

The effectiveness of self-regulation interventions for increasing cognitive and social-emotional functioning of preschool-aged children: A systematic review

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Abstract

The preschool period is an important time for the development of self-regulation. Various interventions and programs have been developed to improve pre-schoolers' self-regulation. A systematic review of self-regulation interventions was conducted to examine the effectiveness of these interventions for improving both social-emotional and cognitive aspects of preschool-aged children's self-regulation. The review also aimed to investigate any specific intervention effects for different types of self-regulation interventions. A systematic review of the literature within PsycINFO, MEDLINE, Scopus, and Education Source databases was conducted. Studies were included in the review if they were randomised control trials, had participants between the ages of two and six, the intervention was conducted by parents or teachers, and the study assessed cognitive or social-emotional aspects of self-regulation pre- and post-intervention. A total of thirty-seven studies were included in this review. Results indicated that interventions could effectively improve both social-emotional and cognitive aspects of pre-schoolers' self-regulation. Parenting programs, play-based interventions and multi-method interventions appeared to be most effective in promoting children's self-regulation. These findings have implications for parents and educators of preschool-aged children and for future developers of self-regulation interventions.

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Introduction

Self-regulation is a term that describes the cognitive, behavioural and emotional skills an individual possess that enable them to control their behaviour (Skibbe et al., 2019).

Successful self-regulation requires three components (Baumeister et al., 2018). The first is that an individual has standards or goals that they wish to achieve. For example, the goal may be to calm down after a stressful event. The second component for successful self-regulation is monitoring. This involves an individual evaluating where their current state is in comparison to their desired goal. In the case of the above example, an individual may monitor whether their current physiological state reflects that of a calm individual. The final component required for successful self-regulation is the capacity to reduce any discrepancy between the individual's current state and their self-regulatory goal (Baumeister et al., 2018). This may involve changing one's behaviour, thoughts or emotions to bring them in line with the desired end goal (Inzlicht et al., 2021).

There are several neurocognitive processes that subserve an individual's capacity to self-regulate, including the ability to hold and update information in the working memory, mental set shifting, and inhibitory control (Diamond, 2013; Montroy et al., 2016; Savina, 2020). These three processes are also known as executive functions. Working memory is described as a small amount of accessible information that is held temporarily in the mind (Cowan, 2014). The ability to update and hold information in working memory allows us to connect and integrate information and make sense of written and spoken language (Diamond, 2013). Mental set shifting, or cognitive flexibility, involves the ability to switch between tasks, change perspectives, and 'think outside the box' (Diamond, 2013). For example, coming up with a new solution to a problem when a current strategy is not working requires someone to 'switch' from their current train of thought to a new perspective. Inhibitory control involves the control of attention, thoughts, and behaviours, and enables us to not act

impulsively or give in to temptations (Diamond, 2013). One might use inhibitory control to maintain focus on a lecture whilst ignoring a conversation being had behind them. This is known as inhibitory control of attention (Diamond, 2013). An example of inhibitory control of behaviour, on the other hand, may include waiting your turn to speak during a conversation rather than interrupting, or resisting the urge to indulge in sweet treats when trying to eat healthy (Diamond, 2013). Each of these executive functions are important for controlling cognitive functioning, which in turn enables self-regulation to occur (Carlson & Wang, 2007; Hofmann et al., 2012).

As well as cognitive processes, self-regulation also encompasses social-emotional aspects, including emotion regulation. Emotion regulation describes the ability to control one's own emotional states, including the duration and intensity of an emotional response (Nigg, 2017). Examples of emotion regulation include attempts to calm down after getting angry or maintaining composure during a stressful situation (Gross, 2015). A number of strategies, both adaptive and maladaptive, can be deployed to regulate one's emotions (Aldao & Nolen-Hoeksema, 2012). Adaptive strategies include cognitive reappraisal and acceptance of emotion (Aldao & Nolen-Hoeksema, 2012). Cognitive reappraisal describes the process by which a person thinks about a situation differently in order to reduce the level of emotion the situation may have elicited (Gross, 1998). On the other hand, the suppression of negative emotions has been found to be counterproductive, with evidence suggesting emotional distress persists while attempting to suppress emotions (Campbell-Sills et al., 2006).

Other social-emotional factors related to self-regulation include aggression, impulsivity and other externalising behaviours. Externalising behaviour is often conceptualised as a breakdown of self-regulation, as the individual is no longer able to control their emotions, impulses and behavioural responses (Denissen et al., 2018; Healey & Halperin, 2015). Failure to self-regulate may be due to insufficient effort by an individual,

known as underregulation, or because the response chosen by the individual is counterproductive, known as misregulation (Heatherton & Baumeister, 1996). Breakdowns in self-regulation that lead to externalising behaviour are common in early childhood, as children have not fully developed the capacity to regulate their behaviour (Beeghly et al., 2016).

Theoretical approaches to self-regulation development

The development of self-regulation begins in early childhood and develops exponentially during these early years (Jones et al., 2003; Montroy et al., 2016). During infancy, regulation of internal states and behavioural responses are facilitated by caregivers, a process known as co-regulation (Erdmann & Hertel, 2019). For example, when an infant cries, a caregiver will provide comfort in order to decrease their distress. Over time, children begin to internalise the co-regulation strategies their caregivers use and begin to develop their own self-regulation capabilities (Erdmann & Hertel, 2019; Silkenbeumer et al., 2016). Feldman (2009) hypothesised that children face different self-regulatory goals throughout early childhood. The main regulatory goal for new-borns is the regulation of physiological processes in the body. During the first year of life, the main self-regulatory goal is the regulation of emotions. This includes the development of regulatory strategies such as avoidance or self-comforting strategies like thumb-sucking to reduce distress (Braungart-Rieker & Stifter, 1996). In the second year of life, the goal shifts to the regulation of attention and in the following preschool years, other self-regulatory skills develop and mature rapidly, including the development of executive functions and self-restraint (Feldman, 2009).

Theoretical approaches to the development of executive functions have typically taken a neuropsychological approach, highlighting the importance of neural growth in the prefrontal cortex for the development of executive functioning (e.g. Duncan, 2001). One theoretical approach, however, emphasises the link between cognitive control and the

development of reflection. The Cognitive Complexity and Control (CCC) theory, posits that changes over time in children's executive functioning are due to increased ability to integrate and reflect on complex rules in the working memory (Zelazo et al., 2008; Zelazo et al., 2003). Evidence of this ability come from research of the Dimensional Change Card Sort (DCCS; Zelazo et al., 1996). The DCCS requires children to sort cards based on specific rules. For example, a child may be asked to sort by colour, meaning red cards are sorted into one pile, and blue cards are sorted into another, or they may be asked to sort by shape, meaning cards with rabbits are sorted into one pile, and those with boats in another.

At age three, children completing the DCCS find it difficult to switch between these pairs of rules, despite knowing what the rules are (Zelazo et al., 1996). For example, a three-year-old may be able to verbally explain the pairs of rules, but when asked to switch from sorting by colour to sorting by shape, the child continues to sort by colour. The CCC theory posits that this inability to switch rules is due to a failure to reflect on the fact that different rules apply depending on whether they are playing by colour or by shape (Zelazo et al., 2003). As a result, the two rule pairs fail to be integrated into one rule system, and the child continues sorting by the rule they have previously been using (Zelazo et al., 2003).

