A systematic review of video-modelling interventions for children and adolescents with ADHD

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Abstract

Objective: To identify, appraise and synthesise the evidence for video-modelling interventions for individuals with ADHD. **Method:** We searched four electronic databases. Two independent researchers screened abstracts and methodologically assessed data using the Kmet appraisal checklist. **Results:** 15 studies met the inclusion criteria (11 original studies and four follow-up studies). Of the 11 original studies, one was a randomised controlled trial (RCT), one a controlled between-group comparative design, two were one group pre-test post-test studies, one an experimental 2x2 factorial design and six were single-case experimental design studies. Studies included 1-35 participants with ADHD aged 5-16 years. Three studies targeted behaviour, three social play skills, two social behaviour, one social skills, one goal orientation and friendship quality and one attention/comprehension of social behaviour. In four studies video-modelling was the whole intervention, with no other intervention components reported. Nine studies reported positive outcomes immediately after intervention, two studies reported mixed findings. All studies were found to have good or strong methodological quality. **Conclusion:** There is preliminary evidence to suggest video-modelling may be a promising intervention approach for targeting the social skills and behaviours of individuals with ADHD when used in conjunction with other intervention components. Future studies need to lower the risk of bias and use larger sample sizes before the efficacy of video-modelling interventions can be fully investigated.

Keywords: ADHD, psychosocial intervention, social interactions, video feedback, video-modeling, video self-modeling

Introduction

Attention deficit hyperactivity disorder (ADHD) is a prevalent developmental disorder affecting between 5-7% of children (Thomas, Sanders, Doust, Beller, & Glasziou, 2015). The social and behavioural difficulties of children with ADHD are profoundly greater than those experienced by their typically-developing peers. A recent meta-analysis of 109 studies of children with ADHD found within social functioning, children had most substantial difficulty with peer functioning and social skills (Ros & Graziano, 2018). These difficulties are known to lead to adverse outcomes in later life if left unaddressed (Mrug et al., 2012). Current guidelines acknowledge pharmacological treatment alone is insufficient for addressing social functioning difficulties and recommend non-pharmacological interventions to be used in conjunction with pharmacological treatment. Non-pharmacological interventions include social skills training, behavioural intervention, cognitive training, and parent skill training (Catalá-López et al., 2017; Lambez et al., 2020). However, even after receiving empirically-based intensive treatment children with ADHD continue to experience social difficulties beyond their typically-developing peers (Mrug et al., 2012). A Cochrane systematic review of randomised controlled trial (RCT) interventions aimed at improving social skills found intervention approaches had minimal effectiveness for improving the social difficulties of children with ADHD (Storebø et al., 2011). One reason for the lack of effectiveness of current approaches may be that the intervention components are not congruent with the underlying nature of the behavioural and social difficulties experienced by children with ADHD.

The social and behavioural difficulties of children with ADHD

Some researchers theorise that the social difficulties of individuals with ADHD are attributable to deficits in skill acquisition (Tur-Kaspa, 2005). However, other researchers suggest that the underlying reasons for their social difficulties include impaired aspects of social cognition and a lack of behavioural inhibition; describing individuals with ADHD as

having difficulty with forethought, problem-solving and performing skills in the moment (Barkley, 1997). In Barkley's (1997) well-documented cognitive model of behavioural inhibition, a lack of behavioural inhibition is used to explain the social deficits of individuals with ADHD. Barkley (1997) postulated that children with ADHD react immediately to emotionally charged events because of difficulty with emotion regulation. He suggested that a decreased capacity for forethought resulted in children having fewer anticipatory emotions/consequences toward future social interactions or events. He further added they may take little responsibility for their social or other skill difficulties because they see them as outside their control, suggesting that individuals with ADHD have a skills performance, rather than knowledge deficit. Therefore, intervention and assistance to develop skills may be more effective when aspects of social cognition are targeted. This may be achieved through giving individuals with ADHD feedback on their skills, supporting them to anticipate areas for further skill development and by supporting them to demonstrate the skills in the natural environment in which they need to be performed (Barkley, 1997).

Video-Modelling

Video-modelling stems from Bandura's (1997) social learning theory, which focuses on the concept that observational learning through modelling has a profound impact on the skill development of children. Another key concept in Bandura's social learning theory is self-efficacy, which pertains to one's beliefs about their performance capabilities and their influence over events that affect their life; linking to their motivations and behaviours. Thus video modelling, where individuals watch footage of themselves (video self-modelling) or others (pre-taped video-modelling) demonstrating desired target behaviours successfully and discussing the behaviours, reflects aspects of both Bandura's (1997) social learning theory and Barkley's (1997) cognitive model of behavioural inhibition.

Video-modelling has been successfully incorporated into interventions across multiple diagnostic categories (Dowrick, 1999, 2012). Compared with other forms of video based-

instruction (i.e., pre-taped video footage of adults performing the desired skill), self-modelling has been researched most extensively (Dowrick, 1999, 2012). Video-modelling comprises both video feedback and video feed-forward techniques. Video feedback is used when the child currently demonstrates the desired skill, but at a very low frequency. In this technique, footage of the child successfully engaging in the target skill is captured, and instances of their lack of engagement in the target skill is removed (Dowrick, 1999, 2012). In video feed-forward, footage of the child is recorded when they are receiving assistance from adults to perform a desired skill, which they rarely/never demonstrate. Adult assistance is usually edited out of the footage resulting in children viewing footage of themselves engaged in the target skill (Dowrick, 1999, 2012).

Effectiveness of Video-Modelling

Video-modelling is an empirically validated psychosocial intervention technique for children with other developmental disabilities who have significant social problems, such as children with autism spectrum disorders (ASD) and behavioural difficulties (Nikopoulos & Keenan, 2004; Rai, 2008). In systematic reviews and literature reviews, video self-modelling has commonly been found to promote changes in extant behaviours and to encourage the development of new skills such as social interaction, perspective-taking, complex play, self-help tasks and academic skills (Wang, Cui, & Parrila, 2011). Given that video-modelling supports self-reflection, evaluation of one's own performance, and the ability to anticipate situations there is also potential for this approach to support self-awareness and perception and, therefore, alter metacognition (Zlotnik et al., 2020).

Video-modelling for individuals with ADHD

As ADHD is a neurodevelopmental disorder, it appears plausible that incorporating video-modelling into interventions for children with ADHD would yield similar gains in social skill development as it has for other populations (Dowrick, 1999, 2012). However, the frequency with which video-modelling has been incorporated into interventions for children

with ADHD is largely unknown (Storebø et al., 2011). Further, current and past use of video-modelling in interventions for individuals with ADHD has not yet been systematically investigated and reported.

In this systematic review, we aimed to identify, appraise and synthesise video-modelling interventions for individuals with ADHD. To identify the use of video-modelling in interventions in the existing literature, both video self-modelling (i.e., video of self) and pre-taped video-modelling (i.e., video of others) were included. Additionally, studies were included provided video-modelling was at least one of the main intervention components. For the purpose of this systematic review, we adopted Dowrick (1999, p. 23) definition that describes video self-modelling as, "an intervention procedure using the observation of images of oneself engaged in adaptive behavior. Most commonly, these images are captured on video, edited into two to four-minute vignettes, and repeatedly reviewed to learn skills or adjust to challenging environments as part of a training or therapy protocol." Video-modelling can also contain pre-taped footage of others demonstrating desired behaviours (Dowrick, 1999).

This systematic review was therefore guided by the following research questions:

1. What is the study design, intervention approach and reported outcomes of video-modelling intervention studies for individuals with ADHD?
2. What is the methodological quality of video-modelling intervention studies for individuals with ADHD?

Methods

To guide the methodology and transparent reporting of this systematic review, the PRISMA statement was used (Liberati et al., 2009). The PRISMA checklist describes aspects of research that are deemed essential for the reporting of systematic reviews. The first and second author did not assist with the study selection or rating the methodological quality of included studies due to a potential bias of their work being included in the review.

