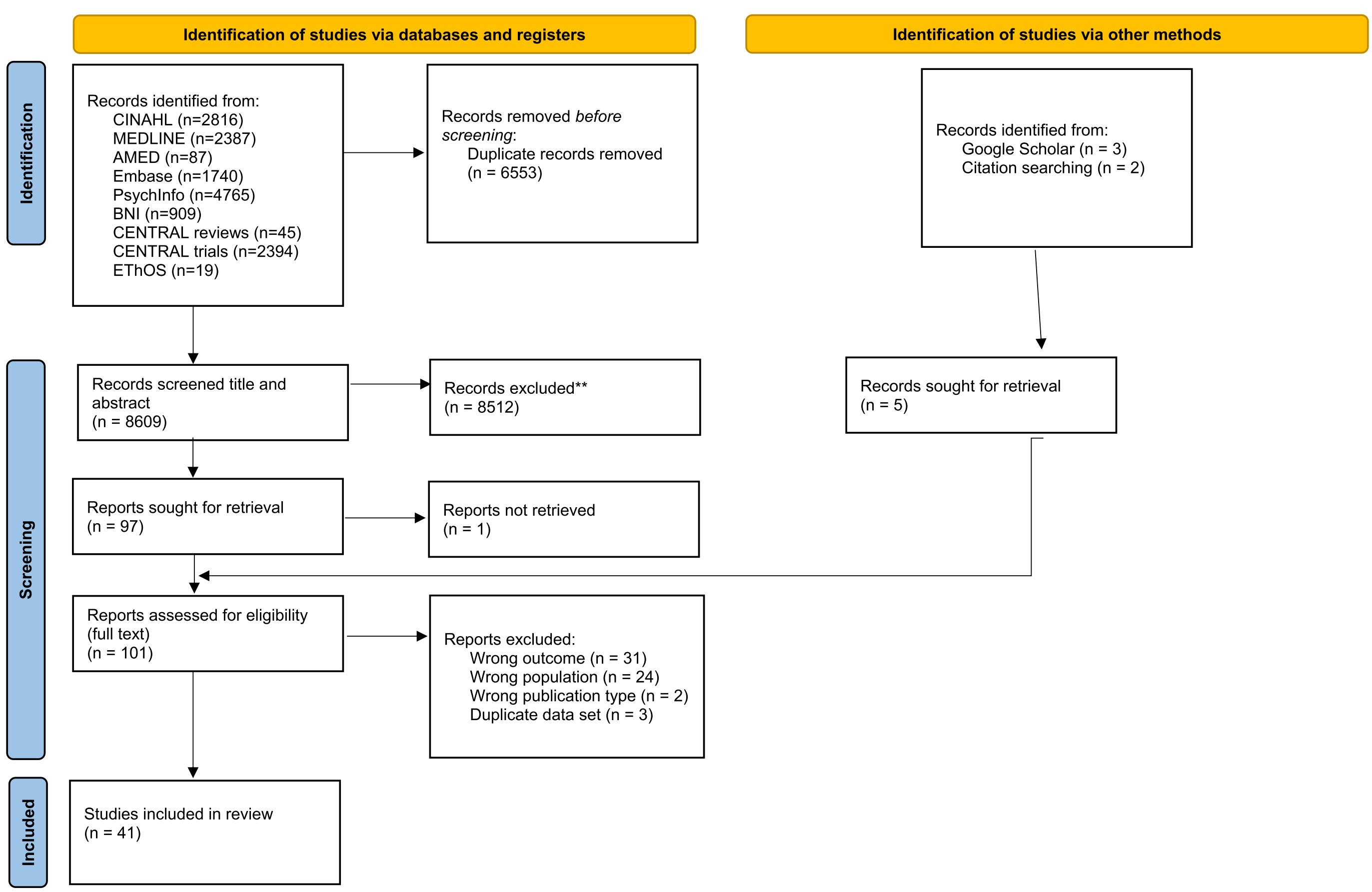

Fig. 1. PRISMA flowchart to detail papers identified and excluded at each stage.

Table 1
Study characteristics of papers included in review.

	First author (year), Recruitment source, location	Study Aim and Design	Participants (number; sex; age in years)	ID diagnosis; IQ	Mental imagery aspect (generation, maintenance, inspection, transformation, or phenomenology or therapeutic intervention in which mental imagery is a core component)	Main findings	Quality appraisal rating
1	Barrowcliff and Evans (2015); Referred to NHS services; UK	To report on the use of EMDR for PTSD symptoms with a client with moderate-severe ID. Single case study	N = 1; F; 40s	moderate-severe learning disability; No IQ given	EMDR (imagery practice to generate safe place)	Participant was able to identify safe place easily although required several weeks of imagery practice to support its ready application. Significant improvement in trauma symptoms were maintained at 12-month follow-up.	Mixed
2	Borys (1980); State residential institution; USA	Do people with ID use mental rotation and therefore show increased reaction times judgments with increasing angular separation between stimuli? Quasi-experimental, repeated measures design	N = 22; NG; mean age 19.26 (SD 1.76)	"educable mentally retarded"; mean FSIQ 65	Transformation. Two mental rotation tasks; the Cone task(identifying same/ different pairs of stimuli, mental rotation task involving one stimulus being rotated 0°, 45°, 90°, 135° or 180° degrees clockwise from the upright) and the Block task (predicting the arrangement of three coloured blocks which had been rotated through 90°, 180°, 270° or 0° degrees by the examiner)	Participants exhibited a linear increase in their reaction time judgments as a function of increasing angular separation between stimuli. ID participants were using an analogical mental rotation process to perform task.	Mixed
3	Brougham et al. (2020); Further education colleges; Scotland UK	Can individuals with ID can generate and use a compassionate image? Qualitative, between groups.	N = 31; ID group n = 16; F = 6 M = 10; mean age 19.63 Non-ID group n = 15; F = 6 M = 9; mean age 21.27	WASI scores ID mean FSIQ = 59.0 Non-ID group mean FSIQ = 92.7	Generation (Generate compassionate mental image using adapted instructions, including using a storyboard provide context for the exercise, simplified language, slower pace, and forced choice and open-ended questions) Phenomenology of MI reported	Individuals with ID could generate their own compassionate image. Types of image generated were very similar in those with and without ID. People with ID required more scaffolding to prompt and use the images.	Good
4	Brown and Bullitis (2006); ID group recruited through agency providing services to people with ID; non-ID group undergraduate students; Australia	To explore the presence or absence of MI across different sensory modalities in people with and without ID. Qualitative, between groups.	N = 26; ID group n = 16; F = 9 M = 7; mean age 43 y 8 m (min 31 y 5 m max 70 y) Non-ID group n = 10; F = 5 M = 5; mean age 27 y 10 m (min 18 y 8 m max 50 y 1 m)	PPVT-R conducted with 15 ID group Mean Raw Score 80.87; Mean Age Equivalent 7 y, 1 m; ID group all had history of institutionalisation	Generation and inspection (asked participants to create mental images of photos they had previously been shown across different sensory modalities and manipulate these images) Phenomenology of MI investigated	All non-ID and most ID participants reported MI, predominantly in the visual domain, but across other modalities. MI was more frequent and varied in non-ID group.	Poor
5	Buhler (2014); Through a service agency operating under the Maryland Developmental Disabilities Administration; USA	Can EMDR be successfully used with people with ID? Multiple-baseline across participants A-B-A with follow-up design	N = 6; F = 3 M = 3; mean age 51.6 (min 37 max 69)	WASI scores mean FSIQ = 65.5	EMDR (imagery practice to generate safe place)	EMDR can be effective for treating PTSD in people with ID.	Mixed
6	Campione et al. (1985); ID group 7th and 8th grade students; non-ID group 4th grade students; USA	To compare ID and non-ID groups of children on tasks requiring mental imagery rotation, imposition, and subtraction. Quasi-experimental, cross sectional, between groups	N = 50; ID group n = 25; NG; mean age 10.4 y Non-ID group n = 25; NG; mean age 9.1 y	ID group mean WISC FSIQ = 72, mean CA 14.5y, mean MA of 10.4y Non-ID group mean PPVT-R IQ = 118, mean MA of 10.7y	Transformation (mental image rotation, imposition, and subtraction tasks, based on Ravens matrices). Each item consists of three figures presented in a row. In rotation problems, the left-most figure in each row is rotated 90°	ID and non-ID groups were equivalent on tasks at baseline. Groups required the same amount of input to master tasks. Non-ID groups retained and generalised rules better. Both ID and non-ID	Good

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Table 1 (*continued*)

	First author (year), Recruitment source, location	Study Aim and Design	Participants (number; sex; age in years)	ID diagnosis; IQ	Mental imagery aspect (generation, maintenance, inspection, transformation, or phenomenology or therapeutic intervention in which mental imagery is a core component)	Main findings	Quality appraisal rating
					clockwise to obtain the figure in the centre, and that figure is then rotated another 90° clockwise to obtain the right-most figure. In the imposition problems, the figures in the left and centre positions of each row are superimposed to obtain the figure in the right position. In the subtraction problems, the figure in the centre of each row is deleted from the figure in the left column of that row to obtain the entry m the extreme right column.	groups are able to learn MI tasks.	
7	Carretti et al. (2022); participants in previous experimental studies; Italy	To analyse developmental trajectories in spatial-sequential and spatial-simultaneous working memory, based on chronological age and mental age. Cross sectional, observational	N = 411; DS group n = 84; F = 46.43%; age 7–30 TD group n = 327; F = 38.84%; age 4–8	Diagnosis of Down Syndrome	Transformation (mental image rotation, imposition, and subtraction tasks, based on Ravens matrices) Maintenance (Working Memory Matrices; a matrix presented and participant has to indicate immediately after presentation all target cells on a blank matrix)	People with DS performed better on spatial-sequential than spatial-simultaneous working memory tasks. Developmental trajectories in DS are similar to TD until about 13 years, while they are different in late adolescence and adult age	Good
8	Courbois (1996); Non-ID group from school; ID group from 4 specialised institutions; France	To assess imagery abilities of participants with ID on tasks requiring image generation, maintenance, inspection, and transformation (rotation). Quasi-experimental, cross sectional, between groups	N = 76; Sociocultural ID group n = 20; F = 10 M = 10; mean age 15.5 (SD 1.14) Organic ID group n = 20; F = 9 M = 11; mean age 15.83 (SD 1.01) Non-ID group 8-year-olds n = 20; F = 10 M = 10; mean age 8.16 (SD 0.47) Non-ID group 5-year-olds n = 16 (F = 7 M = 9) mean age 5.56 (SD 0.31)	Sociocultural ID group mean FSIQ = 51.65 Organic ID group mean FSIQ = 48.15 Non-ID group 8-year-olds FSIQ NG Non-ID group 5-year-olds FSIQ NG	Generation (adaption of Kosslyn, Margolis, Barrett, Goldknopf and Daly, 1990 task; imagine an uppercase letter as it would appear on a 4 × 5 grid of cells) Maintenance (memorise a simple or complex pattern appearing on a grid maintained over short or long duration) Inspection (over short, long or no distance) Transformation (mental rotation required to judge if two stimuli were identical)	ID groups performed significantly lower than non-ID groups even when matched for mental age. Organic ID group showed specific difficulties with image maintenance, were slower to generate MIs, but faster at mental rotation than the sociocultural ID group. Aetiology of ID may impact on MI skills.	Mixed
9	Courbois et al. (2007); NG; France	To investigate the effect of visual properties of a figure on the ability of people with ID to use mental rotation. Quasi-experimental, cross sectional, between groups	N = 50; ID group n = 16; F = 8 M = 8; mean age 15.92 (SD 11 m) Matched MA group n = 18; F = 9 M = 9; mean age 8 (SD 4 m) Matched CA group n = 16; F = 8 M = 8; mean age 16.5 (SD 4 m)	NG; ID group mean FSIQ = 54.5 (SD 4.37) based on WISC-III, no detectable brain lesion	Transformation (mental rotation task involving three 2-D unfamiliar shapes composed of four arms. For each shape, there was a version with a salient feature and a version with no salient feature)	ID group were able to encode and imagine rotations of unfamiliar figures. ID group did not have significantly different error rates from CA- and MA-matched groups. ID participants find mental rotation tasks more difficult when stimuli have no feature with a salient axis of elongation.	Good
10	de la Iglesia et al. (2004); Children recruited from Spanish state	To investigate the effect on recall in a paired-associates task of different strategies	N = 51; Child ID Group n = 22; F = 8 M = 14; mean age	Child ID group (KBIT) mean IQ = 53.13 (SD 10.28), min 40 max 73 Adults mean IQ (KBIT)	Generation (to consider the impact of mental image generation in performance on	Both adults and children with DS can follow verbal instructions to form mental images of the	Mixed