At age four, however, children are able to switch between the rule pairs (Zelazo et al., 1996). This is because they have knowledge of the higher-order rule that different rules apply depending on whether they are playing by colour or shape (Zelazo et al., 1996). As a result, a hierarchical system of rules is developed, where children use the higher order rule of whether they are playing by shape or colour to reflect on which of the rule pairs they will sort by (Zelazo et al., 2003). These age-related changes in the ability to integrate and reflect on complex rules are believed to underlie increases in cognitive control across childhood (Zelazo et al., 1996).

Other theories of executive function development take on a more social interaction approach. Hughes and Ensor (2009) proposed that executive functioning is developed through the process of parental scaffolding. Scaffolding describes the process by which adults provide children with knowledge and support in a way that assists the development of their own problem-solving skills (Landry et al., 2002). For example, if a child is struggling to build a stable tower of blocks, a parent may provide suggestions for how the tower could be built instead of building it for them. Over time, this scaffolding helps the child to develop the problem-solving skills to complete the task themselves.

Hughes and Ensor (2009) conducted a longitudinal study examining the relationship between maternal scaffolding and pre-schoolers' executive functioning. Mothers and their children were asked to complete a series of structured tasks. These included tasks such as tidying up toys and sorting lollies into colours. Observations were made regarding how often mothers engaged in scaffolding strategies such as using open-ended questions, praise, and elaboration during the task. Children's executive functioning at age two and again at age four were examined using a battery of executive functioning tasks. Results showed that maternal scaffolding predicted individual differences in children's executive functioning ability (Hughes & Ensor, 2009).

Furthermore, research by Hammond et al. (2012) has suggested that scaffolding of pre-schoolers' problem solving influences the development of their executive functioning skills indirectly through increases in language ability. It is thought that scaffolding increases children's use of private speech, or "thinking out loud" when solving problems and that, in turn, this increases children's ability to use and regulate higher cognitive processes (Fernyhough & Fradley, 2005). These findings, along with those of Hughes and Ensor (2009), suggest that scaffolding may help to support the development of pre-schoolers' executive functioning.

Further research has also suggested that parenting styles may influence the development of executive functioning in children. Roskam et al. (2014) found that harsh punishment and inconsistent discipline during early childhood was related to poor development of executive functioning, particularly inhibition. On the other hand, warm and responsive parenting, especially from mothers, was found to be related to better inhibition development in children (Roskam et al., 2014). These findings suggest that parents may play an important role in the development of children's cognitive functioning.

Social interactions are also thought to play a role in the development of social-emotional aspects of self-regulation, such as emotion regulation (Morris et al., 2007). A tripartite model of emotion regulation was developed by Morris et al. (2007) explaining three main mechanisms through which emotion regulation develops in children. The first of these is observational learning of emotion regulation. Children learn how to regulate their emotions through observing how other people respond in certain situations. For example, a child may learn to breathe deeply when upset after observing their teacher model the same behaviour. This aspect of the model is in line with social learning theory (Bandura, 1971), which posits that children learn behaviour through observing and imitating others.

The second mechanism through which emotion regulation may be developed is through emotion-related parenting practices (Morris et al., 2007). How a parent reacts to a child's emotional displays, for example, can impact how a child develops the ability to regulate their emotions (Eisenberg et al., 1998). Research suggests that punitive responses to children's emotional distress can lead to children developing inappropriate strategies to regulate their emotions, such as avoidance (e.g. Eisenberg & Fabes, 1994). On the other hand, supportive and problem-focused responses from parents are associated with greater social-emotional functioning and emotion regulation strategies in children (Eisenberg et al., 1996).

The final mechanism of emotion regulation development described in this model is the emotional climate of the family (Morris et al., 2007). The emotional climate of a family is made up of the levels of negative and positive emotions expressed as a family, and the quality of the relationships within the family. When the emotional climate of a family is unpredictable, with high levels of expressed negative emotions or hostile parent-child interactions, a child will likely develop poor emotion regulation strategies. This is due to the lack of parental modelling of self-regulation and the distress caused by the highly negative environment (Morris et al., 2007). On the other hand, a child will likely develop effective emotion regulation strategies when their emotional climate is consistent, with high levels of expressed positive emotions and responsive parenting (Eisenberg et al., 2001; Morris et al., 2007). These children are more likely to feel safe expressing their emotions as they know their parents will meet their emotional needs (Morris et al., 2007).

In summary, this section highlights some of the theoretical approaches present in the literature that contribute to our understanding of the development of self-regulation. Social influences, such as the observation of others and the quality of parent-child relationships appear to have strong influences on the development of both cognitive and social-emotional aspects of self-regulation. It is therefore important to consider the role of social relationships when developing interventions to support the growth of children's self-regulatory capabilities.

The importance of self-regulation

As previously described, breakdowns in self-regulation can lead to behavioural difficulties. Difficulties regulating behaviour, including aggression and impulsivity are also characteristics of a number of common childhood disorders including Attention Deficit Hyperactivity Disorder (ADHD) and conduct disorder (American Psychiatric, 2013). ADHD is a neurodevelopmental disorder characterised by inattention, hyperactivity and impulsivity.

Children with ADHD often struggle to sustain attention during class, have difficulty waiting their turn and may struggle to sit still (American Psychiatric, 2013). Conduct disorder is characterised by persistent aggressive and anti-social behaviour, including theft and engaging in physical fights with others (American Psychiatric, 2013).

Children with ADHD have been found to have poorer outcomes in adulthood, including impaired social functioning, greater dependency on family for financial stability, and increased risk for substance abuse (Altszuler et al., 2016; Merrill et al., 2020). Conduct disorder in childhood has been associated with increased substance use in adulthood, as well as future criminal behaviour (Erskine et al., 2016). Furthermore, ADHD has been linked to poorer academic achievement, such as poorer grades and lower reading and math ability (Arnold et al., 2020; Massetti et al., 2008). Both ADHD and conduct disorder have also been associated with an increased risk of dropping out of high school, which has further implications for later employment (Erskine et al., 2016)

Additional implications of poor self-regulation include negative impacts on children's physical health and social functioning. A study conducted by Moffitt et al. (2011) investigated whether self-control at age three predicted physical health, criminal offending, and financial status later in life. One thousand children were longitudinally followed from birth until the age of 32. Results indicated that poor self-control at age three predicted poorer physical health in adulthood as well as a greater risk of substance dependence. Poorer self-regulation in early childhood was also associated with financial struggles in adulthood and was associated with higher criminal offending in adulthood (Moffitt et al., 2011). On the other hand, greater self-regulation skills in childhood may be associated with a reduced likelihood of developing depression and anxiety as an adult (Robson et al., 2020).

The ability to regulate one's behaviour, emotions and cognitive functioning is also important for academic achievement (McClelland et al., 2006; McClelland et al., 2007;

Skibbe et al., 2019). McClelland et al. (2006) examined whether children's learning-related skills, including self-regulation and social competence, predicted increased reading and maths ability from kindergarten through to the sixth grade. Over 500 children aged four to six were followed until they reached the sixth grade. Learning-related skills of each child were examined at kindergarten, with their maths and reading skills being examined at kindergarten and each year after until sixth grade. Results indicated that higher learning-related skills at kindergarten predicted greater reading and maths ability at sixth grade. Similarly, greater social skills at kindergarten also predicted greater maths and reading ability at sixth grade. McClelland et al. (2006) concluded that learning-related skills such as self-regulation and social competence may be important for increasing children's academic performance later in school.