Protocol and Registration

This systematic review is registered with PROSPERO International Prospective Register of Systematic Reviews (ID 2015:CRD420150204). The protocol can be accessed via the web link, http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42015023204.

Selection Criteria

The inclusion criteria for studies were as follows: (1) at least one participant needed a clear primary diagnosis of ADHD; (2) the study could be of any design, provided an intervention was delivered; (3) the intervention could target any skill; however, needed to include video-modelling as the whole intervention or as a component of the intervention; and (4) the intervention needed to be directly aimed at the individual with ADHD.

Studies with participants with multiple diagnoses (e.g., ADHD and oppositional defiant disorder) were included. Studies were excluded where ADHD was a secondary condition (e.g., in addition to cerebral palsy or developmental delay). When participants had 'developmental disabilities' the full-text was accessed to establish if any participants had an ADHD diagnosis. Studies with participants with mixed diagnoses (i.e., autism, intellectual disability and ADHD) were included provided at least one participant had a primary diagnosis of ADHD and the data on the child/children with ADHD could be separated and extracted. Studies were excluded where video-recordings or video-modelling was used for the purpose of assessment, rather than intervention. Additionally, studies were excluded if the video-modelling intervention was delivered to parents or caregivers, rather than directly to the individual with ADHD. Follow-up studies of an initial intervention were included and reported under the initial intervention study.

Information Sources and Search

We conducted a systematic literature search across four databases: CINAHL, Medline, PscyINFO and Web of Science. The first and second author compiled a list of search terms in

consultation with the eighth author, who is a librarian with extensive knowledge in conducting searches for systematic reviews. During this process all identified key words and terms from previous studies and reviews on the topic were reviewed and included. The first and eighth author then conducted the searches together at the REMOVED FOR PEER REVIEW Library before the final search was completed September 9th, 2020. See Table 1.

A total of 385 abstracts were retrieved. The number of abstracts from each database was: CINAHL = 129, Medline = 144, PscyINFO = 35, Web of Science = 77. Duplicate abstracts (*n* = 218) were removed across the databases. An independent search of grey literature by two of the authors resulted in the identification of two additional master's thesis dissertations (Laurin, 1993; Schmitt, 2009). This resulted in the screening of 169 records in total. Figure 1 presents a flow diagram of the abstract reviewing process in alignment with PRISMA procedures.

Table 1. Search terms

	Database	Search Terms	Limitations
Subject headings search	CINAHL	"Attention Deficit Hyperactivity Disorder" AND "Videorecording"	1994 - 2020
	Medline	(Attention Deficit Disorder with Hyperactivity OR "Attention Deficit and Disruptive Behavior Disorders") AND (Videotape Recording OR Video recording)	Ovid MEDLINE(R) <1946 to September 2020>
	PsycINFO	(attention deficit disorder OR attention deficit disorder with hyperactivity) AND (videotape instruction OR videotapes/ OR videotape recorders)	PsycINFO <1987 to September 2020>
	Web of Science	(No Subject Headings)	-
Free text words search	CINAHL	("attention deficit disorder*" OR "attention deficit disorder with hyperactivity" OR ADHD OR "attention deficit and disruptive behavio* disorder*") AND ("videotape recording*" or "video recording*" OR "videotap*" OR "video instruction*" OR "video feedforward" OR "video modeling*" OR "video modelling*" OR "video self-modeling*" OR "video self-modelling*")	1994 -2020
	Medline	(attention deficit disorder*.mp OR ADHD.mp) AND (videotap* OR video instruction*.mp OR video feedforward.mp OR video model?ing*.mp OR video self-model?ing*.mp)	Ovid MEDLINE(R) <1946 to September 2020>
	PsycINFO	(attention deficit disorder*.mp OR ADHD.mp OR "attention deficit and disruptive behavior disorders".mp) AND (videotape recording* OR video recording* OR video instruction*.mp OR video feedforward.mp OR video model?ing*.mp OR video self-model?ing*.mp)	PsycINFO <1987 to September 2020>
	Web of Science	("attention deficit disorder*" OR "attention deficit disorder with hyperactivity" OR ADHD OR "Attention Deficit and Disruptive Behavio* Disorder*") AND ("Videotape Recording*" OR videotap* OR "video recording*" OR OR "video instruction*" OR "video feedforward" OR "video modeling*" OR "video modelling*" OR "video self-modeling*" OR "video self-modelling*")	1900-2020/9/9
Results from above searches	CINAHL	129	-
	Medline	144	-
	PsycINFO	35	-
	Web of Science	77	-

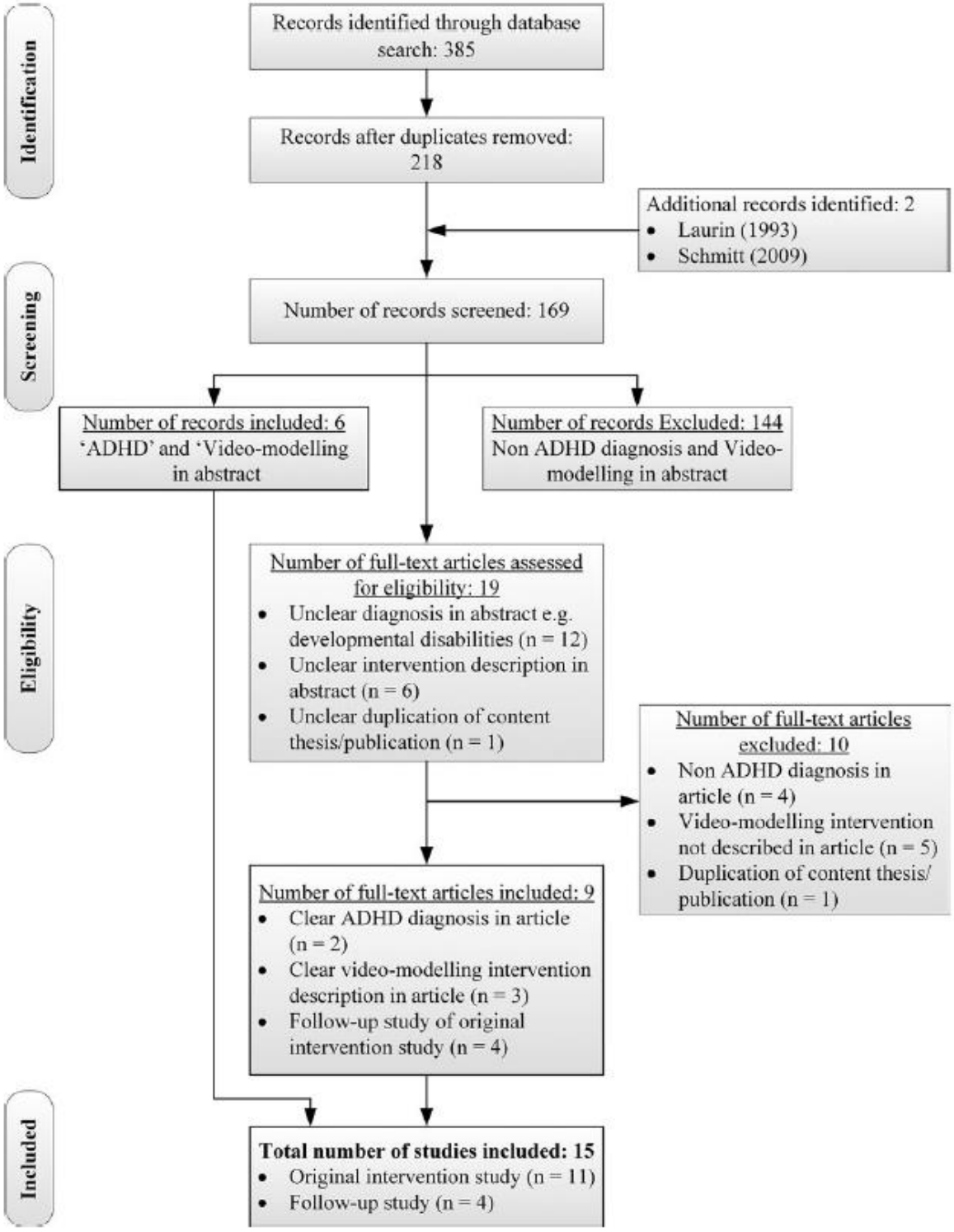

FIGURE 1 PRISMA flow chart

Study Selection

Two independent abstracts reviewers (4th and 5th authors) screened the abstracts against the selection criteria described above. Due to the small number of abstracts screened (i.e., 169), the two authors both reviewed 100% of the abstracts. In order to establish consistency