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Table 1 (*continued*)

	First author (year), Recruitment source, location	Study Aim and Design	Participants (number; sex; age in years)	ID diagnosis; IQ	Mental imagery aspect (generation, maintenance, inspection, transformation, or phenomenology or therapeutic intervention in which mental imagery is a core component)	Main findings	Quality appraisal rating
	school, early healthcare unit n = 3 and Downs Syndrome Association. Adults recruited from Spanish occupational workshop; Spain	(imagery, drawing and repetition) in children and adults with DS. Mixed design, Cross sectional	9.20 (min 7 max 12) Adult ID Group n = 29; F10 M19; mean age 29.76 min 18 max 57	43.02 (SD 5.01), min 40 max 57	immediate and delayed recall of paired-associates task)	paired associates to be learned. In learning paired associates, most successful strategy was seeing drawings, then mental imagery, then repetition.	
11	de la Iglesia et al. (2005); Children recruited from Spanish state school, early healthcare unit n = 3 and Downs Syndrome Association. Adults recruited from Spanish occupational workshop; Spain	To investigate the effect on prose recall of different memory strategies (auditory listening, mental imagery, looking at drawings) in children and adults with DS. Mixed design, Cross sectional	N = 52; Child ID group n = 22; F = 7 M = 15, mean age 9.20 (min 7 max 12) Adult ID group n = 30; F11 M19; mean age 29.5 (min 18 max 57)	Child ID group (KBIT) mean IQ = 53.13 (SD 10.28), min 40 max 73 Adults mean IQ (KBIT) 43.02 (SD 5.01), min 40 max 57	Generation (mental image generation in prose-recall task; Three prose texts were learned using colour drawings, mental imagery and auditory learning. The results for recall using the first two strategies were then compared to those for auditory learning)	Both adults and children with DS can follow verbal instructions to form mental images of the prose to be recalled. In learning prose, most successful strategy was seeing drawings, then mental imagery, then listening to story. Pattern of results the same for immediate and delayed recall	Good
12	Dilly (2014); Secure forensic hospital; UK	To describe the use of EMDR with a person with mild ID and complex presentation in a forensic setting. Single case study	N = 1; M = 1; age 25	Diagnosis of intellectual disability	EMDR safe place visualisation technique developed using multi-sensory prompts (a selection of photographs and a scented pine cone)	A "safe place visualisation technique" was developed to manage participant's arousal and used in every session. Symptom reduction in re-experiencing, avoidance and arousal were maintained at one- and six-month follow-up.	Good
13	Di Nuovo et al. (2018); rehabilitation centre for people with ID; Italy	Can MI moderate the effect of cognitive components on the degree of mental deterioration in adults with ID? Cross sectional, observational	N = 40; F13 M27; mean age 35.70 (SD 11.89), min 16 max 64	Mild or moderate ID	Generation, maintenance, inspection, transformation (used Mental Imagery Test (MIT); Di Nuovo, Guarnera, & Castellano, 2014). The MIT comprises 8 tasks; Visualizing letters (imagine uppercase letters and deciding whether they contain curved parts); Brooks 'F' Test (to mentally examine the contour of a letter F; Clock (imagine what hour a clock reflected in the mirror indicates); Cube (visualize a large cube made up of many small cubes, and identify how many corner and middle external faces it shows); Subtraction of parts (to subtract in imagination parts from figures); Map (to mentally explore distances between features on a map); Imagined paths (to imagine, according to sequential indications from the examiner, the paths of a dot moving in the space); Representation of shapes of objects (to visualize objects of different shapes,	A significant relationship found between MoCA and all factors of WAIS-IV, except for Processing Speed. A significant relationship found between MIT score and cognitive domains of the WAIS-IV. A strong correlation shown between MoCA score and MIT score (r = 0.70, p < .01).	Poor

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Table 1 (*continued*)

	First author (year), Recruitment source, location	Study Aim and Design	Participants (number; sex; age in years)	ID diagnosis; IQ	Mental imagery aspect (generation, maintenance, inspection, transformation, or phenomenology or therapeutic intervention in which mental imagery is a core component)	Main findings	Quality appraisal rating
					discriminating the wider from the higher)		
14	Doerr et al. (2021); participants in previous experimental studies; Italy	To analyse developmental trajectories in spatial visualisation and mental rotation, based on chronological age and mental age. Cross sectional, observational	N = 87; F40 M47; mean age 19.46 (SD 9.57) min 7.75 max 53.25	Diagnosis of Down Syndrome	Transformation (mental rotation task Ghost Picture test) Two similar silhouettes are presented beneath the target figure, but only one of them is identical to the target but is rotated, while the other is a mirror image of the target figure. Participants are asked to choose the figure that matches the target silhouette.	Mental rotation performance increased after 5 years which continued until 14 years and then decreased. Developmental trajectories in mental rotation depended on the rotation degree. Development level, not chronological age better describes changes in spatial visualisation and mental rotation of individuals with DS.	Mixed
15	Gibson et al. (1995); Regular and resource elementary school classrooms in 3 rural schools; USA	To compare visual imagery strategies on learning in children with ID and groups of children matched for MA and CA. Randomised Controlled trial	N = 166; ID group n = 44; (F18 M 26); mean age 12.04 (SD 0.46), min 10.67 max 13.01 Matched MA group n = 62; NG; mean age 7.02 (SD 0.48) min 6.10 max 7.92 Matched CA group n = 60; NG; mean age 11.55 (SD 0.36) min 11.00 max 12.33	Mild ID; IQ mean 62.61 (SD 5.21), min 52 max 70	Generation (generate image of pictures to illustrate a story). Children were either read a story (control condition), shown pictures accompanying a story (imposed imagery) or asked to generate their own images to accompany the story (induced imagery).	ID group did not recall as much information as MA matched group. Using pictures improved recall for both ID children and TD children of equivalent MA, suggesting strategic support of imagery process benefits ID group. However, children with ID scored as poorly in the condition in which they were instructed to create mental images as the control condition. Conclude ID group are not deficient in mental imagery but require this to be supported, as they may not do this spontaneously or when simply instructed to do so.	Mixed
16	Gordon et al. (1994); Elementary school; USA	To compare the ability of children with ID and those matched for MA to remember and discriminate real from imagined events, both immediately and over a delay. Quasi-experimental, cross sectional, between groups	N = 46; ID group n = 23; (F11 M12); mean age 10.3 (min 8.1 max 13.0) Non-ID group n = 23; (F8 M15); mean age 6y 5 m (min 6.1 max 6.8)	ID group mean PPVT-R scores = 57.35 Non-ID group mean PPVT-R scores = 95.96	Generation and inspection (children were asked to engage in and imagine themselves engaging in interactive activities with experimenter)	Both ID and non-ID groups performed well on this complex task of remembering and discriminating activities performed and imagined. Patterns of responses were similar for both groups. Performed activities were remembered significantly better than imagined activities by both ID and non-ID group. ID group were more likely to misclassify activity as performed or imagined when questioned later.	Good
17	Hardiman et al. (2018); referred to NHS services; UK	To conduct a mixed-methods investigation of the effects of a CFT intervention in people with ID. Mixed methods	N = 3; (F2 M1); age 31,47,48 (mean age 42)	Mild-moderate ID "based on clinical judgement and recent BPS guidelines"	Compassion Focused Therapy (imagery practice to generate safe place, practiced weekly in therapy sessions and clients encouraged to practice between sessions)	All participants reported reliable reductions in anxiety but remained above clinical cut-off for diagnosis. Self-compassion improved for all participants, with continued improvement at follow-up for two participants.	Good

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Table 1 (*continued*)