A further study by McClelland et al. (2007) also found similar results, with greater behavioural self-regulation skills, including greater attention, working memory and inhibitory control capabilities, predicting greater growth in vocabulary, literacy skills, and maths ability over the preschool year. A more recent study also suggests that the earlier a child develops cognitive self-regulation skills, the higher their literacy and language skills are likely to be (Skibbe et al., 2019). Children with greater cognitive skills such as greater attention, working memory and inhibitory control capabilities would be able to focus on the task at hand, remember instructions, and inhibit unhelpful behaviours in the classroom. On the other hand, children with poorer cognitive self-regulation may have difficulties paying attention and staying on task making learning and academic achievement much more difficult (McClelland et al., 2007).

Taken all together, the research by Moffitt et al. (2011), McClelland et al. (2006) and Robson et al. (2020) indicates that greater self-regulation skills in early childhood may predict multiple indices of functioning later in life. It is therefore important that children are

supported to develop the required skills to regulate their emotions, cognitions and behaviours. Given this importance, this thesis examines the intervention literature to determine the evidence base for self-regulation interventions for preschool-aged children.

Self-regulation interventions and programs

Several interventions have been developed that target the promotion of self-regulation and greater executive functioning in children. These interventions range from parenting programs aimed at supporting parents with behaviour management strategies (e.g. Sanders, 1999) through to physical-activity and mindfulness-based interventions (e.g. Jackman, 2016; Xu et al., 2018).

Examples of parenting programs that may be effective for improving social-emotional aspects of children's self-regulation include the Positive Parenting Program (Triple P; Sanders, 1999) and the Incredible Years program (Webster-Stratton, 2001). Triple P aims to reduce emotional and behavioural difficulties in young children by teaching parents behavioural management strategies and ways to promote positive and nurturing relationships with their children (Sanders, 1999). The program has five levels ranging in intensity. Level one consists of providing information to parents about parenting strategies. Level five, on the other hand, involves an intensive 10-week training program for families struggling to cope with family distress alongside their child's severe behaviour problems (Sanders, 1999). The Incredible Years program aims to increase children's social-emotional competence and to reduce behavioural difficulties such as aggression (Webster-Stratton, 2001). Incredible Years has parent, teacher, and child training programs, with teachers and parents being taught strategies to manage difficult behaviour, problem-solving skills and ways to support positive relationships with their children/students. Puppet shows, role-playing and other play-based activities are used to teach children problem solving, social skills and emotion regulation skills to help reduce behavioural difficulties (Webster-Stratton, 2001). Both Triple P and

Incredible Years have been shown to effectively improve children's self-regulation by reducing externalising behaviour (Sanders et al., 2014; Webster-Stratton et al., 2008). The effectiveness of parenting programs for promoting self-regulation in children is understandable, given the importance of parent-child relationships for the development of executive functioning and emotion regulation (Morris et al., 2007; Roskam et al., 2014).

Interventions and programs incorporating mindfulness practices have also been used to promote self-regulation and executive functioning in children. (e.g. Flook et al., 2010; Jackman, 2016; Thierry et al., 2016; Zelazo et al., 2018). Mindfulness requires an individual to have awareness of the present moment and common elements of mindfulness-based programs include meditation and a focus on breathing (Leyland et al., 2019). Both of these practices require attentional control to maintain engagement and research suggests that engaging in meditation and breathing practices can improve attention in the long term (Tang et al., 2015). Improved emotion regulation may be a further benefit of engagement in mindfulness practices (Tang et al., 2015). Engaging in mindfulness practices has been associated with reductions in amygdala activity when presented with negative emotional stimuli, suggesting that mindfulness can lead to increased regulation of emotions (Lutz et al., 2014). Interventions such as the OpenMind (Jackman, 2016) and MindUp programs (Thierry et al., 2016) employ various mindfulness practices to support the development of children's cognitive and emotional regulation. The OpenMind program teaches children seven mindfulness practices, including breathing exercises, gratitude practices, yoga, and identification of emotions (Jackman et al., 2019). The MindUp program involves 15 mindfulness lessons ranging from deep breathing through to mindful eating practices to help support children to focus their attention (Thierry et al., 2016).

Aside from mindfulness, play-based programs have also been shown to promote self-regulation, particularly the cognitive aspects of self-regulation (e.g. Healey & Halperin, 2015;

Keown et al., 2020). Children learn a vast array of self-regulatory skills through play (Whitebread et al., 2009). Interventions such as the Red Light Purple Light (RLPL) program (Tominey & McClelland, 2011) and the Enhancing Neurobehavioural Gains with the Aid of Games and Exercise (ENGAGE) intervention (Healey & Halperin, 2015) incorporate many childhood games modified to enhance children's self-regulation. The RLPL program, for example, includes games such as The Freeze Game, which requires children to dance to music and freeze once the music has stopped. As the game progresses, new rules are added to make the game more complex. The ENGAGE program involves a similar game, known as Musical Statues as well as other common childhood games such as Simon Says, Leap Frog, and the card game Snap (Healey & Halperin, 2015). Games such as Musical Statues and Simon Says require children to attend to instructions and inhibit motor responses, both important executive functions required for self-regulation (Savina, 2014).

Another intervention that utilises play as a mechanism to support children's self-regulation is Tools of the Mind (Bodrova & Leong, 2007). Tools of the Mind was developed with the aim of improving children's executive functioning and academic achievement. The program encourages hands-on learning, pretend play with peers and incorporates various executive functioning promoting activities (Bodrova & Leong, 2007). Scaffolding from teachers also plays an important role in this program, with teachers helping to organise children's thinking during pretend play. Evidence suggests that the Tools of the Mind program may be an effective intervention for promoting the development of children's self-regulation (Blair et al., 2018).

In addition, physically demanding games may further promote self-regulation (Best, 2010). Games that involve exercise, such as soccer and tag, are inherently demanding on the brain and require a number of cognitive skills including task-switching, planning of movements, and retention of rules. Frequent engagement in physically demanding games

enhances these executive skills (Best, 2010). It is also thought that exercise enhances executive functioning through increased activity of the prefrontal cortex and increased grey matter production in the frontal lobe (Colcombe et al., 2006; Davis et al., 2011; Heatherton & Wagner, 2011). Studies examining the effect of physical activity on children's self-regulation have utilised a variety of exercise types. For example, Burkart et al. (2018) used locomotor activities such as running, skipping and hopping to assess the impact of exercise on pre-schoolers' self-regulation. Others have used dance, orienteering and trampoline-based activities to promote self-regulation (e.g. Xu et al., 2018; Zach et al., 2015).

Further interventions targeting children's self-regulation include social-emotional learning (SEL) programs. These programs typically aim to assist children with developing social skills, identifying emotions, perspective taking, relaxation skills, and problem-solving skills (Lawson et al., 2018). Examples of SEL interventions include the Promoting Alternative Thinking Strategies (PATHS) program (Kusché & Greenberg, 1994) and the Second Step program (Frey et al., 2000). PATHS consists of lessons focused on emotion recognition, strategies for calming down, and pro-social skills such as sharing with others (Fishbein et al., 2016). The lessons are taught by kindergarten teachers and incorporate role-playing to further build children's self-regulation. The Second Step program aims to reduce aggressive behaviour and promote social problem solving and emotion regulation in young children (Frey et al., 2000). The program utilises modelling from teachers and group discussions to help children develop social-emotional skills. Evidence suggests that both the Second Step program and the PATHS curriculum may effectively improve children's social-emotional functioning (e.g. Holsen et al., 2008; Humphrey et al., 2016)

It is evident that a large number of interventions have been developed with the aim to improve children's self-regulation. Many of these interventions target specific areas of self-regulation such as executive functioning, or children's behaviour. Given the large number of

studies examining self-regulation interventions and the wide range of outcomes targeted in these interventions, there is a need to consolidate the evidence of their effectiveness at improving children's self-regulation.