in their ratings against the inclusion criteria, the authors first trained by scoring 20 abstracts together. The authors had 95% agreement during training and proceeded to score the remaining 149 abstracts independently. The independent ranking of abstracts resulted in 96% agreement between authors (143 of the 149 abstracts). The authors screened the 169 abstracts into 3 categories: included (*n* = 6), excluded (*n* = 144) or requires full-text (*n* = 19) (i.e., when the population or use of video-modelling was unclear in the abstract).

Three authors (3rd, 4th and 5th authors) then met to establish agreement on the abstracts where disagreement occurred as well as to decide the eligibility of the 19 studies where the full-text was required. Of the 19 full-text articles reviewed, 9 met the selection criteria. Of these 5 were original intervention studies and 4 studies were follow-up studies (Barnes, Wilkes-Gillan, Bundy, & Cordier, 2017; Cantrill, Wilkes-Gillan, Bundy, & Cordier, 2015; Cordier, Munro, Wilkes-Gillan, & Docking, 2013; Wilkes-Gillan, Bundy, Cordier, & Lincoln, 2014a). This resulted in a total of 11 original intervention studies being included (see Figure 1).

Data Collection Process/Data extraction

To extract the data from each of the included studies, the Cochrane Handbook for Systematic Reviews section 7.3a (Higgins & Green, 2011) and the Centre for Reviews and Dissemination (2009) guidance for undertaking reviews in health care (2009) were used. The data were extracted under 3 categories: 1) study and participant information (study design, participant diagnosis and age, inclusion criteria, medication use and outcome measures), 2) intervention (description of the video-modelling intervention, other intervention components, skills targeted and main findings), and 3) the methodological quality of included studies. Data on the methodological quality of included studies was extracted and scored independently by the 3rd and 4th authors who were not authors of any of the studies included in the review.

Methodological Quality: Risk of Bias in Individual Studies

The Australian National Health and Medical Research Council (NHMRC) Evidence Hierarchy for intervention studies (National Health and Medical Research Council, 1995) and the Kmet appraisal checklist (Kmet, Lee, & Cooks, 2004) were used to assess the methodological quality of included studies. Using the NHMRC Hierarchy of Evidence, studies are considered on hierarchical levels based on the strength of the study design. Level I are systematic reviews, level II RCT's, level III-1 pseudorandomised controlled trials, level III-2 comparative studies with concurrent controls, level III-3 comparative studies without concurrent controls, and level IV are case series with pre-test/post-test outcomes. The Kmet checklist was selected as it is suitable for assessing quality across a broad range of study designs (i.e., single case, quasi-experimental, and RCTs).

To achieve an overall score on the Kmet, the checklist uses ordinal ratings to score reported information (i.e., yes = 2, partial = 1 or, no = 0) for each item. Examples of items include: the description of the research objective, appropriateness of the study design, description of subject characteristics, blinding, sample size, analytic methods, estimates of variance, control of confounding factors and reporting of results and conclusions. A score of 'not applicable' reduces the total possible Kmet sum of scores, which can be calculated to a percentage score. A score of: > 80% is considered strong quality, 60-79% good quality, 50-59% adequate quality, and < 50% poor quality. The 3rd author scored the Kmet for all included original intervention studies (n = 11) and follow-up studies (n= 4). The 4th author independently scored the Kmet for 80% of the studies (scoring 12/15 studies).

Inter-rater reliability for Kmet ratings were established based on weighted Kappa calculations. The agreement (Weighted Kappa) between raters was 0.92 (95% CI: 0.86 – 0.98). To avoid potential bias, researchers involved in abstract selection, data extraction and rating the methodological quality, were not involved with any study that had potential to be included.

Data Analysis

Data was synthesised to obtain meaningful interpretation of the findings based on the areas of data extraction being: 1) study and participant information, 2) the intervention, and 3) the methodological quality of included studies.

Results

Participants

The 11 included intervention studies had sample sizes that ranged from 1-35 participants with ADHD. The total number of participants in the included studies was 106 (mean = 9.6, SD = 11.8). Participants were between the ages of 5 and 16 years and the majority were male. All but one study (Foley-Nicpon et al., 2017) reported verifying participants' formal ADHD diagnosis. Eight studies reported using rating scales (e.g., Conner's ratings scales) based on the International Diagnostic and Statistical Manual of Mental Disorders 3rd and 4th edition with parent and/or teacher reports to confirm ADHD symptomology. Two studies did not report the use of a screening tool to confirm ADHD symptomology of participants (Axelrod, Bellini, & Markoff, 2014; Embregts, 2002). In one study (Foley-Nicpon et al., 2017) it was unclear which measure/methods were used for self-reported ADHD. Co-morbid conditions reported in participants with ADHD across the studies were oppositional defiant disorder (Axelrod et al., 2014; Sibley et al., 2012; Wilkes-Gillan, Bundy, Cordier, & Lincoln, 2014b; Wilkes-Gillan, Bundy, Cordier, Lincoln, & Chen, 2016; Wilkes, Cordier, Bundy, Docking, & Munro, 2011) and mild intellectual disability (Embregts, 2002). Participants' medication use/status was reported in all but two studies (Embregts, 2002; Foley-Nicpon et al., 2017). Other participant groups included 37 children identified as having attentional difficulties (Carrol, Bain, & Houghton, 1994), one classmate without ADHD (Laurin, 1993), and 52 typically-developing playmates across studies by Wilkes-Gillan and colleagues (see Table 2).

Table 2. Video-modelling studies including individuals with ADHD

Study/Aim	Design/Treatment	Participants	Reported Age Range Years	Inclusion Criteria	Diagnosis and Medication	Outcome Measure	Quality (Kmet score)[a] & NHMRC[b]
Axelrod (2014) Aim: To investigate effects of video self-modelling intervention on compliance and aggressive behaviour of three children in psychiatric hospital	Multiple baseline design across settings (hospital ward and hospital-based classroom). Phases were: 1. Baseline 2. Intervention 3. Follow-up	▪ ADHD: 2 (with co-morbid ODD) ▪ Non-ADHD: 1 (ODD only) ▪ All male	▪ 7-8 years old (SD = 0.6)	▪ Admitted to acute care psychiatric hospital in previous fortnight ▪ Referred due to history of high rates of aggressive, defiant, noncompliant behaviour	*Diagnosis:* Obtained by review of each patient's most recent psychiatric report *Medication:* 1 participant = 20 mg Adderall XR. 1 participant = 36 mg Concerta. Non-ADHD participant = none	*Percentage of compliance with instructions:* Observed behaviour rating of compliance with adult instructions *Percentage of instructions leading to an aggressive episode:* Observed behaviour of aggression following instruction *Treatment acceptability questionnaire:* 7-items. Completed by teacher, para-professional, nurse, and direct care staff.	*Quality:* Strong (92.9%) *NHMRC:* IV
Carrol (1994) Aim: To establish if an interactive video improved attention and comprehension of social behaviour in children	2 x 2 factorial design - 1 of 4 conditions: 1. Interactive video positive-negative exemplars 2. Interactive video positive-neutral exemplars 3. Linear video positive-negative exemplars 4. Linear video positive-	▪ 72 children (62 male, 10 female) ▪ 35 with diagnosed with ADHD by a medical professional as per DSM-III R criteria. ▪ 37 identified as having attentional difficulties	▪ 10.6 – 13.5 years old (SD = 1.7)	▪ Primary school aged children with attentional difficulties (formally diagnosed or reported by teachers) ▪ Living in metropolitan Western Australia	*Diagnosis:* 35 children clinically diagnosed. 37 children had attentional difficulties reported by teachers against DSM III-R and the Conners Rating Scale *Medication:* 33 children taking medication daily	*Subscales of attention:* 1. time attending to task 2. intervention sequences 3. total time attending (Whole interval time sampling, 10-second observation intervals). *Subscales of comprehension:* 4. straight recall scores 5. higher level questioning scores 6. total raw scores (20 questions on information from modelled sequences. 10 questions on straight recall; 10 questions	*Quality:* Good (78.6%) *NHMRC:* III-3