	First author (year), Recruitment source, location	Study Aim and Design	Participants (number; sex; age in years)	ID diagnosis; IQ	Mental imagery aspect (generation, maintenance, inspection, transformation, or phenomenology or therapeutic intervention in which mental imagery is a core component)	Main findings	Quality appraisal rating
18	Hart and Robbins (2014); referred to NHS services; UK	To evaluate a new service providing relaxation training over a 12-week intervention. Case study	N = 15; NG; NG	Mild-moderate ID	Relaxation training (generate guided imagery using scripts tailored to each individual)	Results showed a positive downward trend in anxiety. Results from the pulse oximeter readings were universally positive, showing a reduction in heart rate after using relaxation techniques.	Poor
19	Hemayattalab and Movahedi (2010); mentally retarded school; Tehran	To investigate the effects of mental imagery and physical practice on the learning of a perceptual-motor task (basketball free throw) in adolescents with ID. Randomised Controlled Trial across 5 conditions (physical practice only, mental practice only, physical practice followed by mental practice, mental practice followed by physical practice, and no imagery–no physical practice)	N = 40; NG; age min 12 max 15	"Trainable mentally retarded students"	Generation (mentally practice throwing basketball). Participants randomly assigned to one of five conditions (physical practice, mental practice, physical practice followed by mental practice, mental practice followed by physical practice, and no practice)	In people with ID MI practice is more effective than no practice, but less effective than physical practice. A combination of mental practice and physical practice is more effective than only physical practice.	Poor
20	Hinnell and Virji-Babul (2004); ID group recruited through Downs Syndrome organisation, non-ID group through schools; Canada	To ascertain if people with DS with a mental age greater than 5 years can perform spatial mental transformations. Quasi-experimental, cross sectional, between groups	N = 16; ID group n = 7; F4 M3; mean age 29.8 (SD 5.4), min 22 max 26 Non-ID group n = 9; F5 M4; mean age 7.2 (SD 1.2), min 6 max 9	ID group consisted of those with Down Syndrome	Transformation (mental rotation task). Participants viewed an upper case 'F' or a mirror image of an 'F' presented at one of eight different orientations. Participants determined whether the letter was reversed or non-reversed.	Individuals with Down Syndrome performed mental rotation tasks well above chance level, indicating that the skill set does develop and does exist, although it may be compromised compared to TD individuals.	Good
21	Ikeda et al. (2014); Special schools and mainstream elementary schools; Japan	To examine features of inhibitory control in children with ID, children with ID and ASD, and mental-age matched TD children. Quasi-experimental, cross sectional, between groups.	N = 41; ID alone group n = 11; F7 M4; mean 15.83 (SD 1.68) min 13.17 max 18.08 ID + ASD group n = 9; F3 M6; mean age 15.44 (SD 1.38) min 12.83 max 17.08 TD group n = 21 F10 M11; mean age 8.46 (SD 0.52) min 7.50 max 9.25	ID diagnosis made by psychiatrist or paediatrician; criteria chronological age under 18, IQ under 70	Inspection (Real Animal Size Test and Pictorial Animal Size Test). Participants are presented with pictures of large (e.g. elephant) or small animals (e.g. frog) printed as big or small images mismatched with the animal's real size.	ID alone group showed impaired inhibitory control compared to TD group. The ID group did not differ from the TD or ID+ ASD groups in terms of error rates. Suggests ID participants were able to successfully complete the MI aspect of the task.	Good
22	Jens et al. (1990); schools; Australia	How well do children with and without ID discriminate events in which they actually participated versus those for which they only imagined participating, both at an initial interview and after an 8-week delay? Randomised controlled trial	N = 54; ID group n = 24; F5 M19; mean age 10 y 8 m (Min 7y 5 m to max 16y 7 m) TD group n = 30; NG; average age of 6y 5 m (min 5y 7 m max 7y 0 m)	ID group mean FSIQ = 63.25 (min 47 max 76.5)	Generation (imagine participating in an activity). Children were asked to perform a series of tasks or only imagine performing them. They then remembered which had been performed and which imagined at immediate interview and after 8-week delay.	ID group and age matched TD group were equally good at remembering activities performed or imagined both at immediate recall and 8-week delay.	Mixed
23	Karatzias et al. (2019); referred to NHS ID services; UK	To compare EMDR plus SC versus SC alone for PTSD in adults with ID.	N = 29; EMDR+SC n = 15; F9 M6; mean	Diagnosis of mild-to-moderate ID EMDR+SC mild ID n = 13	EMDR (protocol details assessing components of distressing memory,	EMDR+SC resulted in lower levels of anxiety and more participants	Good

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Table 1 (*continued*)

	First author (year), Recruitment source, location	Study Aim and Design	Participants (number; sex; age in years)	ID diagnosis; IQ	Mental imagery aspect (generation, maintenance, inspection, transformation, or phenomenology or therapeutic intervention in which mental imagery is a core component)	Main findings	Quality appraisal rating
		Randomised controlled feasibility trial with qualitative process evaluation	age 42 (SD 11.3) SC n = 14; F9 M5; mean age 42 (SD 12.1)	moderate ID n = 2 SC mild ID n = 11 moderate ID n = 3	including an image, and the current emotional and physiological components of the image)	being PTSD symptom free post treatment. EMDR+SC showed higher dropout rates.	
24	Kwong (1994); inner city school; Canada	To explore the awareness and use of various memory strategies in adolescents with ID compared with those without ID. Quasi-experimental, cross sectional, between groups.	N = 19; ID group n = 9; F6 M3; mean age 174.7 m (min 164 m max 184 m); TD group n = 10; F9 M1; mean age 174.7 m (min 105 m to 133 m)	Mild ID ID group mean WISC-R FSIQ score = 68.8 (min 60 max 76)	Generation (assessing visual imagery as memory strategy). Compared the frequency and type of different memory strategies used by participants.	ID participants preferred maintenance rehearsal and visual imagery as memory strategies. TD participants used a wider range of memory strategies and more complex strategies. ID ppts reported using MI spontaneously and consistently regardless of nature of the task. They used elaborative rehearsal to a less extent and seldom used mnemonics.	Good
25	Leevers and Harris (1998); from mainstream nursery, ID school and centres for children with autism; UK	To test whether children with autism display an inability to imagine impossible entities when the task demands are minimal. Compared children with autism with children with moderate ID and TD 4-year olds. Quasi-experimental, cross sectional, between groups.	N = 48; ASD group n = 16; F3 M13, mean age 11y2m (SD 24.8), min 7y 9 m max 15y 2 m ID group n = 16; F6 M10, mean age 11y7m (SD 16.5) min 9y 11 m max 14y 4 m TD group n = 16; F10 M6; mean age 4y 5 m (SD 4.2) min 4y 0 m max 4y 11 m	Moderate ID verbal mental age (TROG) 4–6 years exactly	Inspection (picture completion using drawing or colouring to complete pictures of real and impossibleanimals)	Children in all groups able to choose the correct pattern to make a picture look real if impossible, and also complete pictures to make them real or impossible. No difference between groups - ID group as competent as other groups on tasks.	Good
26	Meneghetti et al. (2018); day centres for people with DS and kindergartens; Italy	To explore mental rotation ability in individuals with DS and compared them with a group of TD children matched on mental age. Quasi-experimental, cross sectional, between groups.	N = 96; DS group n = 48; F17 M31; mean age 169.33 m (SD 41.03) TD group n = 48; F19 M29; mean age 66.83 m (SD 3.47)	Down Syndrome diagnosis	Transformation (mental rotation task; Ghost Picture test) Two similar silhouettes are presented beneath the target figure, but only one of them is identical to the target but is rotated, while the other is a mirror image of the target figure. Participants are asked to choose the figure that matches the target silhouette.	DS participants have worse mental rotation performance than TD children of comparable mental age, and are influenced differently by angular disparity: for items rotated by 180°, DS participants were unable to perform above chance	Good
27	Mevissen, Lievegoed, and De Jongh (2011); referred by mental health professional; The Netherlands	To investigate the applicability of EMDR in 4 people with mild ID, suffering from PTSD. Case study	N = 2*; F1 M1; Age 32 and 53	Mild ID and moderate-mild ID	EMDR intervention	In all cases PTSD symptoms decreased and the gains were maintained at 13–28 months follow-up. In addition, depressive symptoms and physical complaints subsided, and social and adaptive skills improved. EMDR has potential applicability for people with mild ID.	Good
28	Mevissen, Lievegoed, Seubert, and De Jongh (2011); referred by mental health	To assess the applicability of EMDR in two clients with moderate ID, serious behavioural problems, and histories of	N = 1*; M1; 'middle aged'	Moderate ID WPPSI-R; average developmental level 4.9 years	EMDR intervention	PTSD-like symptoms decreased in only 5 sessions. Gains were maintained at 10 months follow-up. EMDR is a potentially	Good

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	First author (year), Recruitment source, location	Study Aim and Design	Participants (number; sex; age in years)	ID diagnosis; IQ	Mental imagery aspect (generation, maintenance, inspection, transformation, or phenomenology or therapeutic intervention in which mental imagery is a core component)	Main findings	Quality appraisal rating
	professional; The Netherlands	negative life events. Case study				applicable psychotherapeutic treatment method for clients with ID, even those with substantially limited verbal capacities	
29	Mevissen et al. (2012); referred for outpatient treatment; The Netherlands	To assess the applicability of EMDR for psychological trauma in people with severe ID. Case study	N = 3*; F2 M1; aged 10, 10 and 49	Severe ID	EMDR intervention	In all cases PTSD symptoms decreased, with gains maintained at 15.5 months to 2.5 years. Depressive symptoms and physical complaints diminished, and social and adaptive skills improved. EMDR seems to be an applicable treatment method for clients with severe ID. Reduction and maintenance of PTSD symptoms in individuals with severe ID appears to be both desirable and obtainable	Good
30	Mevissen et al. (2017); referred to child and adolescent psychiatry services; The Netherlands	To explore the effectiveness of EMDR therapy for PTSD in persons with mild to borderline ID. Non-concurrent, multiple baseline, across subjects' design	N = 2; F1 M1; Age 10 and 18	Mild ID (FSIQ of 66 and 67)	EMDR intervention	For both participants PTSD symptoms decreased with EMDR treatment. Both no longer met PTSD criteria at post-treatment, and at 6-week follow-up. EMDR can be effective treatment for PTSD in children and adolescents with mild ID.	Mixed
31	Porretta and Surburg (1995); integrated schools; USA	To examine the effect of imagery practice in conjunction with physical practice on the performance of anticipating coincidence (striking) by adolescents with mild ID. Randomised Controlled Trial	N = 32; F17 M15; mean age 15y 1 m (min 13 y 1 m max 17y 8 m)	Mild ID (mean IQ = 66; range 56–75)	Generation of mental imagery across modality (imagine swinging baseball bat). Participants randomly assigned to a physical practice plus imagery practice group or physical practice only group.	Imagery practice in combination with physical practice seems to facilitate performance on a gross motor coincident timing task when compared to physical practice alone. All participants could use mental imagery and describe this to researcher.	Mixed
32	Rickard et al. (1984); activity centre for mentally retarded; USA	To investigate how people with ID and varying levels of cognitive functioning respond to 4 different types of relaxation training. Quasi-experimental, cross sectional, between groups.	N = 20; Group 1 n = 5; NG; mean age 33.4 (SD 13.63) Group 2 n = 5; NG; 23.0 (SD 8.75) Group 3 n = 5; NG; 61.4 (SD 4.77) Group 4 n = 5; NG; 44.6 (SD 5.41)	Mean IQ Group 1 = 93.2 (SD 5.54) Group 2 = 76.6 (SD 2.61) Group 3 = 61.4 (SD 4.77) Group 4 = 44.6 (SD 5.41)	Relaxation Training (visual image relaxation exercise with verbal instructions)	All participants (except 2) successfully engaged with visualizing relaxation images. Apart from lowest IQ group, all groups engaged with every type of relaxation exercise. Participants in lowest IQ group could follow relaxation exercises but at a lower level than other groups	Poor
33	Rodenburg et al. (2009); Inpatient epilepsy service; The Netherlands	To report a case study into effects of EMDR on trauma symptoms in adolescent with mild ID and epilepsy. Case study	N = 1; M1; 18	WAIS III FSIQ 67–77	EMDR (imagery practice to generate safe place)	Over 5 EMDR sessions a significant positive change in trauma symptoms was observed with PTSD symptoms improved to non-clinical levels. Suggests EMDR is effective for treating	Good