Culturally responsive practice

It is important that interventions aimed at promoting children's self-regulation are culturally responsive, meaning that the knowledge, values and frames of reference of other cultures are taken into consideration when developing interventions (Gay, 2010). In the New Zealand context, culturally responsive practice is particularly important given our bicultural society (Lourie, 2016). Māori are the indigenous people of New Zealand, with 17% of the current population identifying as Māori (Statistics New Zealand, 2021). Māori are also disproportionately represented in educational underachievement statistics and are less likely to feel a sense of belonging at school, compared to non-Māori New Zealanders (Ministry of Education, 2020). Incorporating Māori ways of being and worldviews into current education practices should therefore be a priority to ensure education services are culturally responsive to our Māori population.

The current early childhood curriculum in New Zealand, Te Whāriki, is one example of culturally responsive practice within mainstream early childhood education. Using the metaphor of a woven mat, the framework emphasises the importance of holistic development, relationships, family and community, and empowerment in early childhood education (Ministry of Education, 2017). These principles align with Māori models of wellbeing, such as Te Whare Tapa Whā, which highlights the importance of family and spirituality as well as physical and mental health for overall wellbeing (Durie, 1994). A qualitative study of Māori and Pasifika early childhood centre practices has also identified the importance of family and community relationships for children's development (Rameka et al., 2017). Common themes identified in the study that were deemed important for children's development and sense of

identity included knowledge of one's whakapapa, or genealogy, communal caregiving practices, and immersion in cultural practices such as waiata (Rameka et al., 2017).

Macfarlane et al. (2014) identified that an educational or community environment that reflects one's cultural values and creates a sense of identity contributes to Māori success and well-being. Cultural connectedness has also been linked to social-emotional development in young children (Kukutai, 2020). It is therefore important that Māori values and principles, such as those outlined in Te Whāriki and Rameka et al. (2017), are reflected in current practices aimed at promoting the development of our young people. This includes developing culturally responsive interventions aimed at supporting self-regulation for tamariki.

Previous reviews

A number of systematic reviews and meta-analyses have been carried out to assess the effectiveness of interventions and programmes aimed at promoting self-regulation. Reviews of self-regulation interventions have typically had a wide focus, with the studies included using a wide age range of participants and interventions which have been used across school, home, and community settings (e.g. Álvarez-Bueno et al., 2017; Neudecker et al., 2015; Pandey et al., 2018). Some reviews have also focused on specific populations of children such as those with Attention Deficit Hyperactivity Disorder (ADHD; e.g. Chimiklis et al., 2018; Neudecker et al., 2015).

Neudecker et al. (2015) conducted a systematic review examining the effectiveness of exercise-based programmes for promoting cognitive, motor and social-emotional development for children aged 18 and under diagnosed with ADHD. The authors reviewed 21 studies and found that studies that used a mixed method of exercise (such as running, jumping and ball games) showed the largest effects on ADHD symptomology. Although this review shows promising results for the effectiveness of exercise programs for children with ADHD, it is not clear whether the length of the exercise program, or the intensity of the

exercise is important. The studies examined in this review varied widely in terms of the design of their exercise interventions, making it difficult to determine the intensity and duration of exercise that is best for promoting social-emotional, cognitive, and motor development for children with ADHD. The review by Neudecker et al. (2015) also included a wide age range, meaning it is difficult to determine what interventions might work best for a particular age group like preschool-aged children, for example.

Other reviews have focused on specific types of self-regulation interventions, such as those focused on physical activity, mindfulness or social-emotional learning. A review by Wood et al. (2020) investigated the effects of physical activity interventions for improving preschool-aged children's attention, inhibitory control and working memory capabilities. Of the six identified studies, five showed that physical activity improved at least one aspect of children's executive functioning. A further review of physical activity interventions by Álvarez-Bueno et al. (2017) found similar results. Thirty-six studies were reviewed that examined the effect of physical activity on young people's executive functioning. Participants in the included studies were aged between four and 18 years old and had no psychiatric disorders. Twenty-nine of the included studies found that physical activity improved participants' executive functioning, particularly working memory ability and inhibitory control (Álvarez-Bueno et al., 2017).

Further reviews have investigated the impact of mindfulness programs on self-regulation. Mak et al. (2018) examined whether mindfulness interventions effectively improved children's executive functioning, such as task switching and sustained attention. Thirteen randomised control trials (RCTs) of mindfulness-based interventions, including yoga, meditation, and Tai Chi, were reviewed. Only five out of the 13 studies reported findings that demonstrated the effectiveness of mindfulness-based interventions at improving children's executive functioning. The authors suggest that more research is needed to

conclude that mindfulness-based interventions can effectively improve children's executive functioning (Mak et al., 2018). A further review by Sun et al. (2021) found more promising results. Sixteen studies were identified as examining the impact of yoga and mindfulness interventions on pre-schoolers self-regulation. Thirteen of the 16 included studies were found to show positive impacts of yoga or mindfulness on children's self-regulation, including both cognitive and social-emotional aspects. These results suggest that mindfulness-based interventions may effectively improve children's self-regulation (Sun et al., 2021).

Reviews of social and emotional learning (SEL) programs have also been conducted. Blewitt et al. (2018) investigated the effectiveness of social and emotional learning (SEL) programs at promoting the social and emotional competence and behavioural self-regulation of young children. SEL was defined as the application of skills related to social-emotional competence, relationship building, self-awareness, and self-management skills. The review included 79 studies, all with participants aged between two to six years and with SEL interventions that were delivered in early childhood settings. Results indicated that SEL programs effectively improved children's behavioural self-regulation and emotional and social competence in comparison to control groups (Blewitt et al., 2018).

A further review by Murano et al. (2020) found similar results. This review examined the effectiveness of universal SEL interventions, and SEL interventions targeted specifically for children identified as needing additional support. Forty-eight studies were included in this review, with 15 of these studies examining the effects of targeted SEL interventions. Meta-analysis showed that both universal and targeted interventions were effective in improving children's social-emotional functioning and for reducing behavioural problems (Murano et al., 2020). These results suggest that SEL interventions may be effective interventions for improving children's self-regulation skills.

Although many reviews have examined specific types of interventions (e.g. Álvarez-Bueno et al., 2017; Mak et al., 2018; Wood et al., 2020), a review by Pandey et al. (2018) has focused more broadly on universal or multi-method interventions. The review included 49 RCTs of self-regulation interventions. These interventions included programs based on the school curriculum, exercise-based interventions, mindfulness programmes, social skills building, and programmes involving parents and siblings. The studies reviewed included participants aged from two to 17 years old. Self-regulation was measured in a variety of ways across all studies, but the majority used reliable and valid assessment tools such as the Behaviour Rating Inventory of Executive Functions (BRIEF) or the Head Toes Knees Shoulders (HTKS) task. Curriculum-based interventions were the most common self-regulation interventions used across studies and were commonly used with preschool-aged children. Out of 21 studies examining curriculum-based self-regulation interventions, 16 studies reported significant improvements in children's self-regulation. Sixty-seven percent of studies that used physical exercise reported higher self-regulation in children who took part in the exercise interventions compared to control groups. Half of studies that examined the effectiveness of mindfulness interventions reported significant improvements in self-regulation, while 56% of studies that used family-based interventions such as parent skills training reported significant improvements in self-regulation. Finally, 66% of studies examining social skills training reported significant improvements in children's self-regulation (Pandey et al., 2018). Overall, this research suggests that self-regulation interventions of all types may be effective across a range of age groups and settings.