Study/Aim	Design/Treatment	Participants	Reported Age Range Years	Inclusion Criteria	Diagnosis and Medication	Outcome Measure	Quality (Kmet score)[a] & NHMRC[b]
	neutral exemplars					on application/synthesis of student's observations.	
Embregts (2002) Aim: Evaluate effectiveness of intervention on the social behaviour of children	Multiple baseline design across subjects. Phases included: 1. Baseline 2. Resident intervention 3. Resident and staff intervention Duration unknown.	▪ ADHD: 5 (with mild mental retardation) ▪ All male ▪ 7 Direct care staff.	▪ 10.5-12.9 years ▪ 32.5 years Staff	▪ ADHD diagnosis ▪ Residents in a facility for children with mild retardation (Mean IQ 70; range 62-85) ▪ Inappropriate social behaviours.	*Diagnosis:* All diagnosed with ADHD according to DSM-IV. Not specified who diagnosed the participants. *Medication:* Not reported	*Resident behaviours:* Videotaped target social behaviours and responses to rating of behaviours. Two scorers rated behaviours. *Staff satisfaction survey:* 12-item 5-point Likert-scale to rate satisfaction post intervention. Focused on intervention effectiveness, feasibility and acceptability.	*Quality:* Good (71.4%) *NHMRC:* IV
Foley-Nicpon (2017) Aim: Goal orientation and friendship quality after social skills intervention	Controlled between-group comparative design: treatment (social skills intervention) vs comparison	▪ ADHD: 3 (in treatment group) ▪ high ability students with self-reported social difficulties ▪ Total sample n = 43	▪ Mean age 9.91 years (SD: 1.02)	▪ All were students enrolled in summer talent development program at large, Midwest University. Any student registered for program was eligible	*Diagnosis:* Three students self-reported ADHD. Unclear what measure/methods were used for self-report. *Medication:* NR	*Behaviour:* The Patterns of Adaptive Learning Scales Social skills (Friendships): The Friendship Qualities Scale	*Quality:* Strong (95.0%) *NHMRC:* III-2
Laurin (1993) Aim: To determine if video self-modelling intervention led to positive change in social skills with peer	Multiple baseline single subject design. Phases included: 1. Baseline 2. Treatment (9 x 20-minute sessions) 3. Reversal period	▪ ADHD: 1 (male) ▪ Non-ADHD: 1 (male peer for classmate partner to form dyad for intervention)	▪ ADHD: 9 years ▪ Non-ADHD: 9 years	▪ ADHD: diagnosis ▪ Peer: without ADHD. ▪ Peer randomly selected from pool of participants.	*Diagnosis:* Confirmed ADHD diagnosis. Conners Teacher Rating Scale used to confirm symptoms. *Medication:* Subject took Ritalin	*Social skills:* Videoed social interactions reviewed, frequency of targeted behaviour during all phases. 15 min segments of videotapes divided into 10-90 second blocks to record frequency of target social behaviour. Free Play Rating System (Grenell, 1987) used.	*Quality:* Good (70.0%) *NHMRC:* IV
Schmitt (2009) Aim: Compare self-monitoring	14 wk multiple baseline design:	▪ ADHD: 3 (male)	▪ 9-11 years	▪ ADHD diagnosis ▪ IQ>85 ▪ Males	*Diagnosis:* ADHD diagnosis from physician or	*On-task behaviours:* Scored using whole-interval time sampling procedure.	*Quality:* Strong (85.7%) *NHMRC:* IV

Study/Aim	Design/Treatment	Participants	Reported Age Range Years	Inclusion Criteria	Diagnosis and Medication	Outcome Measure	Quality (Kmet score)[a] & NHMRC[b]
intervention, with Video self-modelling and self-monitoring interventions, to increase on-task behaviour	1. Baseline (observed 20 min x 2 days/week) 2. Self-monitoring (2 weeks) 3. Self-monitoring and video-modelling (2 weeks) 4. Maintenance			▪ Regular education classroom ▪ Difficulty remaining on task in the classroom (Teacher rated Conner's-3).	psychologist (Confirmed by Conner's-3) *Medication:* 2 participants taking daily medication.1 participant non medication.	▪ Running tally maintained by observer and participant. ▪ Classroom behaviours video-recorded. *Perceptions of intervention:* Teacher/subject questionnaire: efficacy, feasibility and acceptability of intervention.	
Sibley (2012) Aim: Evaluate preliminary effects of video-feedback on the social behaviour of a male with ADHD in a summer treatment program	Single subject: 1. Baseline (9 days) 2. Intervention (week 5 of the 8 week camp) 3. Post-intervention (removed intervention last week of camp) 4. Posttreatment generalisation (4 days)	ADHD: 1 male (diagnosed with ADHD and oppositional defiant disorder).	▪ 16 years	▪ Participant of summer treatment program for secondary school students ▪ ADHD diagnosis ▪ Average IQ ▪ Attends regular education class at school ▪ Participant had marked social deficits and peer rejection.	*Diagnosis:* ADHD combined type and oppositional defiant disorder - confirmed by parent/teacher rating scales. *Medication:* No history of medication use.	*Intervals of inappropriate behaviour:* 5 min video rated for behaviour, (coded appropriate/ inappropriate). *Adolescent-counsellor agreement:* percentage agreement of participant's self- vs. councellor perception of behaviour. *Negative tracking system* Monitor behaviour in business meeting and recreation period. 15 defined negative behaviours.	*Quality:* Strong (92.9%) *NHMRC:* IV
Wilkes (2011) Aim: Efficacy of play-based intervention to improve social play skills of children with ADHD	One group pre-test post-test design. 7 wkly sessions in clinic (one-hour sessions)	▪ ADHD group: 14 (71.4% male) ▪ Typically-developing playmate group: 14 (57.1% male)	▪ 5-11 years ▪ ADHD group mean age 7.6 years (SD = 1.6) ▪ Playmate group mean age 7.3 years (SD = 1.6)	*ADHD group:* • Symptom scores above clinical cut-off on parent Conners Rating Scale-3rd ed. *Playmate group:* • No diagnosis	*Diagnosis:* Formal diagnosis by a psychiatrist or paediatrician. *Medication:* Continued medication or non-medication use.	*Test of Playfulness:* used pre and post intervention to measure children's play and social play with playmate - observed in video recording of children's play during intervention session. Also used to measure from post	*Quality:* Strong (100%) *NHMRC:* IV