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	First author (year), Recruitment source, location	Study Aim and Design	Participants (number; sex; age in years)	ID diagnosis; IQ	Mental imagery aspect (generation, maintenance, inspection, transformation, or phenomenology or therapeutic intervention in which mental imagery is a core component)	Main findings	Quality appraisal rating
						trauma symptoms in people with mild ID and epilepsy.	
34	Roskos-Ewoldsen et al. (2006); high schools and university students; USA	To investigate whether participants with ID scan more slowly, at the same rate, or faster than participants without ID. Quasi-experimental, cross sectional, between groups.	N = 32; ID group n = 15; F = 8 M = 7; mean age 17.64 (SD 5.98) min 16.17 max 20.5 Non-ID group n = 17; F10 M7; mean age 19.84 (SD 1.95) min 18.17 max 24.33	ID group mean IQ = 57.13 (SD 11.60) min 40 max 74 Non-ID group NG	Inspection (involving learning the location of five landmarks on a map and scanning between these)	ID group needed more trials to learn the landmark locations and had generally slower scan times. ID and non-ID groups were identical in rate of scanning for both perception and imagery conditions. People with ID have no particular deficit in image inspection.	Good
35	Screws and Surburg (1997); Middle school; USA	To examine the efficacy of using MI in developing skill on motorically oriented task and cognitively oriented task in middle school children with mild ID. Randomised Control Trial	N = 30; NG; mean 12.5 (min 11 max 13)	Mild ID WISC-R FSIQ = 50–70	Generation (imagine completing a motor task). Participants randomly assigned to a physical, imagery or no-practice control group.	Physical practice significantly improved performance on both tasks. Imagery practice also enhanced motor performance on both peg board (cognitively oriented task) and pursuit rotor (motorically oriented task) although only statistically significant for peg board task. All participants could use MI practice to facilitate motor task performance.	Mixed
36	Stenfert Kroese and Thomas (2006); referred to NHS ID services; UK	To illustrate the application of an adapted form of imagery rehearsal therapy to adults with ID. Case study	N = 2; F2; age 18y and 24y	Mild ID; Both participants had IQ 55–69	Imagery Rehearsal Therapy (using image generation to replace distressing dreams with different endings)	For both participants, nightmares ceased within 6 weeks and maintained at 6 months follow up. Imagery rehearsal therapy is suitable for people with ID.	Good
37	Surburg (1991); high school; USA	To explore the use of imagery practice to facilitate the preparation of adolescents with mild ID to perform a motor task. Randomised Controlled Trial	N = 63; sex NG ID group n = 32; mean age 16.5 (SD = 1.31) min 14 max 18 TD group n = 32 Mean age 16.3 (SD = 1.51) min 14 max 18	Mild ID IQs on the Woodcock-Johnson Psycho-Educational Battery or Stanford-Binet Intelligence Scale ranged from 49 to 70 (mean = 65, SD = 6.21); classification based on multiple criteria including IQ, scores on an adaptive behaviour instrument, and grade attainment.	Generation (imagery practice in completing a button press, reaction time task)	Imagery practice was effective with subjects with and without mental retardation. Imagery practice facilitated performance of subjects in the group who experienced catch trials but also used imagery practice. For adolescents with mild ID who manifest marked preparatory difficulties as related to motor skill execution, imagery practice is a strategy that should be considered to enhance the skill.	Mixed
38	Surburg et al. (1995); integrated schools; USA	To examine the role of imagery practice as supplementary practice in performance of throwing task in people with ID. Randomised Controlled Trial	N = 40 Indiana group n = 20 F11 M9; mean age 16y 6 m, (SD 11.9 m), min 15y 0 m, max 18y 5 m Ohio group n = 20; F11 M9; mean age 14y 7 m (SD 1y 4 m),	Intelligence based on Stanford-Binet test and certain behavioural characteristics. Indiana group mean IQ = 70.5 (SD 6.58), min 59 max 81 Ohio group mean IQ = 66 (SD 6.64), min 53 max 72	Generation (compared imagery and physical practice with only physical practice on a throwing task)	Groups using imagery as well as physical practice showed superior performance to non-imagery groups. Imagery practice improves motor performance of students with mild ID.	Mixed

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	First author (year), Recruitment source, location	Study Aim and Design	Participants (number; sex; age in years)	ID diagnosis; IQ	Mental imagery aspect (generation, maintenance, inspection, transformation, or phenomenology or therapeutic intervention in which mental imagery is a core component)	Main findings	Quality appraisal rating
			min 13y 2 m max 17y 9 m				
39	Uecker et al. (1994); mainstream and self-contained learning disabled classrooms; USA	To compare TD children, LD children (not in the ID range), and DS children on a mental rotation task that examines their use of imaginal spatial processes. Quasi-experimental, cross sectional, between groups	N = 56, Control Group n = 22; F12 M10; mean age 9y 2 m (SD 1.4), LD Group n = 24; F7 M17; mean age 10y 3 m (SD = 1.1), DS Group n = 10; F2 M8; mean age 8y 4 m (SD = 1.9)	DS group mean PPVT-R age of 3y, 1 m (SD = 1.1)	Transformation (Participants were required to use mental rotation to determine on what side the stimulus of a stick figure was holding a ball)	Control group were quickest in performing the mental rotation task, followed by LD group and then DS group. DS group were significantly less accurate than control and LD groups. Mental rotation skill was arrested in the DS population.	Good
40	Vicari et al. (2006); children's hospital; Italy	To investigate the possible dissociation between visual–object and visual–spatial working memory in individuals with Williams syndrome and Down syndrome. Quasi-experimental, cross sectional, between groups	N = 66; WS group n = 15; F5 M10; 19y 8 m (SD 6y 1 m) WS comparison group n = 15; F8 M7; 6 y 10 m (SD 10 m) DS group n = 18; F7 M11; 15 y 10 m (SD 5y 8 m) DS comparison group m = 18; F8 M10; 5 y 1 m (SD 7 m)	DS group mean mental age 5y 2 m (SD 8 m)	Inspection (Mental Colour Comparison Test modified (De Vreese, 1991) stating whether two typically coloured objects are the same, and Animal tails (Farah et al., 1988) (judging which of two stated animals has a longer tail) Transformation (Stick Test; Carlesimo, Perri, Turriziani, Tomaiuolo, & Caltagirone, 2001; participants use mental rotation to determine which of four similarly shaped stimuli would match a rotation of the original stimulus) and Spatial Rotation Test; participants create a visual image by mentally rotating geometric drawings and match with one of six alternatives).	Visual–object and visual–spatial working memory may be differentially compromised in people with ID underlain by different genetic syndromes. Reduced visual, but relatively preserved, spatial abilities were shown in perceptual and imagery tasks in individuals with DS.	Good
41	Wilen (1982); special educational school classes; USA	To investigate the use of imagery and verbal elaboration strategies to facilitate the paired-associate learning of adolescents with ID. Randomised controlled trial	N = 48; F24 M24; mean age 19 (min 17y max 21y)	Moderate ID "Mentally Retarded Trainable Level" based on a comprehensive psychological evaluation administered by a certified school psychologist. FSIQ under 55	Generation (assessing visual imagery, verbal elaboration and a combined imagery-verbal elaboration condition as memory strategies)	Participants paired-associate performance can be substantially improved through the use of cognitive strategies (imagery, verbal elaboration or a combined imagery-verbal elaboration condition) compared with rote learning. No significant difference found between the 3 cognitive strategies.	Mixed

NHS = National Health Service; UK = United Kingdom; USA = United States of America; PTSD = Post Traumatic Stress Disorder; IQ = Intelligence Quotient; FSIQ = Full Scale Intelligence Quotient; ID = Intellectual disability; MI = mental imagery; NG = not given; PPVT-R = Peabody Picture Vocabulary Test-Revised; WISC = Weschler Intelligence Scale for Children; WAIS = Weschler Intelligence Scale for Children; y = years; m = months; MA = mental age; CA = chronological age; KBIT = Kaufman brief intelligence test; TD = typically developing; SC = standard care; EMDR = Eye Movement Desensitisation and Reprocessing; DS = Down Syndrome; LD = learning disability; CCAT = Criteria Cognitive Aptitude Test; WPSSI-R = Wechsler Preschool and Primary Scale of Intelligence; MoCA = Montreal Cognitive Assessment; WS = Williams Syndrome; RT = reaction times; CFT = Compassion Focused Therapy; BPS = British Psychological Society; WASI = Wechsler Abbreviated Scale of Intelligence; KBIT = Kaufman Brief Intelligence Test; ASD = Autism Spectrum Disorder; SC = Standard Care; TROG = Test for Reception of Grammar; WPPSI-R = Wechsler Preschool and Primary Scale of Intelligence – Revised; SD = Standard Deviation.

* Papers originally included additional participants but only the results of those not diagnosed with ASD are reported here.

Quality appraisal tools were completed independently by OH and HG for 40% of articles, resulting in an inter-rater agreement level of 97%, $k = 0.94$. All conflicted decisions were resolved through discussion, and 100% agreement was reached on all studies.

Quality appraisal was not used as a decision-making tool for inclusion in this review (Popay et al., 2006). Given the disparate range of identified papers, and the variability in quality, it was felt that important information about mental imagery in people with intellectual disabilities could be lost if papers with methodological flaws were excluded. However, the quality of papers is critically appraised within the synthesis.

6.7. Data synthesis

Data was synthesised using narrative synthesis techniques (Popay et al., 2006), and the PRISMA statement (Moher et al., 2009). This approach uses words to summarise and explore data from all studies (both quantitative and qualitative) in order to address the research questions. Data synthesis was organised around Kosslyn's (1980, 1994) model of mental imagery, using the four aspects of image generation, maintenance, inspection and transformation, in order to structure the synthesis. Additional studies were organised according to their focus on various therapeutic interventions, or their exploration of the phenomenology of mental imagery.

7. Results

The 41 included studies were conducted in ten countries, with 32% (n = 13) conducted in the USA. Other countries included the UK (n = 8), The Netherlands (n = 5), Italy (n = 5), Australia (n = 2), France (n = 2), Canada (n = 2), Japan (n = 1), Spain (n = 2) and Iran (n = 1). The number of participants in each study ranged from one to 411.

Nine studies were RCTs, 15 were quasi-experimental, four were cross-sectional, four were qualitative, eight were case reports and two used experimental single case design. In terms of the focus of the study, 28 were experimental studies examining the ability of people with ID to engage in aspects of mental imagery, and 13 reported on therapeutic interventions, of which mental imagery formed a core component (as per inclusion criteria). These included EMDR (n = 9), Imagery Rehearsal Therapy (n = 1), Relaxation Training (n = 2) and Compassion Focused Therapy (n = 1). One paper specifically investigated the phenomenology of mental images.

Four studies did not clarify that a diagnosis of intellectual disability was given to participants, instead making mention of other categorisations such as 'mentally retarded trainable level', although it was clear from the source that participants met inclusion criteria in terms of having an intellectual disability. Ten studies did not report the severity of the participants' intellectual disability (i.e., mild, moderate, severe etc). Sixteen studies did not report a Full-Scale IQ for participants.

Fifteen studies contained adult participants (aged 18 years or older) and 17 studies focused on children. Nine studies contained both child and adult participants. Three studies did not report participants' age, and three only provided mean ages for groups of participants. Nine studies did not report the sex for either all (n = 8) or a subgroup (n = 1) of participants.

Participants were recruited from a variety of settings, with 17 studies recruiting from schools or colleges, 14 from healthcare settings (including five from the United Kingdom's National Health Services), and a range of other settings such as day centres (n = 3), state institutions (n = 2), agencies providing services to people with intellectual disabilities (n = 3), and from previous experimental studies (n = 2). One study did not state their recruitment sources, and some studies recruited from multiple different sources.

7.1. What do we understand about the abilities of people with intellectual disabilities to engage with mental imagery (the generation, maintenance, inspection, and transformation of mental images)?