The present review

Although numerous systematic reviews have been conducted which examine the effectiveness of self-regulation interventions for children, very few reviews have focused solely on preschool-aged children or have looked at both cognitive and social-emotional

outcomes. Moreover, numerous reviews focus only on specific populations of children or specific types of interventions such as exercise and mindfulness-based programs (e.g. Chimiklis et al., 2018; Mak et al., 2018; Neudecker et al., 2015). While the review by Pandey et al. (2018) examined a wide range of universal self-regulation interventions, the studies included varied widely in terms of the age of participants, with preschool-aged children through to late adolescents participating. It is therefore difficult to determine the effects of self-regulation interventions for preschool-age children alone. It is important to examine the effectiveness of self-regulation interventions for preschool-aged children given the poor developmental trajectories of preschool-aged children with low self-regulation capabilities (e.g. Moffitt et al., 2011). The preschool period is also an important time period for the development of self-regulation skills (Montroy et al., 2016), therefore a systematic review focused solely on this age group is needed.

The present review adds to the current literature on self-regulation interventions by providing up to date information about the effectiveness of these interventions and provides an indication as to the effectiveness of these interventions for preschool-aged children. This systematic review aims to examine the effectiveness of self-regulation interventions at increasing preschool-aged children's cognitive and social-emotional functioning. This review also aims to identify specific intervention effects for different types of self-regulation interventions such as parenting-based programs, mindfulness interventions, and physical activity-based interventions. The review aims to address the following questions:

1. Do self-regulation interventions improve preschool-aged children's cognitive functioning?
2. Do self-regulation interventions improve preschool-aged children's social-emotional functioning?

3. Are there specific intervention effects for different types of self-regulation interventions?

Method

To examine whether self-regulation interventions can improve the social-emotional and cognitive functioning of pre-school aged children, a systematic review was conducted, in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Page et al., 2021)

Eligibility criteria

Studies were included in this review if they met the following criteria:

1. Participants were preschool or kindergarten age when they participated in the intervention. For this review, this was defined as being aged between two and five years old. Studies that included participants who were six years old were also included if they were still kindergarten age in the context in which the study was based.
2. The intervention or program was led either by parents or teachers. Interventions which involved the professional development of teachers or parenting programs led by specialist trainers were included in this review. Although these interventions may be led by a specialist or researcher, the direct implementation of the program with the children was being conducted by parents or teachers and is thus within the scope of the systematic review.
3. A randomised control trial (RCT) design was used to evaluate the impact of the intervention. To keep criteria broad to encompass all possible RCTs, there was no restriction on the composition of the comparison group (i.e., it could be business as usual or another intervention).

4. Studies were required to assess the effectiveness of the intervention to improve participants' cognitive and/or social-emotional functioning. For this review, cognitive functioning was defined as any quantitative measure of children's executive functioning, including working memory, attention, inhibitory control and cognitive flexibility. Studies examining effortful control were also included. Social-emotional functioning was defined as any quantitative measure of children's emotional regulation or quantitative measures of externalising behaviour such as impulsivity, hyperactivity, and aggression. These outcomes had to be measured both pre- and post-intervention for the study to be included in the systematic review. The post-intervention measure had to be undertaken within six weeks of the intervention concluding.

Studies were excluded if they were non-randomised or qualitative studies, or if they did not examine cognitive or social-emotional outcomes as described above. Studies where the researchers or specialist trainers directly conducted the intervention with children were excluded. Parent-led and teacher-led interventions were chosen in order to focus on the evidence base for interventions that are able to be resourced in 'real life' settings, thus ensuring the review focused on sustainable approaches to support children's self-regulation abilities.

Information sources

The databases that were searched for this systematic review were PsycINFO, MEDLINE, Scopus, and Education Source. These databases were systematically searched by the thesis author in July 2021. References were also identified through hand searching the reference lists of identified articles and review articles that were found during the initial search.

Search strategy

The search terms used for each database were “self-regulation” OR “self-control” OR “emotion* regulation” AND “random*”. For the search carried out in the PsycINFO database, the search was narrowed to include only studies that included preschool-age subjects (age two to five years). For Education Source, Scopus and MEDLINE searches, the additional search terms “preschool*”, “kindergart*” OR “early childhood” were used as these databases did not include subject age as a narrowing factor. The search in all databases was limited to only those published in English and those published in academic journals.

Selection process

The selection of articles for this systematic review followed the PRISMA guidelines (Page et al., 2021). Articles identified using the above search terms were exported into the referencing software EndNote 20. Duplicates were removed and the titles and abstracts of the remaining articles were assessed against the eligibility criteria for this review. Those that did not meet criteria were removed. The full articles of the remaining articles were assessed against the eligibility criteria. Those that did not meet criteria were removed, with reasons for removal noted.

Data collection

Data from each study was retrieved independently by the thesis author using the data collection form for intervention reviews of RCTs from the Cochrane Collaboration (Cochrane, 2014). Data was retrieved for the following categories: the author and publication year, characteristics of the participants, description of the interventions and comparison groups, the social-emotional functioning and/or cognitive outcomes measured, and the main statistical findings, including mean scores and standard deviations of pre- and post-assessment measures and effect sizes where present. Once extracted, the characteristics of

each study (excluding the main findings) were tabulated into summary tables with studies grouped in terms of the type of intervention.

Risk of bias assessment

To assess the risk of bias in the included studies, the Cochrane risk-of-bias tool for randomised control trials was used (Higgins et al., 2011). This tool examines the risk of bias for each study based on seven categories: the generation of random sequencing, how allocations to groups were concealed, how blinding of both participants and personnel as well as outcome assessors was carried out, how incomplete outcome data was handled and whether there was any selective reporting or other bias present. For this review, the domain examining the blinding of participants was not assessed due to the nature of the interventions being examined. It was not feasible for participants to be blinded in the included studies as children and any parent or teachers directly implementing the intervention needed to be aware of the intervention they were receiving or providing. The risk of bias for each category was rated as low, high, or unclear if there was insufficient evidence to assess the risk. The overall risk of bias for each study was also determined. If one or more domains were assessed to be high risk, the overall risk of bias for the study was deemed high. If all domains were rated as low risk, the overall risk of bias in the study was deemed low. If two or more domains were rated as ‘unclear’ due to insufficient information, with the rest of the domains rated as low risk, the overall risk of bias for the study was deemed to be unclear.