Study/Aim	Design/Treatment	Participants	Reported Age Range Years	Inclusion Criteria	Diagnosis and Medication	Outcome Measure	Quality (Kmet score)[a] & NHMRC[b]
				• Regular playmate • Conners Rating Scale scores below clinical cut-off	Number of children taking medication not specified.	intervention to 18-months following intervention	
Cordier (2013) Aim: pragmatic pre-to post play-based intervention	Analysis of secondary outcomes from study above					Pragmatic Protocol and Structured Multidimensional Assessment Profiles via observation pre-post intervention.	*Quality:* Strong (100%) *NHMRC:* IV
Wilkes-Gillan (2014a) Aim: Follow up of gains	18-month Follow-up: parent interview and clinic play session.	▪ Follow-up: 5 of original 14 children with ADHD		▪ Attended play-based intervention 18-months prior	▪ Unchanged diagnosis in last 18-months	*Semi-structured interviews:* with parents used to ascertain parents' experiences of the intervention and *Test of Playfulness*	*Quality:* Strong (90.0%) *NHMRC:* IV
Wilkes-Gillan (2014b) Aim: Evaluate parent-delivered intervention for social play skills of children with ADHD and playmates, and empathy of children with ADHD	One group prettest posttest study with one-month follow-up. 7-wk intervention with 3 clinic play sessions.	▪ ADHD group: 9 (88.9% male) ▪ Playmate group: 9 (44.4% males) ▪ Parents of children with ADHD: 9 mothers (7/9 fathers also involved)	▪ ADHD group mean age 8.2 years (SD = 1.1) ▪ Playmate group mean age 8.9 years (SD = 1.7) ▪ Mothers of children with ADHD mean age 41.7 years (SD = 4.2)	▪ 6-11 years with a formal diagnosis of ADHD ▪ ADHD symptoms confirmed by Conners Comprehensive behaviour Rating Scale	*Diagnosis:* formal diagnosis of ADHD *Medication:* Continued medication use. 4/9 children took medication for ADHD symptoms	*Test of Playfulness:* Outcome measure used pre and post and 1-month following intervention to measure children's social play skills and empathy while playing with playmate. Social play skills examined in both children with ADHD and playmates; empathy examined in children with ADHD only.	*Quality:* Strong (90.0%) *NHMRC:* IV
Cantrill (2015) Aim: long-term Effectiveness/ appropriateness of intervention on social play	At 18-months: parent interview and observed play sessions at home and clinic.	Follow-up: 5 of original 9 children with ADHD		▪ Attended play-based intervention 18-months prior	▪ Unchanged diagnosis in last 18-months	*Semi-structured interviews:* to ascertain parents' experiences of the intervention and *Test of Playfulness*	*Quality:* Strong (90.0%) *NHMRC:* IV

Study/Aim	Design/Treatment	Participants	Reported Age Range Years	Inclusion Criteria	Diagnosis and Medication	Outcome Measure	Quality (Kmet score)[a] & NHMRC[b]
Wilkes-Gillan (2016) Aim: Examine the effectiveness of a play-based intervention for improving the social play skills of children with ADHD in peer-to-peer interactions	RCT two-group parallel trial: Intervention-first group received 10-wk play-based intervention. Control-first received no treatment for 10-weeks before the intervention.	▪ ADHD group: 29 (86.2% male) ▪ Playmate group: 29 (44.8% male)	Mean age years (SD) ▪ Intervention: ADHD group: 8.2 (1.5) ▪ Playmate group: 8.5 (1.9) Control: ▪ ADHD group: 8.5 (1.7) ▪ Playmate group: 7.9 (2.3)	▪ Children with ADHD needed to be between 5 and 11 years with a formal diagnosis of ADHD ▪ Children with ADHD needed to invite a typically-developing playmate	<u>*Diagnosis:*</u> formal diagnosis of ADHD made by a paediatrician or psychiatrist <u>*Medication:*</u> Medication taken for ADHD 9 of 15 in the Intervention: First: and 11 of 14 in the Control-First	<u>*Test of Playfulness:*</u> was used to examine children's play skills in peer-to-peer play interactions pre, post and one-month following the intervention	<u>*Quality:*</u> Strong (96.0%) <u>*NHMRC:*</u> II
Barnes (2017) Aim: Investigate social play, social skills and parent-child relationships 12 months after intervention	Two-group before and after design with a longitudinal component	At 12-months: ▪ ADHD group: 13 (84.6% male) ▪ Playmate group: 13 (46.2% male)	▪ ADHD group mean age 10.0 yrs (SD = 2.1) ▪ Playmate group mean age 9.3 yrs (SD = 2.3)	▪ Attended play-based intervention 12-months prior	▪ Unchanged diagnosis in last 12-months	<u>*Test of Playfulness:*</u> social play <u>*Social Skills Improvement System:*</u> social skills <u>*Parenting relationship Questionnaire*</u>: parents' perspectives across seven scales (i.e. attachment)	<u>*Quality:*</u> Strong (90.0%) <u>*NHMRC:*</u> IV
Woltersdorf (1992) Aim: Evaluate video-modelling on four target behaviours for each participant	Multiple baseline design 5-months: 1. Baseline (5 days) 2. Intervention (daily) 3. Maintenance (wkly- 2 wks) 4. Follow up (no Tx)	▪ ADHD (with no aggressive behaviour): 4 ▪ All male ▪ All attended private elementary schools	▪ ADHD: 9-10 years	▪ No learning disabilities ▪ No history of psychotropic medication ▪ No current psychotherapeutic relationships ▪ Disruptive behaviour	<u>*Diagnosis:*</u> ADHD diagnosis. Mother's Measure for Sub-grouping (MOMS) and Teacher behaviour rating scale: Conners confirmed ADHD diagnosis	<u>*Classroom behaviour observations:*</u> Observations of participants in classroom. Video recording of participant's behaviour. Interval count on instances of targeted behaviours.	<u>*Quality:*</u> Strong (90.0%) <u>*NHMRC:*</u> IV

Note. [a]A Kmet score of > 80% was considered strong quality, a score of 60-79% was considered good quality, a score of 50-59% adequate quality, and a score < 50% was considered to have poor methodological quality. [b]NHMRC = National Health and Medical Research Council Evidence Hierarchy Level: I - systematic reviews, II – RCTs, III-1 – pseudorandomised controlled trials, III-2 – comparative study with concurrent controls, III-3 – comparative study without concurrent controls, IV – case series with pre-test/post-test outcomes.

Use of Video-Modelling Intervention

Of the 11 included studies seven used video self-modelling, one used pre-taped footage (Carrol et al., 1994) and three studies used a mixture of video self-modelling and pre-taped footage (Embregts, 2002; Wilkes-Gillan et al., 2014b; Wilkes-Gillan et al., 2016). For target outcomes, three studies targeted behaviour, three social play skills, two social behavior, one social skills, one goal orientation and friendship quality and one comprehension of social behaviour. Three of the studies used video-modelling as the whole intervention, with no other intervention components described (Axelrod et al., 2014; Carrol et al., 1994; Woltersdorf, 1992). Intervention components used in conjunction with video-modelling reported in the other eight studies included: direct-care staff training (Embregts, 2002), verbal feedback and positive reinforcement from the teacher (Laurin, 1993), the use of MotivAider signaling for self-monitoring of behaviour (Schmitt, 2009), a summer treatment program (Sibley et al., 2012), a social skills lunch group (Foley-Nicpon et al., 2017) and a combination of peer-modelling, therapist-modelling, play and parent training (Wilkes-Gillan et al., 2014b; Wilkes-Gillan et al., 2016; Wilkes et al., 2011). The reported intervention length ranged from a once off 15-minute session (Carrol et al., 1994) to 10 weeks (Wilkes-Gillan et al., 2016) across the 11 studies (see Table 3).

Reported Effects of Interventions

Of the 11 studies, nine reported positive improvements in target skills/behaviours during and immediately after the intervention and two reported mixed findings. There was only one high level RCT study with a control group (NHMRC level II), which reported a significant improvement and large effect size in children's social play skills following a play-based intervention.