7.1.1. Generation

Fifteen studies specifically investigated the ability of people with intellectual disabilities to generate a mental image. Of these three were rated as good quality (Brougham, Pert, & Jahoda, 2020; Gordon, Jens, Hollings, & Watson, 1994; Kwong, 1994). Ten were rated as mixed quality (Courbois, 1996; de la Iglesia, Buceta, & Campos, 2005; de la Iglesia, José Buceta, & Campos, 2004; Gibson, Glynn, Takahashi, & Britton, 1995; Jens, Gordon, & Shaddock, 1990; Porretta & Surburg, 1995; Screws & Surburg, 1997; Surburg, 1991; Surburg, Porretta, & Sutlive, 1995 and Wilen, 1982). Three were rated as poor quality (Brown & Bullitis, 2006; Di Nuovo, Angelica, Santoro, & Platania, 2018; Hemayattalab & Movahedi, 2010).

7.1.1.1. Generating random patterns. Two studies looked at participants' ability to generate visual images of random patterns. Screws and Surburg (1997) conducted a RCT in which participants completed a peg board test, and examined the effects of physical practice, mental imagery practice, and no practice on performance. A lack of clarity around whether allocation to groups was concealed, as well as similarity of groups at baseline, and blinding (for participants, those delivering treatment and outcome assessors) mean the validity of results is uncertain. Whilst physical practice significantly improved performance, imagery practice also significantly enhanced motor performance, suggesting participants could generate images to complete mental imagery practice of the task. Courbois (1996) conducted a generally robust, quasi experimental study investigating all four aspects of mental imagery, although it was unclear whether participants included in comparisons were similar which threatens the internal validity of the study as differences between groups may be due to selection bias. They concluded that adolescents with intellectual disabilities found complex images more difficult to generate and have poorer mental image generation skills than mental age matched typically developing children. Courbois (1996) adapted the Kosslyn et al. (1990) paradigm for participants who cannot read. They excluded three participants who were unable to learn the task (one of whom had an intellectual disability) suggesting that people with intellectual disabilities were as able to complete the mental imagery generation task as their mental age matched, typically developing peers. Low error rates were seen across all groups.

7.1.1.2. Generating meaningful stimuli. Three studies asked participants to create images of meaningful stimuli. Brougham et al. (2020) reported in a well-designed qualitative study that people with and without intellectual disabilities performed similarly on a task to generate a compassionate image. This paper clearly linked the research question with an appropriate qualitative methodology and method of data analysis, although the researchers' cultural or theoretical position was not stated. Whilst participants with intellectual disabilities required additional prompts and scaffolding to generate and use their images, these images were very similar to those generated by participants without intellectual disabilities. Brown and Bullitis (2006) asked participants to create mental images of photos they had previously been shown and manipulate these images. Participants with intellectual disabilities seemed less familiar with the idea of mental imagery than those in the comparison group, and provided more concrete descriptions of the imagery, although with considerable individual variation. Eighty-seven percent of participants with intellectual disability could spontaneously describe a mental image they generated, and the remaining participants could also do this but required prompting. Di Nuovo et al. (2018) used the Mental Imagery Test (MIT) which contained two subtests focused on image generation, Visualizing Letters and Clock. This study had various quality issues including no clear inclusion criteria, little detail about the participants and setting of the study, no confounding factors considered or managed, and a lack of clarity over whether the exposure was measured in a reliable and valid way. Unfortunately, results were not provided for individual subtests, but the authors reported participants with intellectual disabilities had no difficulties engaging with the MIT.

7.1.1.3. Image generation to enhance memory. Several studies looked at participants' ability to generate mental image as a memory strategy. Kwong (1994) reported a high quality, methodologically sound study into the types of memory strategies used by people with and without intellectual disability. Participants with intellectual disability preferred maintenance rehearsal and visual imagery as memory strategies. Typically developing participants used a wider range of memory strategies and more complex strategies. Participants with intellectual disabilities reported using mental imagery spontaneously and consistently regardless of the nature of the task. They used elaborative rehearsal to a lesser extent and seldom used mnemonics. de la Iglesia et al. (2004) examined performance on a paired-associated test and reported that both adults and children with Down syndrome can follow verbal instructions to form mental images when learning this task. They found that whilst generating mental images was more effective than repetition as a memory strategy, it was less helpful than seeing actual drawings of images. A similar study by the same authors (de la Iglesia et al., 2005) compared similar groups of children and adults with Down syndrome on a prose recall task. They found that again, the most helpful memory strategy was seeing actual drawings of images related to the prose, followed by generating a mental image of the prose, and lastly by attentive listening to the content of the prose. Both of these studies would have been strengthened by including a comparison group and taking multiple measures of outcomes before and after intervention.

Wilen (1982) also used a paired-associates test to examine the effect three different memory strategies (mental imagery, verbal elaboration, or a combined imagery-verbal elaboration condition) compared to rote learning in a RCT design. Performance was substantially improved with cognitive strategies compared with rote learning, although no significant difference was found between the three different cognitive strategies. A threat to the validity of this otherwise well-designed study is the lack of blinding for participants, those delivering the intervention, and outcome assessors. Gibson et al. (1995) compared groups of children with intellectual disabilities with those matched for mental age and chronological age on conditions which included being shown pictures illustrating a story (imposed imagery), a condition in which children were instructed to imagine such pictures (induced imagery), and a control condition. Whilst the imposed imagery condition increased recall for both groups, the induced imagery results were not significantly different from control condition for children with intellectual disabilities. This indicated that simply being given an instruction to generate mental images may have been insufficient, and that children with intellectual disabilities require support in the form of scaffolding or detailed instructions and practice to generate mental images. The instructions for participants in the induced imagery condition were very basic and lacked any detail as to how mental imagery could be generated. There were no steps included to help children practice mental imagery, to check they understood the instructions, or to assess at the end of the experiment whether they had been able to generate mental images. Therefore, this, along with a lack of clarity around blinding for participants, and failure to blind those delivering the intervention or assessing outcomes detracted from this otherwise well-designed RCT.

7.1.1.4. Image generation to enhance motor skills. A number of studies used a motor skill task to investigate whether participants could generate a mental image of practicing this skill in order to enhance performance. Hemayattalab and Movahedi (2010) reported that all participants were able to generate mental images of a basketball free throw and that mental imagery practice improved scores compared to no practice (although it was less effective than physical practice). Methodological flaws in this RCT included lack of blinding, unclear whether allocation to groups was concealed, and lack of clarity about the appropriateness of the statistics (given that four experimental conditions as well as a control condition were included with a relatively small number of participants). Poretta & Surburg et al. (1995) reported that all participants could use mental imagery to practice a motor skill and describe this to researchers. Imagery practice in combination with physical practice facilitated performance on a gross motor coincident timing task when compared to physical practice alone. A lack of blinding threatened the internal validity of this study. Screws and Surburg (1997) found that all participants could generate a mental image to practice a motor pursuit task. Whilst physical practice significantly improved performance on the motor pursuit tasks, imagery practice also significantly enhanced motor performance, although to a lesser extent. Surburg (1991) found mental imagery practice was effective for all subjects in improving motor skill performance on a response-type task that included reaction time and movement time components. Methodological issues with a lack of blinding and clarity around whether allocation to groups was concealed, and if groups were similar at baseline were present in this study. These issues were also present in the study by Surburg et al. (1995), who compared imagery and physical practice with only physical practice on a throwing task. They found that all participants had engaged with the imagery component and could describe this to researchers. Imagery practice resulted in improved performance compared to physical practice alone.

7.1.2. Maintenance

Only three studies specifically examined participants' abilities to maintain a mental image. Carretti, Meneghetti, Doerr, Toffalini, and Lanfranchi (2022) was rated as a good quality paper, Courbois (1996) was rated as mixed quality and Di Nuovo et al. (2018) was rated poor quality.

Carretti et al. (2022) conducted a cross sectional study comparing a large sample of people with Down Syndrome and typically developing children on tasks assessing aspects of visual working memory. This included the Working Memory Matrices which required participants to observe a series of matrices, and a number of target cells are presented in each matrix (either sequentially or simultaneously). Participants then recall the target cells on a blank matrix. Whilst performance is better in both people with Down Syndrome and control groups for spatial-sequential than spatial-simultaneous working memory tasks, both tasks clearly require image maintenance. This paper did not directly compare the performance of the two groups due to differences in the size and mean developmental level of the group with Down Syndrome and the typically developing control group, Courbois (1996) conducted a robust, quasi-experimental study, in which participants memorised a pattern that appeared on a grid. Conditions varied in the complexity of the pattern (simple or complex) and retention duration (long or short). People with intellectual disabilities performed worse on this task than mental age matched typically developing children, with people with sociocultural causes of intellectual disability (defined as being from a very low socioeconomic status background, as well as having other siblings in the family home with intellectual disabilities) performing better those with organic cause of intellectual disability (defined as receiving no psychotropic medication and having no documented brain lesions). Such definitions of intellectual disability are controversial and not in accordance with diagnostic criteria. Complex patterns were more poorly recalled than simple patterns, although there was no effect of retention delay, suggesting the image refreshing process of people with intellectual disabilities is relatively efficient. Di Nuovo et al. (2018) included the Imagined Paths test. Unfortunately, no further information is provided about performance in this task, although it appears participants with intellectual disability were able to complete this task.

7.1.3. Inspection

Eight studies specifically examined the abilities of participants to inspect a mental image, five of which were rated as good quality (Gordon et al., 1994; Ikeda, Okuzumi, & Kokubun, 2014; Leevers & Harris, 1998; Roskos-Ewoldsen, Conners, Atwell, & Prestopnik, 2006 and Vicari, Bellucci, & Carlesimo, 2006), two as mixed quality (Courbois, 1996; Jens et al., 1990), and one as poor quality (Di Nuovo et al., 2018). Tasks to assess mental image inspection were variable in nature.

7.1.3.1. Motor-based. Two studies asked participants to inspect a mental image to determine if it was a real memory or an image of something they had only imagined. Gordon et al. (1994) conducted a very high quality, quasi-experimental study and found that participants with and without intellectual disability performed well on a complex task of remembering and discriminating activities performed and imagined, both at immediate recall and 6-week delay. Patterns of responses were similar for both groups. Jens et al. (1990) used a similar task in a RCT design and again found that participants with intellectual disabilities and a chronologically age matched group of typically developing children were equally good at remembering activities performed or imagined both at immediate recall and 8-week delay. However, issues with allocation to group being concealed, and a lack of blinding posed a threat to the internal validity of this study.

7.1.3.2. Object-based. Within several studies, participants were asked to inspect images based on objects. Ikeda et al. (2014) used well-established measures of image inspection (Real Animal Size Test and Pictorial Animal Size Test) to compare children with intellectual disabilities and typically developing children and autistic children with intellectual disabilities. Whilst children with intellectual disability showed less inhibitory control than other groups, error rates were similar for all groups. The results from this methodologically sound study suggested children with intellectual disabilities were able to successfully complete the mental imagery aspects of these tasks. Leevers and Harris (1998) reported a good quality, robust study in which children with and without intellectual disabilities completed pictures with patterns to make them look real or 'impossible' (e.g., complete a picture of a zebra with stripes or spots). They found children with intellectual disabilities were as competent as the control group in this task. The study would have benefitted from consideration of ethical issues. Vicari et al. (2006) used well standardised measures of visual image inspection (Mental Colour Comparison Test; De Vreese, 1991, and Animal tails; Farah, Hammond, Levine, & Calvanio, 1988) which examined mental image inspection skills, in a well-designed and well-conducted study. Individuals with Down syndrome performed significantly worse than typically developing children on mental colour comparison and animal tails tasks. This contrasted with their performance on mental transformation tasks, suggesting participants with Down syndrome may have a specific deficit in image inspection compared to other aspects of mental imagery.