Results

Study selection

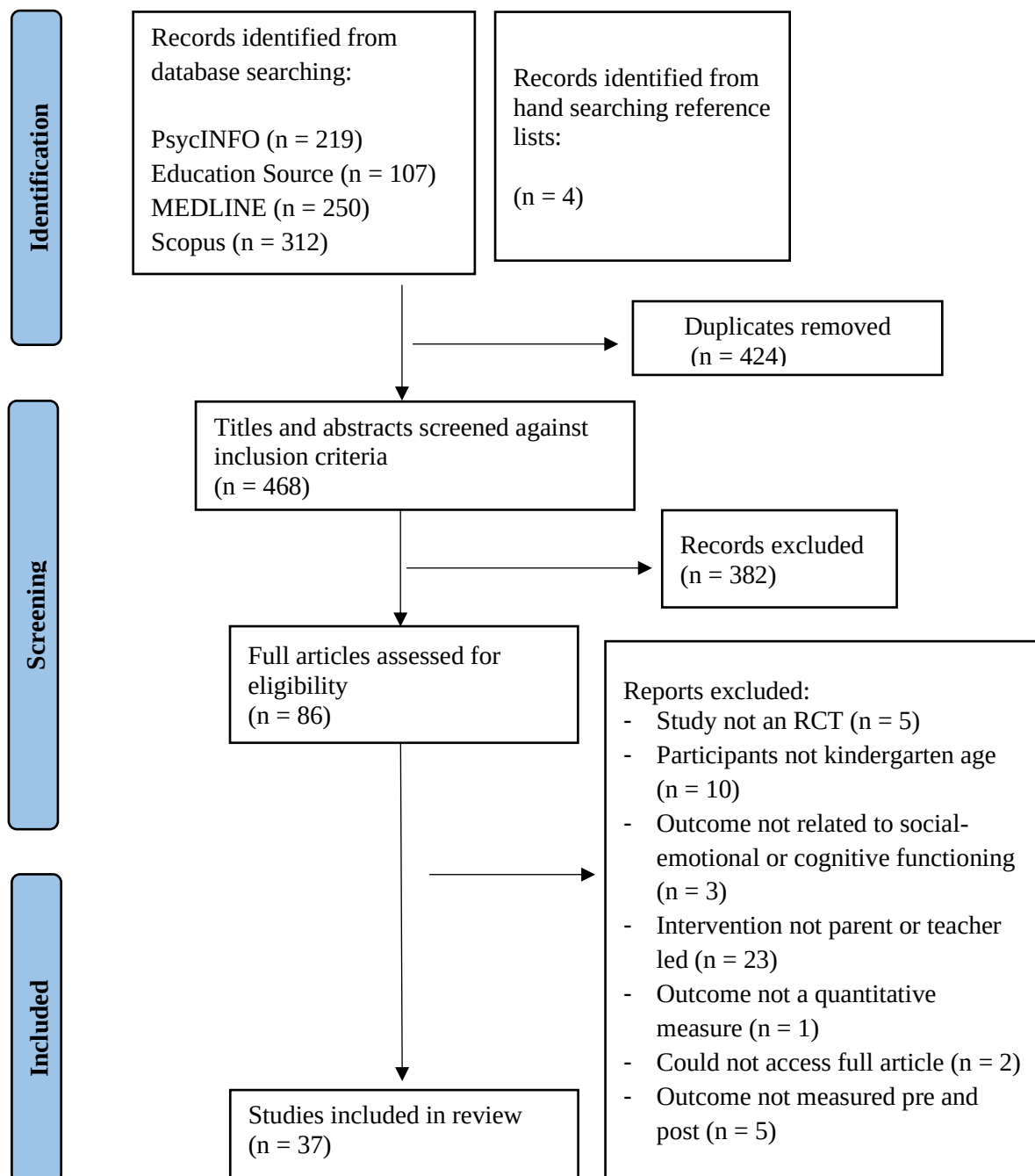
Initial searching of databases identified a total of 888 articles. After removing any duplicates, the titles and abstracts of the remaining 468 articles were screened against the inclusion criteria for this review. Those that did not meet inclusion criteria ($n = 382$) were

removed, and the remaining 86 full articles were assessed for eligibility. Forty-six full articles were excluded as they did not meet inclusion criteria. The majority of those excluded were due to the intervention not being primarily delivered by either parents or teachers ($n = 23$). Studies by Lumeng et al. (2017), Razza et al. (2020), Tamm et al. (2019) and Webster-Stratton et al. (2011) appeared to meet criteria but were excluded from this review as only a small component of the intervention was delivered by parents and/or teachers, with specialist trainers or the researchers conducting the majority of the intervention. A further study by Healey and Healey (2019) was included, despite children being taught the intervention games by researchers, as the majority of the intervention was implemented by parents.

Figure 1 shows the process of selecting articles for this review and includes a full list of the reasons for the exclusion of full articles. A total of 37 articles were included in this review. Thirty of these studies examined at least one social-emotional aspect of self-regulation as an outcome of the study. Twenty-two studies examined at least one cognitive aspect of self-regulation as an outcome of the study. Studies were conducted across multiple countries, with more than half ($n = 20$) being carried out in the USA. A further five studies were conducted in Australia, two each in China and New Zealand, and one study each in Israel, Iran, Brazil, Korea, Canada, Germany, Chile and Finland. Seven different types of interventions and programmes were identified in the 37 studies. These included physical activity interventions, parenting programs, mindfulness-based interventions, play-based interventions, social-emotional learning programs, interventions involving professional development for teachers, and multi-method interventions.

Physical activity interventions

Two studies by Burkart et al. (2018) and Xu et al. (2018) were identified that assessed the effectiveness of physical activity interventions at improving children's self-regulation. The characteristics of these two studies are provided in Table 1. Information regarding the

Figure 1*Process of Selecting Articles*

risk of bias in these studies is presented in Table 2. Both of these studies examined the effects of physical activity on children's executive functioning. Burkart et al. (2018) also examined social-emotional outcomes.

Table 1

Characteristics of Studies with Physical Activity Interventions

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Burkart et al. (2018) USA	71 children M age = 4.5 years, SD = 0.7	Locomotor-based physical activity	Unstructured free play time	Hyperactivity Aggression	Inhibitory control Inattention	BASC-2	Go / No task BASC-2
Xu et al. (2018) China	57 children M age = 4.40, SD = 0.29	10-week trampoline training program	School as usual	n/a	Inhibitory control Cognitive flexibility Working memory	n/a	FIST SCA task Go/No Go WMS task

Note. SE = Social-emotional, Cog. = Cognitive, n/a = not applicable, BASC-2 = Behaviour Assessment Scale for Children – 2nd edition, FIST = Flexible Item Selection Task, SCA = Spatial Conflict Arrow, WMS = Working Memory Span

Xu et al. (2018) examined the impact of a trampoline-based intervention on children's executive functioning. Fifty-seven preschool-aged children were randomly assigned to either 20 minutes of exercise on a trampoline or to business-as-usual. Children's inhibitory control,

Table 2*Risk of Bias Assessment for Studies with Physical Activity Interventions*

Author	Risk of Bias							Overall Risk
	Random Sequence Generation	Allocation Concealment	Blinding Outcome Assessor	SE outcomes	Cog. outcomes	Incomplete Outcome Data	Selective Reporting	Other Bias
Burkart et al. (2018)	Low	?	High	Low		Low	Low	Low
Xu et al. (2018)	Low	Low	n/a	Low		Low	Low	Low

Note. Low = Low Risk, High = High risk, ? = unclear risk, SE = social-emotional, Cog. = cognitive, n/a = not applicable

cognitive flexibility and working memory abilities were examined pre- and post-intervention by a trained researcher blind to participants' group assignment. The tasks used to examine these executive functions included a computerised spatial conflict task, a Go/No Go task, the Flexible Item Selection (FIS; Jacques & Zelazo, 2001) task and a working memory span task. Results showed no differences in performance on any of the tasks between those in the intervention group and those in the control, indicating no impact of the intervention on children's executive functioning (Xu et al., 2018). The overall risk of bias in this study was classified as low.