Of the two studies reporting mixed findings, Embregts (2002) reported no decrease in inappropriate behaviours and an increase in appropriate behaviours for some participants. However, the study had a lower level study design (level IV). Similarly, the other study by

Foley-Nicpon et al. (2017) reported a significant increase in participants' willingness to seek help with their friendships, but no effect was found for friendship quality, conflict, security or closeness. This study also had a lower level study design (level III-2). In addition to reporting the effects of the intervention for improving target behaviours/skills, five of the nine studies also reported on the feasibility or appropriateness of the intervention (see Table 3). Three of these studies used questionnaires to examine treatment acceptability (Axelrod et al., 2014; Embregts, 2002; Schmitt, 2009), with the questionnaire in two studies also examining efficacy and feasibility (Embregts, 2002; Schmitt, 2009). The Wilkes-Gillan et al. (2014a) follow-up study used semi-structured interviews with parents to investigate parent perceptions of intervention efficacy, appropriateness and feasibility.

Table 3. Intervention components and main findings of included studies

Study	Video-Modelling Component	Other Components	Skills Targeted	Main Findings
Axelrod (2014)	Video-modelling description: Video self-modelling. 12 days across 3 wks (4 x per wk). Subject viewed video clips of themselves complying with instructions prior to the schools morning sessions and unit's afternoon free period. Supervised by staff who provided verbal praise and ignored noncompliance. Setting: Hospital psychiatric inpatient unit.	▪ No other concurrent behavioural interventions occurred at the time of the video-modelling intervention	▪ Complying with instructions ▪ Reducing noncompliant, aggressive and destructive behaviours	▪ All participants exhibited higher levels of compliance and fewer aggressive episodes, during intervention, with effects generally maintained post-intervention. ▪ Hospital staff reported intervention easy to implement and beneficial.
Carrol (1994)	Video-modelling description: Pre-taped video modelling. Subject exposed to technology, using practice examples, prior to a 15 minute experimental session. Subject viewed video clips of everyday classroom social situations. In the interactive video condition, the subject watched the video clips, and then viewed different responses at their own pace. In the linear video condition, the subject watched the video clips, and then viewed different responses with no control over the pace of the video material. For both conditions the video clips and comprehension questions comprised the experimental session. Setting: Not specified.	▪ No other concurrent behavioural interventions occurred at the time of the video-modelling intervention	▪ Attending to and comprehending social cues ▪ Responding appropriately to social cues	▪ *Attention:* Significant effects associated with video condition for practice examples F (1,68) = 55.73, p <. 0002, intervention F (1,68) = 22.00, p < .0002, and total time attending to task F(1,68) = 53.66, p < .0002 in favour of interactive video. ▪ *Comprehension:* Significant effects on total raw scores F(1,68) = 16.49, p < .001 in favour of interactive video. Significant effects for Exemplar Type F(1,68) = 18.04, p < .001 in favour of the positive-negative model.
Embregts (2002)	Video-modelling description: Video self-modelling and pre-taped. Subject classified interactions role-played by trainer as appropriate/inappropriate. Subject viewed 16 video-taped examples of appropriate/ inappropriate behaviour of unknown people and 16 video-taped behaviours of himself. Training – 30 minutes x 3 times	▪ Comparison of behaviours between subject and trainer. Subject rewarded for each segment of behaviour rated appropriately ▪ Self-management training	Individual target behaviours: ▪ Turn taking ▪ Interrupting ▪ Shouting/Insults	▪ No decrease in inappropriate behaviours of subjects. ▪ Increase for some subjects of appropriate behaviours ▪ Increase of appropriate staff responses to subject's behaviour

Study	Video-Modelling Component	Other Components	Skills Targeted	Main Findings
	per wk. Subject viewed 10 x 20 second video segments of their behaviour at previous lunch/dinner time and classified behaviour as appropriate or inappropriate. Setting: Therapy room in residential facility.	▪ Training in appropriate social responses ▪ Behavioural contract ▪ Staff training (3x45 min sessions)	▪ Physical and verbal violence ▪ Responding to others initiations ▪ Initiating social interactions	
Foley-Nicpon (2017)	Video-modelling description: Social skills intervention using video modelling/self-modelling. 'Lunch group' talking freely with group and guided "check-in". Participants reported a "high" and a "low" for day (videoed). Facilitators led video modelling. Participants shown three social interactions from previous day's lunch meeting. Students' interactions served as focal point of the footage. Group members gave feedback about the video clip, including what worked/not work well in terms of using social skills. Setting: Lunchtime group (50 mins) university-based summer program	▪ Any student who attended a talent development class was invited to participate in the comparison group. ▪ Undergraduate students hired to work as part of the university centre's summer student programs monitored lunch and an inside or outside activity, such as a craft or kickball game.	▪ friendship quality: companionship, conflict, help, security and closeness	▪ Social skills intervention had a significant and positive impact on treatment participants' willingness to seek help within their friendships compared to the comparison group. ▪ The effect was not found for friendship quality companionship, conflict, security, or closeness.
Laurin (1993)	Video-modelling description: Self-modelling. 9 sessions in 3 weeks (3x p/wk for 15 mins). Sessions 1-3 (baseline) subject videotaped playing with classmate. Target behaviours identified. Sessions 4-6 (intervention) subject viewed edited videotape of self exhibiting targeted behaviours. Researcher provided feedback by stopping to reinforce target behaviour. Subject videoed interacting with classmate. Sessions 7-9 (reversal) subject videoed interacting with classmate without viewing video prior. Setting: School office.	▪ No other concurrent behavioural interventions occurred at the time of the video-modelling intervention	Social skills: ▪ Giving positive attention ▪ Asking about rules ▪ General conversation about activity ▪ Sharing information about himself to his classmate	▪ Significant effects between baseline and intervention ($t(30) = 3.39$, $p < .01$) and between intervention and reversal stages ($t(30) = 8.10$, $p < .001$). ▪ Increase in frequency of target behaviours during intervention, however, frequency of target behaviours decreased to below baseline once the intervention ceased (reversal phase).

Study	Video-Modelling Component	Other Components	Skills Targeted	Main Findings
Schmitt (2009)	Video-modelling description: Video self-modelling. 14 weeks (from baseline to maintenance phase) with Phase B and C lasting 2 weeks each. In Phase C video consisting entirely of on-task behaviours created by subject and his teacher acting out positive behaviour scenarios. Subject watched an edited 3 minute video of himself exhibiting on-task behaviours two times each week. In maintenance phase, subject behaviour video-taped twice per week for 2-4 weeks, to measure effectiveness of intervention. Setting: Subject's classroom.	▪ Phase B researcher and subject discussed on-task behaviour. Subject taught how to self-monitor behaviour using MotivAider. Self-monitoring forms compared for accuracy against researcher. Subjects rewarded for accuracy. Transitioned to self-monitoring behaviour in classroom for 15 mins a day, two days a week	On task behaviours defined as eyes focused on the teacher, white board or books on the subject's desk, without talking to neighbours, blurting out answers, fidgeting or being out of seat	▪ Each subject significant improvement in on-task behaviour at onset of Phase B (self-monitoring intervention). No significant change from Phase B to C. Success of self-monitoring intervention created a "ceiling effect" - little opportunity for additional improvement using video self-modelling intervention. ▪ High level of social validity for teachers and participants.
Sibley (2012)	Video-modelling description: Video self-modelling. Self-rating form/behaviour definitions revised before video feedback sessions. Questions on form for discussion "What was good?" "What would you change?" Participant watched video recording of his behaviour during group meetings with peers with a counsellor. Every 30 seconds counsellor paused video of the meeting to instruct participant to complete the above questions/form. Counsellor then reviewed participant's self-rating and discussed observations. Rewards given for agreement in ratings of behaviour to maintain active participation. Setting: Summer treatment camp.	Concurrent summer camp: ▪ 9 daily treatment modules ▪ Reward and response-cost programs in naturalistic setting to target social, classroom and vocational skills, and behaviours ▪ Business meetings daily for 30-minutes to develop planning and cooperation. Included six other youth attending camp. ▪ Recreation period with peers	Defined target negative behaviours during peer interactions: ▪ Inappropriate laughing ▪ Making exaggerated/ inappropriate movement ▪ Self-stimulating behaviours (nose picking)	▪ Coded inappropriate behaviour increased over baseline and decreased during intervention. ▪ Self-evaluations of behaviour: agreement with counsellor ranged 60-100% (mean 81.42, SD 13.45). ▪ Negative tracking behaviour ranged 0-3 at baseline. Ceased to 0 during intervention phase. ▪ Limited maintenance data due to fixed camp duration. Unclear if video feedback effective in absence of camp.
Wilkes (2011)	Video-modelling description: Video self-modelling. Children filmed playing in playroom with playmate. Before next play session, children watched 3 min video footage of self and playmate (7 sessions). Problem	▪ Typically developing playmates to promote peer-modelling and friendship	Play and pro-social skills: ▪ Cooperative play ▪ Watch/listen	▪ Significant large effect on social play skills of children with ADHD (t = 8.1, p = <0.01, d = 1.5) and playmates (t = 6.9, p = <0.01, d = 1.3) pre to post.