7.1.3.3. Location-based. In contrast to object-based tasks, several studies compared spatial- or location-based tasks. Roskos-Ewoldsen et al. (2006) used a map scanning task to assess mental imagery inspection. This quasi-experimental study was methodologically sound, and of high quality (although no ethical considerations were reported). They found that participants with intellectual disabilities needed additional trials to learn the landmark locations (although this was not statistically significant) and showed overall slower response times, both of which would be expected due to the nature of intellectual disability. Scanning times increased with scanned distance for all participants as expected. They concluded that no specific deficit in image inspection is seen in people with intellectual disability. Courbois (1996) asked participants to inspect an image at 3 different distances. Their results for both people with and without intellectual disabilities were discrepant with predictions from Kosslyn's model as they found shorter response times for longer distances and suggest there may be issues with the experimental paradigm used. Di Nuovo et al. (2018) included a battery of mental imagery tasks in the 'Mental Imagery Test' (MIT). This test contains both object based and spatial based image inspection tasks. Object based tasks are Visualizing letters; Brooks 'F' Test and Representation of shapes of objects. The spatial based task is Map. Whilst this study seems to provide good evidence that people with intellectual disabilities can complete mental imagery tasks, the findings regarding the relationships between IQ scores, MIT and the MoCA screening tool for cognitive impairment, are difficult to understand. A number of methodological flaws were identified with this study, as detailed above. As scores for different subtests of the MIT are not reported and unavailable from the author it is not possible to distinguish between performance on object or spatial based tasks.

7.1.4. Transformation

Eleven studies specifically examined mental transformation skills, predominantly through mental rotation tasks, but also through using image imposition and subtraction tasks. Seven were rated as 'Good' through quality appraisal (Campione, Brown, Ferrara, Jones, & Steinberg, 1985; Carretti et al., 2022; Courbois, Oross III, & Clerc, 2007; Hinnell & Virji-Babul, 2004; Meneghetti, Toffalini, Carretti, & Lanfranchi, 2018; Uecker, Obrzut, & Nadel, 1994 and Vicari et al., 2006). Three were rated as Mixed (Borys, 1980; Courbois, 1996 and Doerr, Carretti, Toffalini, Lanfranchi, & Meneghetti, 2021). One was rated as poor (Di Nuovo et al., 2018).

Several studies found evidence that people with intellectual disabilities had relatively well-preserved mental transformation skills. Campione et al. (1985) report a high quality, methodologically sound study which found that groups with and without intellectual disabilities were equivalent on tasks at baseline, with both groups being able to learn and master mental rotation, imposition, and subtraction tasks. Both groups required the same amount of input to master tasks, although groups without intellectual disabilities retained and generalised rules better. Carretti et al. (2022) included Ravens Coloured Matrices tasks in their cross-sectional study with a large sample size, in order to provide developmental age equivalent scores for participants with Down Syndrome. No additional information about performance on this task was provided. Courbois et al. (2007) also reported a high-quality study which compared groups with and without intellectual disabilities and found that adolescents with intellectual disabilities were able to encode and imagine rotations of unfamiliar figures and did not significantly differ in terms of their error rates from chronologically and mental age matched controls (groups of typically developing 16-year-old adolescents or mental aged matched 8-year-old children). Vicari et al. (2006) conducted a robust study comparing participants with Down syndrome who had intellectual disabilities with those who were typically developing and a group of participants with Williams syndrome (who did not have intellectual disabilities). The study used well-standardised measures of visual image transformation (Stick test and spatial rotation test). They reported that individuals with Down syndrome and typically developing children performed at similar levels (i.e., with no statistically significant difference) on the stick test and spatial rotation tasks. Whilst they identified deficits in mental image inspection for participants, they concluded that people with Down syndrome perform similarly to typically developing group on mental transformation tasks.

However, several studies found evidence that people with intellectual disabilities showed an overall impaired performance compared to typically developing participants. Hinnell and Virji-Babul (2004) conducted a robust study and reported that whilst participants with Down syndrome performed mental rotation tasks well above chance level, indicating that the skill set does develop and does exist, it may be compromised compared to typically developing individuals. The study would have benefitted from multiple measures of outcome being taken before and after the intervention. Similarly, Borys (1980) found that participants exhibited a linear increase in their reaction time judgments as a function of increasing angular separation between stimuli, indicating that participants with intellectual disabilities were using an analogical mental rotation process to perform task. However, they found participants with intellectual disabilities performed slower than the control group and concluded their performance on this task of kinetic imagery is equivalent to that of typically developing children of considerably younger mental ages. This cross-sectional study did not identify confounding factors or consider ethical issues, which could impact the validity of findings. Courbois (1996) found that participants with organic intellectual disability were faster at mental rotation tasks than those with sociocultural cases of intellectual disability. They reported that participants with intellectual disabilities had scores comparable to 5-year-olds, and significantly lower than the 8-year-old comparison group. The categorisation of causes of intellectual disabilities seemed to be made on somewhat arbitrary criterion and is subject to criticism. Uecker et al. (1994) compared performance on a mental rotation task between a control group, a 'learning disabled' group (participants with specific learning difficulties and average IQ) and a Down syndrome group in a well-conducted, robust study (albeit lacking in ethical considerations). The control group were quickest in performing the mental rotation task, followed by the 'learning disabled' group and the Down syndrome group. Participants with Down syndrome were significantly less accurate than the other groups, and the authors concluded that mental rotation skills are arrested in the Down syndrome population. Meneghetti et al. (2018) reported a sound and well conducted study, in which participants with Down syndrome were found to have worse mental rotation performance than typically developing children of comparable mental age, as well as being influenced differently by angular disparity.

Participants displayed specific difficulties regarding the angle of rotation, and the features of stimuli. Doerr et al. (2021) noted that performance decreased with progression of degree of rotation. However, this study failed to identify confounding factors. Both Borys (1980) and Courbois (1996) note that stimuli rotated 180° presented particular difficulty and slower reaction times for participants with intellectual disabilities. Meneghetti et al. (2018) similarly found that participants with Down syndrome were influenced differently by angular disparity, and that for items rotated by 180°, they were unable to perform above chance. Courbois et al. (2007) reported that participants with intellectual disabilities found mental rotation tasks more difficult when stimuli have no feature with a salient axis of elongation. Doerr et al. (2021) examined mental rotation skills in people of different ages with Down syndrome and found that mental rotation performance increased after 5 years of age and continues to improve up to the age of 14 years, after which it decreases.

Di Nuovo et al. (2018) included two tasks that examined mental imagery. These were Cube and Subtraction of parts. Unfortunately, results from these subtests were not presented, although there was no mention of any deficits in performance on these or any subtests of the MIT.

7.2. *What do we understand about the phenomenology of mental images in people with intellectual disabilities compared to the general population?*

Two papers addressed the phenomenology of mental imagery, both comparing the experiences of people with intellectual disabilities with those of the general population. Brown and Bullitis (2006) considered the ability of people with intellectual disabilities to generate mental images across different sensory modalities. Whilst 87% of participants with intellectual disabilities spontaneously described visual mental imagery, the authors concluded that a portion of people with intellectual disabilities cannot consistently describe mental imagery.

Regarding the phenomenology of imagery, participants in both groups varied in the vividness of their imagery. Some participants gave transitory accounts of possible imagery while others who gave clear accounts of imagery, described only static pictures, rather than experiencing moving images, similar to a film clip. Several participants declined to image actions such as climbing a stepladder (due to fear of heights) or standing by a fire, suggesting mental imagery can elicit associated emotions in people with intellectual disabilities.

Whilst this study included people with 'severe to mild' intellectual disabilities, the number of participants in each category was not given and the relationship between mental imagery ability and level of intellectual disability was not explored. The accessibility of the methodology for people with severe intellectual disabilities is doubtful.

The paper employed a qualitative methodology (interviews and video recordings) to gather data and translated this into quantitative (categorical) data to identify how frequently people with and without intellectual disabilities described mental imagery across different modalities. Whilst direct quotes were used to illustrate aspects of mental imagery, no formal qualitative methodology was employed to analyse the data, and no wider themes reported. Attempts were made to infer mental imagery through the presence or absence of behaviours such as 'gross eye movements noted' or 'spontaneous laughter at imagery' which could be attributable to other factors.

In addition to the lack of congruity between the research methodology and the representation and analysis of data, this paper failed to locate the researcher culturally or theoretically and did not consider the impact of the research on the researcher and vice versa. It was given an overall quality appraisal of 'poor'.

One well-designed, robust study (Brougham et al., 2020) reported aspects of the phenomenology of imagery discovered through their mixed methods study. They found no significant differences were found between groups of people with intellectual disabilities and a comparison group on ability to generate a compassionate image, the type of image generated, and ability to generate compassionate words from their image. Participants with intellectual disabilities required scaffolding to elaborate and build detail of their image (e.g., colour, characteristics). The types of image generated by participants with intellectual disabilities were very similar to those produced by the participants without intellectual disability.

7.3. *What do we understand about the role of mental imagery within existing psychological interventions for people with intellectual disabilities?*

Thirteen studies reported on therapeutic interventions that contained mental imagery as a core component. Eight were rated as 'Good' in terms of quality appraisal (Dilly, 2014; Hardiman, Willmoth, & Walsh, 2018; Karatzias et al., 2019; Mevissen, Lievegoed, & De Jongh, 2011; Mevissen, Lievegoed, Seubert, & De Jongh, 2011; Mevissen, Lievegoed, Seubert, & De Jongh, 2012; Rodenburg, Benjamin, Meijer, & Jongeneel, 2009 and Stenfert Kroese & Thomas, 2006), three as 'Mixed' (Barrowcliff & Evans, 2015; Buhler, 2014 and Mevissen, Didden, Korzilius, & De Jongh, 2017), and two as 'Poor' (Hart & Robbins, 2014; Rickard, Thrasher, & Elkins, 1984).

7.3.1. *Eye movement desensitisation and reprocessing therapy*

Nine studies investigated the use of Eye Movement Desensitisation and Reprocessing (EMDR) in people with intellectual disabilities. Generally, EMDR was reported as effective at treating PTSD in people with intellectual disabilities across several good quality studies with a range of designs including a well conducted RCT (Karatzias et al., 2019), ABA design (Buhler, 2014) and a single case study (Rodenburg et al., 2009). A series of studies by Mevissen, Lievegoed, & De Jongh, 2011; Mevissen, Lievegoed, Seubert, & De Jongh, 2011; Mevissen et al., 2017, 2012) examined the use of EMDR with children, adolescents, and adults with varying levels of intellectual ability and found it to be effective for people with mild, moderate and severe intellectual disabilities.