A further study by Burkart et al. (2018) investigated the effectiveness of physical activity for improving both social-emotional and cognitive functioning of children. Forty-six children were randomly assigned to receive either 30 minutes a day of physical exercise

involving a locomotor skill such as running and skipping, and the remaining 32 children were assigned to have 30 minutes of unstructured free play each day for six months. Children's hyperactivity, inattention and aggression levels were rated by teachers before and after the intervention using the Behaviour Assessment System for Children (BASC-2). Inhibitory control was also examined using a computerised Go/No Go task. Results indicated that children who were assigned to the physical activity intervention had decreased hyperactivity, aggression and attention problems post-intervention, as rated by teachers ($p < .001$, $p < .01$ and $p < .001$, respectively). On the other hand, scores on the Go/No Go task were not significantly different between the intervention and control groups. Overall, the physical activity intervention effectively improved participants' classroom behaviour but had no impact on children's inhibitory control (Burkart et al., 2018).

In terms of the risk of bias for this study, the overall risk of bias was deemed to be high. No information was provided regarding allocation concealment in the study, making it difficult to determine whether bias may have occurred during the selection of participants. Furthermore, the nature of the measures used in this study may have resulted in bias. Although one outcome was measured using a computerised task, the majority of the outcomes in this study were assessed by teachers. As teachers implemented the intervention, it is possible that their reports of children's behaviour may have been influenced by the knowledge of which children were in the intervention versus the control group.

Overall, these studies showed limited evidence of the impact of physical activity on children's cognitive functioning. With regard to social-emotional functioning, although Burkart et al. (2018) found positive impacts of physical activity on children's behaviour, the fact that assessors were not blind to participants' group assignment may have biased the reporting of children's behaviour. More evidence is therefore needed to confirm the

effectiveness of physical activity on social-emotional and cognitive aspects of children's self-regulation.

Parenting programs

Nine studies were identified as investigating the impact of parenting programs on children's self-regulation. The characteristics of these studies are included in Table 3. The risk of bias assessment for each of these studies is presented in Table 4. All of these studies examined externalising behaviour, such as aggression, hyperactivity and impulsivity, as an outcome of their study. Externalising behaviour was commonly measured by the BASC-2, the Eyberg Child Behaviour Inventory (ECBI) and the Child Behaviour Checklist (CBCL). Two studies by Aghaie Meybodi et al. (2019) and Herbert et al. (2013) investigated the impact of parenting programs on children's emotion regulation as well as externalising behaviour. In addition, two studies by Somech and Elizur (2012) and Weisleder et al. (2018) investigated the impact of intervention on aspects of children's cognitive functioning.

Two studies by Aghaie Meybodi et al. (2019) and Havighurst et al. (2013) were identified as examining the effectiveness of the Tuning in to Kids (TIK) program for improving social-emotional aspects of children's self-regulation. The TIK program aims to promote responsive parenting and emotional competence in parents and, in turn, reduce disruptive behaviour in children (Havighurst et al., 2009). Aghaie Meybodi et al. (2019) examined the effectiveness of the TIK program at improving Iranian children's behaviour and emotion regulation skills. Fifty-four parents were randomly assigned to take part in the TIK program for two hours each week for six weeks or were assigned to a waitlist control group. There were 27 participants in each condition. The ECBI and ERC were used to assess children's behaviour and emotion regulation, respectively. Both of these measures were completed by mothers. Results showed that children whose parents took part in the TIK

Table 3*Characteristics of Studies with Parenting Programs*

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Aghaie Meybodi et al. (2019) Iran	54 children with clinical levels of externalising behaviour M age = 4.33, SD = 0.93	TIK	Waitlist Control	Externalising behaviour Emotion regulation	n/a	ECBI ERC	n/a
Connell et al. (1997) Australia	24 children M age = 4.27, SD = 1.10	Self-directed Triple P	Waitlist Control	Externalising behaviour	n/a	ECBI PDRC	n/a
Havighurst et al. (2013) Australia	54 children with clinical scores on ECBI intensity score M age = 4.94, SD = 0.62	TIK	Usual paediatric care	Externalising behaviour	n/a	ECBI	n/a
Herbert et al. (2013) USA	31 children Hyperactive M age = 4.58, SD = 0.9	Parenting Your Hyperactive Preschooler Program	Waitlist Control	Externalising behaviour Emotion regulation	n/a	ERC BASC-2 DBRS	n/a
Kong & Au (2018) China	52 children with developmental disability M age = 4.71, SD = 0.93	Incredible Years	Waitlist Control	Externalising behaviour (ODD symptoms)	n/a	CBCL	n/a

Note. SE = Social-Emotional, Cog = Cognitive, n/a = not applicable, TIK = Tuning in to Kids, ECBI = Eyberg Child Behaviour Inventory, ERC = Emotion Regulation Checklist, BASC-2 = Behaviour Assessment Scale for Children – 2nd Edition, PDRC = Parent Daily Report Checklist, DBRS= Disruptive Behaviour Rating Scale, ODD = Oppositional Defiant Disorder, CBCL = Child Behaviour Checklist

Table 3 continued

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Sheridan et al. (2010) USA	220 Children M age = 3.59, SD = 0.30	Getting Ready Intervention	BAU	Behavioural concerns	n/a	DECA SCBE-30	n/a
Somech & Elizur (2012) Israel	209 children M age = 4.05, SD = 0.58	Hitkashrut	Minimal support control group	Conduct problems	Effortful control	ECBI	CBQ
Tully & Hunt (2017) Australia	69 Children M age = 2.58, SD = 0.43	Standard Triple P Brief Triple P	Waitlist	Aggression Disruptive behaviour		CBCL Observation PA-SEC	
Weisleder et al. (2018) Brazil	566 children M age = 3.12, SD = 0.54	Universidade do Bebê (UBB)	BAU	Externalising behaviour	Working memory	CBCL	Working Memory Task

Note. SE = Social-Emotional, Cog = Cognitive, ECBI = Eyberg Child Behaviour Inventory, CBCL = Child Behaviour Checklist, BAU = Business as Usual, DECA = Devereux Early Childhood Assessment, SCBE-30 = Social Competence and Behaviour Evaluation, CBQ = Child Behaviour Questionnaire, PA-SEC= Physical Aggression Scale for Early Childhood

program had reduced externalising behaviour post-intervention compared to pre-intervention ($p < .001$, $\eta_p^2 = .17$). No significant differences in behaviour were found for children of parents in the control group. There were no statistical differences found between pre- and post-intervention scores on the ERC for either group (Aghaie Meybodi et al., 2019).

Havighurst et al. (2013) also found positive effects of the TIK program on preschool-aged children's behaviour. Parents who took part in the TIK program reported their children had lower intensity of behaviour problems post-intervention compared to parents in the control group ($p = .009$, $\eta_p^2 = .16$), as measured by the ECBI (Havighurst et al., 2013). These

Table 4*Risk of Bias Assessment for Studies with Parenting Programs*

Author	Risk of Bias							Overall Risk
	Random Sequence Generation	Allocation Concealment	Blinding	Outcome Assessor	Incomplete Outcome Data	Selective Reporting	Other Bias	
			SE	Cog.				
Aghaie Meybodi et al. (2019)	Low	?	High	n/a	?	Low	Low	High
Connell et al. (1997)	Low	?	High	n/a	Low	Low	Low	High
Havighurst et al. (2013)	Low	Low	High	n/a	Low	Low	Low	High
Herbert et al. (2018)	Low	Low	High	n/a	Low	Low	Low	High
Kong & Au (2018)	Low	?	High	n/a	Low	Low	Low	High
Sheridan et al. (2010)	Low	?	High	n/a	Low	Low	Low	High
Somech & Flizur (2012)	Low	?	High	High	Low	Low	Low	High
Tully & Hunt (2017)	Low	Low	High	n/a	Low	Low	Low	High
Weisleder et al. (2018)	Low	?	High	Low	Low	Low	Low	High

Note. Low = Low Risk, High = High risk, ? = unclear risk, SE = social-emotional outcomes, Cog. = cognitive outcomes, n/a = not applicable

results suggest that the TIK program may be an effective intervention for improving kindergarten children's behaviour (Aghaie Meybodi et al., 2019; Havighurst et al. 2013).