Study	Video-Modelling Component	Other Components	Skills Targeted	Main Findings
Cordier (2013) Wilkes-Gillan (2014a) follow-up	solving discussion with therapist using video feedback and video feed-forward techniques. After viewing footage, the therapist supported children to act on skills targeted in the video footage/discussion while playing in playroom. <u>Setting:</u> Clinic room set up as playroom.	▪ Therapist- modelling to promote play between child with ADHD and playmate ▪ Play setting to practice natural social interactions ▪ Parent involvement to reinforce intervention techniques	▪ Sharing ▪ Responding to playmate's cues ▪ Reciprocal play ▪ Supporting another ▪ Pragmatic skills	▪ Significant large effect on pragmatic skills of children with ADHD pre to post intervention (t = 3.31, p = <0.01, d = 1.04). ▪ Follow-up: No significant increase/decrease in skills 18-months post intervention (p >0.05).
Wilkes-Gillan (2014b) Cantrill (2015) follow up	<u>Video-modelling description:</u> pre-taped video-modelling - DVD with appropriate play behaviours. Children watched DVD with parents who facilitated a discussion about behaviours of the actors. Children practiced these skills during play-dates. <u>Setting:</u> Child's home, clinic playroom.	▪ 3 clinic play sessions with therapist ▪ Parent training – used DVD and manual at home. Weekly play-dates with playmate ▪ Peer-modelling ▪ Parent involvement	Play and pro-social skills: ▪ Cooperative play ▪ Watch/listen ▪ Sharing, supporting ▪ Responding to a playmate's cues ▪ Reciprocal play ▪ Empathy	▪ Social play outcomes of children with ADHD improved significantly pre to post intervention and post intervention to 1-month follow-up. ▪ Children with ADHD improved significantly on two of the seven empathy items from pre- to post-intervention and from post intervention to 1-month follow-up. ▪ Follow-up: no significance difference in social play skills of children with ADHD 18-months post intervention in both home and clinic (p > 0.05).
Wilkes-Gillan (2016) Barnes (2017) follow-up	<u>Video-modelling description:</u> Video self-modelling. (sessions x6 – as in Wilkes 2011). Pre-taped video-modelling. DVD with appropriate play behaviours. Children watched DVD with parents who facilitated a discussion about behaviours of the actors (weekly). Children practiced these skills during play-dates (4 weeks). <u>Setting:</u> Clinic room set up as playroom, child's home.	Intervention clinic play sessions: ▪ Typically developing playmates to promote peer-modelling and friendship ▪ Therapist- modelling the desired pro-social skills and helping the children negotiate when disagreements occurred ▪ Play setting to practice natural social interactions	Play and pro-social skills: ▪ Cooperative play ▪ Watch/listen to another ▪ Sharing, supporting ▪ Responding to playmate's cues ▪ Reciprocal play	▪ Change in overall play skills of children with ADHD in intervention-first group pre to post intervention was significantly greater than control-first group during 10 week wait (t = 8.02, p < .001; 95% CI = 18.79–31.71). ▪ Children's overall play scores improved significantly pre to post intervention (95% CI = 16.27–26.00, d = 1.5) and from pre intervention to one-month follow up (95% CI = 16.98–29.08, d = 1.6).

Study	Video-Modelling Component	Other Components	Skills Targeted	Main Findings
		▪ Parent involvement to reinforce intervention techniques Intervention home-modules: ▪ parents used DVD and manual at home with the child weekly. ▪ Play-dates with playmate (4 weeks)		▪ Significant large effect on social play skills of children with ADHD pre to post intervention. Medium-large effect pre- to one-month follow up. ▪ Follow-up: Children with ADHD maintained gains at home/not clinic
Woltersdorf (1992)	Video-modelling description: Video self-modelling. Children filmed in class. Observed the self-modelled 3 minute video of them performing typical and appropriate classroom behaviours in class. Dependent variables (e.g., fidgeting) were edited out of the footage before shown to the child. Videos were watched in a nearby office prior to their next maths class. Rewards given for compliance and attention to video. After video, subjects in class behaviour was monitored. When threshold of appropriate behaviour reached, progression to maintenance phase. Setting: subjects' classroom.	▪ None other intervention components reported ▪ During the maintenance phase, videos were watched weekly for two weeks. When appropriate behaviours were reached, participants progressed to follow-up ▪ Follow-up phase: observers continued to monitor classroom behaviour. Subjects did not watch videos during follow-up	▪ Fidgeting. ▪ Distractibility ▪ Vocalisations ▪ Maths performance (e.g., number of completed and correct math problems completed during seat work)	▪ Child compliance with intervention 100% (measured by attention to video stimulus). ▪ Effect sizes: intervention 0.87-5.63, maintenance 0.77-3.87, follow-up 0.43-4.02. ▪ Combined treatment effects across each phase and all target behaviours were: intervention 2.82, maintenance 2.08 and follow-up 1.74. ▪ Inter-rater reliability 0.92 (range = 0.78-0.99) across all observations.

Methodological Quality

Of the 11 original intervention studies, one was a randomised controlled trial (RCT), one a controlled between-group comparative design, two were one group pre-test post-test studies, one an experimental 2x2 factorial design and six were single-case experimental design studies.

Of these studies, eight were classified as level IV evidence and one as level III-3 evidence based on the NHMRC Evidence Hierarchy (National Health and Medical Research Council, 1995). Regarding the overall methodological quality of the 11 intervention studies, eight were scored to have strong methodological quality according to the Kmet ratings. The remaining studies were found to have good methodological quality (see Table 3).

Risk of Bias in Included Studies

While all studies were found to clearly report the aim and select an appropriate study design for their aim, studies in this review were at risk of bias. Of the included studies, six studies (Axelrod et al., 2014; Embregts, 2002; Laurin, 1993; Schmitt, 2009; Sibley et al., 2012; Woltersdorf, 1992) used a single-case experimental design with small sample sizes, which limits generalisability of the findings. Further most studies did not clearly report on blinding, sample size justification and confounding factors. Further, two studies (Wilkes-Gillan et al., 2014b; Wilkes et al., 2011) used a pretest-posttest design without control group. However, the authors calculated Cohen's *d* and identified medium to large effect size regarding the effectiveness of intervention. Although Carrol et al. (1994) randomly assigned participants to the experimental conditions using a stratified random sampling procedure, blinding of both participants and investigators was not reported. Further, all studies were at risk of confounding bias. Seven original intervention studies (Axelrod et al., 2014; Embregts, 2002; Foley-Nicpon et al., 2017; Sibley et al., 2012; Wilkes-Gillan et al., 2014b; Wilkes-Gillan et al., 2016; Wilkes et al., 2011) included data of children with other comorbid

diagnoses. Further, all studies except Embregts (2002) and Foley-Nicpon et al. (2017) recruited medicated and non-medicated children.