Papers made various suggestions and adaptations to EMDR protocol to improve accessibility for people with intellectual disabilities. These included adapting instructions to clients' cognitive and emotional level and using the protocol for children (Mevissen, Lievegoed, & De Jongh, 2011) which allowed participants to be able to put images, thoughts, feelings, and physical sensations into words. Participants with a mental age between 4 and 8 were asked to draw the target image instead of describing it verbally (Mevissen, Lievegoed, Seubert, & De Jongh, 2011). The Story Telling Method (Lovett, 1999) was used with participants of a mental age of 3 years, and typically involved caregivers tell the story of the traumatic event. Occasionally, photos, drawings, or physical objects are employed to engage the senses and to activate the trauma memory. Clients were accompanied by the trusted person to provide a sense of safety, to overcome communication disabilities, to facilitate an integration of the therapeutic process with daily life and to function as a co-therapist (Mevissen et al., 2012). For those with physical disabilities, carers also supported in holding bilateral stimulation apparatus.

Some studies identified issues in conducting EMDR with people with intellectual disabilities. Barrowcliff and Evans (2015) reported in a single case study where their participant was easily able to generate a safe place through visualisation. However, she required several weeks of imagery practice to support its ready application. Karatzias et al. (2019) conducted a very good quality randomised controlled feasibility trial with qualitative process evaluation and found higher dropout rates for those receiving EMDR plus standard care, compared to those receiving standard care alone. Whilst this could indicate a difficulty with the acceptability of the intervention, this was not reported through qualitative interviews regarding the participants experience of the intervention. However only 7 of the 15 people receiving EMDR intervention were included in the qualitative analysis.

Imagery appeared to be an important component in managing distress as well as a core component in re-process memories. Dilly (2014) reported a single case study using EMDR with a person with mild ID and complex presentation in a forensic setting. A "safe place visualisation technique" was developed and used in every therapy session to manage participant's arousal. Symptom reduction in re-experiencing, avoidance and arousal were maintained at one- and six-month follow-up.

7.3.2. Imagery rehearsal therapy

One study (Stenfert Kroese & Thomas, 2006) examined the use of Imagery Rehearsal therapy for nightmares with two participants with intellectual disabilities. Within this case report, good attention was paid to providing a detailed client history and demographics, as well as a clear description of the intervention. Unfortunately, adverse events and ethical issues were not considered. Clients were assisted to generate new images through discussion with therapist, drawing out new, replacement images to make them more concrete, and practicing the new dream images everyday with help from caregivers. For both participants, nightmares ceased within 6 weeks and progress was maintained at 6 months follow up. The authors conclude that Imagery Rehearsal Therapy is suitable for people with intellectual disability.

7.3.3. Relaxation training

Hart and Robbins (2014) used three different relaxation techniques (controlled breathing, guided imagery and progressive muscle relaxation). The paper reports a service evaluation, and whilst 23 people were referred to the service, standardised results on an anxiety measure are reported for only six people. In terms of qualitative data, of the 17 people reported to have completed the 12-week intervention, only five provided qualitative feedback. It appears that the three different relaxation techniques were used on an ad-hoc basis with individuals in a 'person centred' program. Due to the study design, it was not possible to directly compare the efficacy of these different approaches. Some participants reportedly preferred guided imagery relaxation strategies, whilst the author acknowledges that ascertaining how well people with limited verbal abilities can engage with guided imagery is problematic. However, results showed a trend towards reduced anxiety after Relaxation Training.

Rickard et al. (1984) compared four groups of participants with differing IQ scores, two of which included participants with IQ scores in the intellectual disability range. Each group consisted of five participants. Each group was presented with a guided imagery relaxation exercise, and of the 10 participants with intellectual disabilities, eight reported being able to engage with the imagery exercise. However, participants with intellectual disabilities did not seem able to use the 10-point Likert scale to self-report levels of relaxation.

7.3.4. Compassion focused therapy

Hardiman et al. (2018) report on a compassion focused therapy (CFT) group, which aimed to increase self-compassion, and was evaluated using a mixed-methods design. Exercises to develop this included soothing rhythm breathing and generating a compassionate image of another person or figure, and of generating an image of a safe place. These exercises were practised each weekly session with clients encouraged to practise between sessions. In addition to imagery being a core part of the intervention, it was also used to enhance understanding of verbal material. All participants reported reliable reductions in anxiety but remained above clinical cut-off for diagnosis. Self-compassion improved for all participants, with continued improvement at follow-up for two participants. They concluded that participants may have learned to use mindful breathing and compassionate imagery as effective interventions to help manage short-term distress. Unfortunately, whilst the authors clearly link their research question to their methodology and analysis of data, the effect of the researcher on the research or vice vera was not considered, and no statement was provided locating the researchers in terms of their theoretical or cultural stance. In addition, CFT includes a number of active components, and therefore any improvements in psychological functioning cannot be attributed to the mental imagery component of CFT.

8. Discussion

Despite the potential application of mental imagery as a psychological intervention in people with limited cognitive and communication skills, such as people with intellectual disabilities, the literature around mental imagery in this population has not previously been synthesised or appraised.

8.1. Research Question 1: what do we understand about the abilities of people with intellectual disabilities to engage with mental imagery (the generation, maintenance, inspection, and transformation of mental images)?

8.1.1. Generation

Generally, there is a body of evidence that people with intellectual disabilities can and do generate mental images in a range of situations and tasks, are as able as the general population to generate images of random patterns and meaningful images. Evidence from five studies suggests that mental imagery consistently improves performance on motor skills tasks in people with intellectual disabilities, possibly because the images required are clearly specified, and concrete, in that they are based on real tasks that participants have already seen or experienced (e.g., Hinnell & Virji-Babul, 2004). Findings that mental imagery improves performance, but not as much as physical practice are in line with findings in the general population. Whilst people with intellectual disabilities can spontaneously use mental imagery as a memory strategy (e.g., Kwong, 1994), they may require additional prompting and scaffolding to do this, and to generate images that are as clear and distinctive as people without intellectual disability. For those studies examining effects at delayed recall, participants were as good as those without intellectual disability, which is perhaps surprising given the difficulties in memory generally experienced by people with intellectual disabilities. People with intellectual disabilities are successfully able to use mental imagery as a memory strategy. Four of the five studies looking at mental imagery as a strategy to assist memory found that people with intellectual disabilities are successfully able to use this strategy and find it aids recall of material. The one study not finding such results (Gibson et al., 1995) did not provide detailed instructions about mental imagery or check participants were able to do this successfully before the experimental task.

8.1.2. Maintenance

Three papers specifically examined image maintenance. These were rated as good, mixed and poor quality. Therefore, whilst there is some evidence that people with intellectual disabilities can complete imagery maintenance tasks, and that their image refreshing process is relatively efficient, it may be that their abilities are more limited in terms of the complexity of stimuli. In addition, the stimuli used in these tasks are less personally relevant or meaningful when compared to some of the image generation tasks, which again may affect performance negatively. This lack of evidence may be because maintenance is used in other components of mental imagery such as inspection and transformation so not examined specifically.

8.1.3. Inspection

Whilst these studies present some evidence that image inspection skills are comparable to the general population, especially on motor-based tasks, there is a general lack of evidence. There is some evidence that these skills require additional support in terms of time taken to learn tasks and overall slower speed compared to people without intellectual disabilities. It may be that for tasks that are more concrete (such as motor-based tasks), mental image inspection is facilitated.

8.1.4. Transformation

There is mixed evidence regarding the transformation skills of people with intellectual disabilities. Whilst three studies reported participants had no deficit in mental transformation, five studies indicated an overall impairment in this skill. Some aspects of mental rotation may be particularly difficult for people with intellectual disabilities, such as stimuli presented at 180°, or stimuli without a clear axis of elongation. Such stimuli lack personal relevance and meaning, and therefore may be more difficult to engage with than other mental images such as a compassionate figure. However there appears to be good evidence that some people with intellectual disabilities can perform mental transformation, albeit at a lower level than the general population.

8.2. Research Question 2: what do we understand about the phenomenology of mental images in people with intellectual disabilities compared to the general population?

Only two studies reported on the phenomenology of mental imagery, and neither of these specifically set out to investigate this, using an appropriate methodology. One study (Brown & Bullitis, 2006) used a qualitative methodology to explore experiences of mental imagery but did not analyse results using an appropriate method of data analysis, rather converting responses into quantitative categories. Brougham et al. (2020) reported aspects of mental imagery experiences, alongside quantitative findings, and used content analysis to categorise responses. No qualitative method of data analysis was used to analyse open ended questions about experiences of mental imagery.

These studies suggest that people with intellectual disabilities experience mental imagery that is similar in nature to other people but may be less vivid or complex. However, these limitations in reported mental imagery may be due to limitations on verbal communication skills and difficulties in conveying complex and rich mental imagery experiences to researchers. There is some evidence that emotions associated with mental imagery are elicited for this population (both negative emotions such as anxiety associated with an image of a ladder and a fear of heights, and positive emotions such as a feeling of calm when using a compassionate image to self-soothe). Overall, there is a lack of studies exploring the phenomenology of mental imagery in people with intellectual disabilities.

A recent review (Ji, Kavanagh, Holmes, MacLeod, & Di Simplicio, 2019) highlights the transdiagnostic role of emotion-laden mental imagery for emotion, motivation and behavioural dysfunction. Whilst the current review identifies some studies into the emotional impact of imagery in people with intellectual disabilities, the impact of emotional mental imagery on motivation and imagery-driven behaviour has not been broached in this population. This is despite the conclusion from Ji et al. (2019) that evidence from the general population suggests that mental imagery-based cognitions are involved in emotional and motivational processing and have a greater impact on emotional and motivational outcomes (including behaviour) than verbal-linguistic cognitions. This, therefore, remains a notable gap in the literature.

8.3. Research Question 3: what do we understand about the role of mental imagery within existing psychological interventions for people with intellectual disabilities?

There is good evidence that EMDR can be adapted to be useful for people with various levels of intellectual disabilities and reduce rates of psychological distress. EMDR uses mental imagery as an essential component (van den Hout & Engelhard, 2012), suggesting mental imagery is accessible to these populations. There was some evidence that people can access other psychological interventions which use mental imagery as a core component, such as Imagery Rehearsal Therapy and Compassion Focused Therapy. However, many of these studies focus solely on treatment outcome and less upon mental imagery and adaptations to promote the use of mental imagery. The literature remains at a preliminary stage, with a reliance on small scale reports and a lack of larger, more methodologically robust studies (with the exception of Karatzias et al., 2019).

Overall, whilst there is some good evidence to suggest that people with intellectual disabilities can engage with all aspects of mental imagery, many studies highlight their need for adaptations such as additional time, support and scaffolding to elaborate and report mental imagery. It appears that mental imagery is not a specific deficit in this population, but due to the nature of intellectual disability, it can be difficult to tease mental imagery deficits from verbal comprehension difficulties (understanding tasks and instructions) and verbal fluency (reporting the experience of mental imagery). This requires careful consideration to ensure experiments are valid.

8.3.1. How to facilitate mental imagery in people with intellectual disabilities

Whilst our theoretical assumption is that people with intellectual disabilities also experience mental imagery, and this is broadly similar to the general population, there are a number of strategies described within the literature to support and enhance the mental imagery of this population. Whilst studies found that people with intellectual disabilities readily use mental imagery in preference to other strategies (Kwong, 1994), other papers reported some difficulties when asking people with intellectual disabilities to engage with mental imagery and described adaptations to facilitate this process.