Observed frequency of behaviour rating using interval time sampling was most commonly used to assess intervention outcomes; with six of 11 original intervention studies solely utilising this methodology (Axelrod et al., 2014; Carrol et al., 1994; Embregts, 2002; Schmitt, 2009; Sibley et al., 2012; Woltersdorf, 1992). Laurin (1993) used both observed frequency of behaviour and the Free Play Rating System (Grenell, Glass, & Katz, 1987) to assess outcomes. Despite calculating the inter-rater reliability of observers in these studies, the behaviour was operationally defined which lacked the evidence of construct validity. Three studies (Wilkes-Gillan et al., 2014b; Wilkes-Gillan et al., 2016; Wilkes et al., 2011) used the Test of Playfulness (Bundy, 2004), an observer-rated instrument in which the reliability and validity were established, as an outcome measure. However, all original intervention studies except Embregts (2002), Wilkes-Gillan et al. (2014b) and Wilkes-Gillan et al. (2016) in this review were at risk of observation bias due to a lack of blinding of researchers for outcomes.

Discussion

We identified, appraised and synthesised the evidence for video-modelling interventions for individuals with ADHD. A total of 11 original intervention studies met the inclusion criteria. This finding contrasts the relatively large amount of studies investigating the use and noted benefits of video-modelling in interventions for children with developmental disabilities, including children with ASD (Rai, 2008; Wang et al., 2011).

Of the 11 included studies, all but one (Sibley et al., 2012) used video-modelling to improve the skills of primary school aged children with ADHD. Sibley et al. (2012) used a video-modelling intervention embedded within a summer treatment program with the aim of improving the social behaviour of an adolescent with ADHD. No studies were found that used video-modelling with individuals over the age of 16. These findings are reflective of

other psychosocial intervention research for individuals with ADHD, with a relatively high number of studies focused on children rather than adolescents and adults (Storebø et al., 2011).

While video-modelling studies for children with ADHD contain preliminary evidence for effectiveness with small samples, the emerging evidence suggests this approach has the potential to be an effective technique to capture the attention of children with ADHD (Dowrick, 1999). Further, the findings from these studies were consistent with previous studies using video-modelling to improve the social skills of children with other diagnoses (Dowrick, 1999, 2012; Wang et al., 2011). Effects during the intervention phase across the included studies were reported as positive except for Embregts (2002) and Foley-Nicpon et al. (2017) who reported mixed results. Embregts (2002) study included children with ADHD and mild mental retardation. The authors highlighted the mixed effects among participants and the need to consider children's cognitive development. The results from this study indicate that video-modelling may be best suited for children with ADHD who do not have any intellectual impairment and who attend mainstream classes. Given the cognitive difficulties associated with the disorder, another consideration is the timing of video-feedback. Children with ADHD have difficulty anticipating and performing the needed skills in the moment of interaction (Barkley, 1997). Thus, a video-feedback session may be most effective when an opportunity to practice the desired skills follows immediately. In this instance, video-feedback prepares children to think about the skills demonstrated in the video as they enter forthcoming interactions (Axelrod et al., 2014; Laurin, 1993; Wilkes et al., 2011). When the practice opportunity involves spontaneous peer interactions and adult assistance, skill development may be further enhanced (Axelrod et al., 2014; Laurin, 1993; Wilkes et al., 2011).

Of the studies that reported improvements during the intervention phase and that included an intervention withdrawal or follow-up period, three (Axelrod et al., 2014; Laurin,

1993; Woltersdorf, 1992) reported that improvements during the intervention period decreased during the withdrawal/follow-up phase. These findings are similar to previous research on psychosocial interventions for children with ADHD that show children have difficulty maintaining and generalising treatment gains over time, after the discrete intervention period (Abikoff, 2009). Two studies in this review (Schmitt, 2009; Sibley et al., 2012) reported limitations of the study design restricting the investigation of the maintenance of intervention gains and two (Wilkes-Gillan et al., 2014b; Wilkes et al., 2011) reported children with ADHD maintained gains in their skills 1-18 months post intervention. However, the Wilkes et al. (2011) and Wilkes-Gillan et al. (2014b) studies used video-modelling in conjunction with numerous other intervention components; making the effect of video-modelling difficult to assess.

These findings may suggest that video-modelling used in conjunction with other intervention components (i.e., parent training and involvement) and extending the use of video-modelling to multiple settings may increase generalisation and maintenance of treatment effects over time (Abikoff, 2009). Findings from a recent systematic review of social skills training (SST) interventions for children with ADHD (Willis, Siceloff, Morse, Neger, & Flory, 2019) found parent involvement in SST to be beneficial. Suggesting a helpful type of parent involvement would be to enable parents to use social skills focused methods combined with positive behaviour strategies to help coach and facilitate children's social skills and peer relationships long after intervention is finished. As video-modelling uses a positive behaviour approach to target social skills and relationships, it has the potential to be used in social skills interventions to help address current shortfalls by continuing parent involvement and skill generalisation after the intervention period. However, further research is required to confirm these postulations.

Limitations

We undertook a rigorous review process by searching relevant databases and by using two independent reviewers to screen abstracts and to rank the methodological quality of included studies. While care was taken to reduce bias, the first and second author were authors of some of the included studies (Barnes et al., 2017; Cantrill et al., 2015; Cordier et al., 2013; Wilkes-Gillan et al., 2014a, 2014b; Wilkes-Gillan et al., 2016; Wilkes et al., 2011). Although these authors did not partake in the screening of abstracts, data extraction process or scoring the methodological quality of included studies, potential bias remains. Another limitation is that video-modelling interventions for individuals with ADHD is only an emerging area of research. All studies included in the review were at a high risk of bias due to the study design, small sample sizes, inadequate blinding, lack of randomisation and lack of control around confounding variables. While our search strategy was comprehensive, only a sparse number of studies were available to draw conclusions from regarding the efficacy, feasibility and acceptability of video-modelling interventions for individuals with ADHD. There was insufficient evidence to conduct a meta-analysis on the efficacy of the intervention approach.

Conclusion and Directions for Future Research

The findings from this review are preliminary in nature, with a need for future larger-scale studies to investigate the effectiveness of video-modelling for improving the skills/behaviours of individuals with ADHD. The ongoing social difficulties experienced by individuals with ADHD and shortfalls of current pharmacological and social skills interventions make the investigation of alternate psychosocial interventions essential (Storebø et al., 2011). Particularly when such interventions have the capacity to be used in conjunction with medication and implemented feasibly over time and across settings. The findings from the included studies indicated that video-modelling may be a promising intervention approach for targeting the social skills and behaviours of individuals with ADHD when used

in conjunction with other intervention components. However, more studies with adequate sample sizes and more rigorous research designs (i.e., RCTs) are needed before the effectiveness of this approach can be fully investigated.

Future studies should aim to: 1) calculate appropriate sample sizes; 2) ensure randomisation, allocation and concealment and blinding procedures are clearly planned and reported; 3) control for medication as a potential confounding variable; 4) examine the effectiveness of video-modelling as both the whole intervention and intervention component; 5) ensure the included population has a clear diagnosis of ADHD without the inclusion of individuals in the study with mixed or varying diagnoses; 6) use valid and reliable outcome measures in conjunction with observational behaviour frequency ratings; and 7) ensure an adequate follow-up after treatment phase.

Key Points for Occupational Therapy

- Video-modelling is a promising approach for helping children with ADHD to develop new skills
- Video-modelling may be most beneficial when combined with other intervention components
- Evidence behind video-modelling is emerging – clinicians should use outcome measures when using video-modelling to determine if the approach is beneficial

Conflict of Interest

The authors declare no conflict of interest.

Author Contribution

SW-G and RC conceptualised and designed the research. All authors were involved in the methodology of the study and writing the methods section of the manuscript. SW-G wrote the introduction, results and discussion sections of the manuscript and all authors contributed to the editing of tables and manuscript.

Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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