It was essential to make instructions understandable to participants. Children with intellectual disabilities did not benefit from a simple instruction to generate their own mental imagery (Gibson et al., 1995), which may imply that they are unable to do this without more specific and individualised guidance. People with intellectual disabilities may be less aware of the concept of mental imagery (although this was also the case for several participants without intellectual disability) and may require simplified and more specific, detailed instructions to both understand the concept of mental imagery, and generate mental images (Brown & Bullitis, 2006). One way to ensure participants are engaging in mental imagery during a task is to explicitly ask them to describe this process after the task to ensure mental imagery is employed (Porretta & Surburg, 1995). Adapting instructions to the person's cognitive and emotional level improves accessibility, including the use of materials designed for children, with appropriate adaptations (Mevissen, Lievegoed, & De Jongh, 2011). Such adaptations may include producing instructions in easy read format and using visual imagery to enhance participants' understanding of verbal material (Hardiman et al., 2018).

Making the imagery task more concrete improves accessibility. This included using physical prompts through which participants could explore and practice a task, before transferring to completing such tasks in their heads (Hinnell & Virji-Babul, 2004). Other strategies included discussing mental images with a client in detail to make them more accessible before drawing out these images on paper with clients (Stenfert Kroese & Thomas, 2006), and talking participants through a practice mental image task to ensure they understand the concept of generating mental images (de la Iglesia et al., 2005). A range of concrete prompts and aids were employed to facilitate mental imagery, including photographs (Brown & Bullitis, 2006), drawings, pictures (Dilly, 2014) and physical objects (Mevissen, Lievegoed, Seubert, & De Jongh, 2011).

In Kosslyn's computational theory of imagery, such maintenance is achieved by the re-activation of visual memory representations in an Object Properties Processing subsystem (Kosslyn, 1980; Kosslyn et al., 2006). One consequence of this shared neural substrate is that mental images can be disrupted by concurrent visual processing (Quinn & McConnell, 2006). Reducing external visual stimulation, through asking participants to shut their eyes, can facilitate mental imagery (Brown & Bullitis, 2006).

Providing extra practice sessions and trials to ensure participants had correctly understood and learned the task was described in several studies (e.g., Hinnell & Virji-Babul, 2004). Participants with intellectual disabilities requires additional trials to learn the task, reduce the number of errors they made, and demonstrate improved performance (Wilen, 1982). Without such additional time, their results may be inaccurate, with poor performance being due to unfamiliarity with the demands of the task, rather than underlying cognitive deficits (Roskos-Ewoldsen et al., 2006). Additional sessions in which the concept of mental imagery is explicitly explained, and practice exercises completed together, rather than assuming participants with intellectual disabilities already understand this concept can be helpful (Hinnell & Virji-Babul, 2004; Screws & Surburg, 1997). An understanding of how mental imagery is thought to facilitate the task being tested can also be helpful, so that participants have a clear understanding of the experiment and what is being tested (Screws & Surburg, 1997).

Participants benefited from additional scaffolding to help shape and elaborate their responses and provide more correct responses. Strategies included using specific, rather than open ended probes (Jens et al., 1990) or cues, in the form of specific questions (Gordon et al., 1994).

In line with developments in the literature regarding strategies to help people with intellectual disabilities generalise skills outside of the therapy setting (e.g., Crossland, Hewitt, & Walden, 2017), explicitly involved another person may support the process of therapy (Mevissen et al., 2012). During treatment, all clients were accompanied by a trusted person to provide a sense of safety, to facilitate communication, to assist integration of the therapeutic process in daily life and to function as a co-therapist. Mevissen, Lievegoed, Seubert, and De Jongh (2011) adapted a technique used with very young children, whereby parents or caregivers tell the story of the traumatic event, rather than needing the client to do this themselves. Rodenburg et al. (2009) also suggested that parents or carers could be involved in EMDR treatment where participants are less able to mentalise or verbalise due to their intellectual disability. Stenfert Kroese and Thomas (2006) reported on the importance of a client's mother in helping her adult daughter to rehearse her new dream as part of her nightly routine. They also helped the client to practice generating this image through guiding them through it. The client incorporated generating the image as part of her daily routine.

Many of these adaptations will be familiar to clinicians working with people with intellectual disabilities, as whilst mental imagery requires additional guidance and scaffolding to make it accessible for people with intellectual disabilities, this is also the case for a range of other psychological processes, and is not specific to mental imagery per se. Strategies to help people retain instructions and generalise the use of strategies in different settings are common issues in psychological interventions with people with intellectual disabilities and require the same attention in these settings. Indeed, such adaptations will also be familiar to clinicians using imagery-based interventions with clients without intellectual disabilities experiencing high levels of psychological distress (Holmes et al., 2019).

8.3.2. Limitations of this review

Within this review, the decision was made to includes reports of interventions in which mental imagery is a core component (i.e., mental imagery is explicitly accessed, and such interventions cannot be conducted without the use of mental imagery). These included EMDR and some Compassion Focused Therapy interventions. To exclude such studies, which explicitly rely on mental imagery, would be to miss a substantial body of evidence available to answer the review questions. Similarly, pragmatic decisions were made to exclude neuropsychological assessments such as Theory of Mind tasks (e.g., the Sally-Anne task) and executive functioning tasks such as Tower of Hanoi. Whilst participants may engage mental imagery in order to complete such tasks, other strategies could also be employed, and without having more information about how participants solved such tasks (which was unavailable in research papers), they could not be unequivocally included as evidence of the use of mental imagery. However, the authors acknowledge that decisions regarding exclusion and inclusion criteria can be critiqued, and that other research teams may have reached different decisions.

Several studies included participants with 'severe' levels of intellectual disability (Barrowcliff & Evans, 2015; Brown & Bullitis, 2006; Mevissen et al., 2012). These suggested that people, with severe intellectual disabilities can engage with mental imagery but at a reduced level compared to those with milder intellectual disabilities. No studies included people with profound intellectual disabilities. People with severe and profound intellectual disabilities have an IQ of below 40, and thus marked deficits in their cognitive skills including memory and executive functioning, which are involved in mental imagery (Pearson, 2019). Participants with severe and profound intellectual disabilities face additional barriers to inclusion in such studies including understanding instructions around mental imagery tasks, and difficulties in communicating their experiences of mental imagery to researchers. Studies attempted to evaluate the efficacy of mental imagery interventions through observer reports of non-verbal communication (e.g., body movements during a mental imagery task Brown & Bullitis, 2006, or behavioural indications of distress post psychological intervention Mevissen et al., 2012). However, a lack of robust methodologies mean it is currently impossible to ascertain whether people with severe and profound intellectual disabilities experience rich mental imagery (and struggle to communicate this imagery to others) or sparse mental imagery.

8.3.3. Implications for psychological therapies

This review provides implications for psychological interventions in this population. That mental imagery is experienced by people with intellectual disabilities in a similar (albeit potentially reduced level), suggests that, with appropriate adaptations, mental imagery interventions may be effective for this population.

Within the general population, there are various well-established mental imagery interventions. For example, imagery rescripting reduces distress across a range of psychological disorders, including post-traumatic stress disorder, social anxiety disorder, major depressive disorder and obsessive-compulsive disorder (Morina et al., 2017). This intervention has not been adapted for people with intellectual disabilities, possibly because the understanding of how people with intellectual disabilities use and experience mental imagery has not been established. However, the relationship between an ability to engage with clinical mental imagery interventions and performance on experimental imagery tasks based on Kosslyn's model has not been established in the general population. Indeed, studies regarding the emotional and behavioural impact of imagery may be more relevant for clinical interventions (Ji et al., 2019), and this remains an unexplored area of the literature regarding people with intellectual disabilities.

Additional barriers to providing mental imagery interventions for people with intellectual disabilities include the lack of established evidence base for such interventions. Mental imagery has been extensively investigated within experimental and clinical psychology, with a number of mental imagery interventions developed to treat psychopathology, including for those with limited cognitive skills including children (e.g. Schwarz et al., 2020). Despite this, such interventions have not yet been considered for people with intellectual disabilities (Hronis, 2021). People with intellectual disabilities are routinely excluded from the development of new interventions due to their additional communication needs and cognitive deficits. However, specific research into interventions for people with intellectual disabilities is hampered by a range of factors including smaller populations which make large scale research difficult to conduct, and a lack of funding available for this marginalised group (Beail, 2016).

A related issue is the lack of standardised outcome measures for people with intellectual disabilities, and there are no validated measures of mental imagery for use with people with intellectual disabilities (see Richardson & Sheikh, 2020 for a review). Without confidence in their ability to measure and work with mental imagery, clinicians working with people with intellectual disabilities may lack confidence to attempt the adaptation of such mental imagery interventions for this population. However, it is of note that idiosyncratic visual analogue scales are frequently used clinically to assess how frequent and distressing mental imagery is for clients within general populations, and to measure change on such dimensions. In the absence of validated scales an individualised approach to assessment and measurement can prove beneficial for treatment development and innovation (Hales et al., 2015).

8.3.4. Implications for further research

Intellectual disability is not a unitary condition and encompasses numerous specific disorders and conditions. The literature presented provides evidence for difference in the mental imagery profiles within the intellectual disability population (e.g., Doerr et al., 2021), which requires further investigation.

Research into the phenomenology of an experience (such as mental imagery) would be best addressed using a qualitative methodology with an interpretative analysis, which focuses on lived experiences. An example of this would be Interpretative Phenomenological Analysis, which has successfully been used with people with intellectual disabilities (Rose et al., 2019). One difficulty with asking people to verbally report images is that their compromised verbal skills may impact on the quality and texture of their reports of imagery, thus making it impossible to know whether a report of imagery that lacks richness and texture is due to poor mental imagery skills, or a lack of sufficient verbal skills to describe the experience. Using a range of methods to capture information about imagery (such as asking participants to create drawings of images associated with their mental imagery) may help circumvent this issue and has been used with other clients with verbal communication difficulties (Boden & Larkin, 2020).

The development of standardised measures of imagery, which have been validated for this population will facilitate research in this area and increase the confidence of clinicians exploring mental imagery interventions with people with intellectual disabilities.

The adaptation and evaluation of interventions such as EMDR has been successfully explored and reported through various small-scale research projects. This has allowed for larger, more robust trials of the intervention to be subsequently conducted (Karatzias et al., 2019). In a similar way, effective mental imagery interventions for mainstream populations should be adapted for people with intellectual disabilities. People with intellectual disabilities experience a range of additional communication needs and cognitive deficits. If interventions are successfully adapted to be accessible to this population, they are likely to also be made available to a wider range of people with some additional needs.

9. Conclusion

Whilst the literature into aspects of mental imagery in people with intellectual disabilities is underdeveloped in comparison to the general population, there is exists a range of relatively good quality studies of various designs to support the similarity of mental imagery across both populations. Given the importance mental imagery plays in the maintenance of various psychopathologies, and the effective treatment of various psychological disorders in mainstream services, this review has important implications for the adaptation of such interventions for people with intellectual disabilities.

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Olivia Mary Hewitt: Conceptualization, Methodology, Formal analysis, Writing – original draft, Funding acquisition. **Craig Steel:** Methodology, Supervision, Writing – review & editing. **Susie A. Hales:** Conceptualization, Writing – review & editing. **Nikita Hayden:** Methodology, Validation, Investigation. **Hatice Gundeslioglu:** Validation, Investigation. **Katherine Tapp:** Validation, Investigation. **Peter Langdon:** Conceptualization, Methodology, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare no conflicts of interest.

Data availability

Data will be made available on request.

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