A further two studies included in this review examined the effectiveness of the Positive Parenting Program (Triple P; Sanders, 1999) for improving children's self-regulation. Triple P aims to reduce emotional and behavioural difficulties in young children by teaching parents behavioural management strategies and ways to promote positive and nurturing relationships with their children (Sanders, 1999). The first of these studies, by Connell et al. (1997), examined whether self-directed Triple P could lead to improvements in children's behaviour. Twelve parents were randomly assigned to self-directed Triple P for 10 weeks and a further 11 parents were assigned to a waitlist control group. Parents in the intervention condition received the program's workbook and were asked to read and complete the tasks within the workbook each week for 10 weeks. Examples of tasks and topics within the program include monitoring children's behaviour, creating clear rules in the home, using reward charts for good behaviour and spending quality time with children. Children's behaviour was measured using the intensity and problem score scales of the ECBI and the Parent Daily Report Checklist (PDRC). Both measures were completed by mothers and fathers (Connell et al., 1997).

Results showed that children whose parents took part in Triple P had lower intensity scores post-intervention compared to pre-intervention, as rated by both mothers and fathers ($p = .0005$ and $p = .002$ respectively) (Connell et al., 1997). These post-intervention intensity scores were also significantly lower for those in the intervention group compared to those whose parents were in the control group ($p = .0005$ for both mother and father reports). Children whose parents received Triple P also had lower problem scores post-intervention compared to those in the waitlist, as rated by both mothers and fathers ($p = .0005$ and $p =$

.020 respectively). These results indicate that self-directed Triple P was effective in reducing child problem behaviours (Connell et al., 1997).

The second study to examine the effectiveness of Triple P for promoting self-regulation in preschool children was by Tully and Hunt (2017). The aim of this study was to investigate whether Triple P reduced aggression in preschool-aged children. Participants were assigned to receive one of three conditions: standard Triple P, brief Triple P or were assigned to a waitlist. There were 23 participants in the standard condition, 24 in the brief condition and 22 in the waitlist condition. Standard Triple P involved intensive group sessions where parenting skills were taught to parents, while brief Triple P involved group discussions with fewer skills being taught to parents. Children's behaviour was assessed using the aggressive behaviour scale of the Child Behaviour Checklist (CBCL) and the Physical Aggression Scale for Early Childhood (PA-SEC). Both these measures were completed by mothers and their partners. An observational measure was also used to assess children's aggression levels and other disruptive behaviours such as non-compliance. Parents and their children were observed doing a number of tasks such as cleaning up toys and completing puzzles, with these observations then coded by researchers blind to the participants' group assignment (Tully & Hunt, 2017).

Tully and Hunt (2017) found that children whose parents had been assigned to standard Triple P had lower aggression levels on the CBCL and PA-SEC at post-intervention compared to those in the waitlist ($p < .01$, $d = -0.82$ and $p < .01$, $d = -0.89$ respectively). This was based on mother reports only, with no significant differences between groups found for aggression rated by fathers or partners. No statistical differences in aggression were found between those in the brief intervention compared to the waitlist group. Furthermore, children whose parents received standard Triple P showed fewer aggressive and disruptive behaviour during the observation than did those in the brief intervention and the waitlist group ($p < .01$,

$d = -1.02$). These results indicate that standard Triple P can effectively reduce children's aggression levels and that this level of Triple P may be more effective than when Triple P is provided in a brief format (Tully & Hunt, 2017).

Additional parenting programs identified in this review include the Parenting Your Hyperactive Preschooler (PYHP) program (Herbert et al., 2013), Incredible Years (Kong & Au, 2018), the Getting Ready intervention (Sheridan et al., 2010), Universidade do Bebê (UBB; Weisleder et al., 2018) and Hitkashrut (Somech & Elizur, 2012). The PYHP program involved teaching parents strategies to manage their child's behaviour and improve their emotion regulation (Herbert et al., 2013). Seventeen parents were assigned to receive 14 sessions of PYHP and a further 14 were assigned to a waitlist. Children's behaviour was assessed using the BASC-2, the Disruptive Behaviour Rating Scale (DBRS) and the ERC. All three measures were completed by parents (Herbert et al., 2013).

At post-intervention, children whose parents received PYHP had significantly reduced externalising behaviour at post-intervention compared to those in the waitlist, as measured by the BASC-2 ($p < .035$, $d = 0.48$) (Herbert et al., 2013). Children of parents in the intervention group also had significantly lower ratings of hyperactivity and oppositional behaviour than those in the waitlist ($p = .008$, $d = 0.71$ and $p = .046$, $d = 0.44$ respectively). Finally, children of parents in the intervention group had significantly lower ratings on the lability/negativity subscale of the ERC at post-intervention, compared to those in the waitlist ($p = .039$, $d = 0.45$). No significant differences were found between groups at post-intervention for scores on the emotion regulation subscale of the ERC. These results suggest that the PYHP program is an effective intervention for managing disruptive and hyperactive behaviour in young children and may also help to improve children's emotion regulation (Herbert et al., 2013).

Kong and Au (2018) also found positive impacts on children's behaviour after their parents received a parenting intervention. This study examined the effectiveness of the

Incredible Years program for children with developmental disabilities. Children whose parents took part in Incredible Years had significantly less oppositional behaviour post-intervention compared to those in the waitlist, as rated by both mothers ($p = .019$, $\eta_p^2 = 0.12$) and their partners ($p = .002$, $\eta_p^2 = 0.21$) (Kong & Au, 2018).

Not all studies of parenting programs identified in this review found positive impacts on children's self-regulation. A study by Sheridan et al. (2010) investigated the impact of the Getting Ready intervention, which supports parents to engage warmly and effectively with their children. This intervention was led by teachers who visited parents at their homes throughout the year, providing strategies to improve the parent-child relationship. The self-control and behavioural concerns scales of the Devereux Early Childhood Assessment (DECA) and the aggression scale of the Social Competence and Behaviour Evaluation (SCBE-30) were used to assess children's behaviour. Results found no significant impact of the intervention on scores on the self-control and behavioural concerns scales of the DECA. Additionally, no impact of the intervention on children's aggression was found (Sheridan et al., 2010).

Weisleder et al. (2018) also found no impact of a parenting-based program, called Universidade do Bebê (UBB), on children's social-emotional functioning. Parents were assigned to receive monthly workshops aimed at promoting shared reading and positive parent-child interactions or were assigned to business as usual. Children's behaviour was examined before and after the intervention using the CBCL. No differences between groups were found on the CBCL post-intervention, suggesting the intervention had no impact on children's behaviour (Weisleder et al., 2018). This study did, however, examine cognitive outcomes as well. Children's working memory abilities were examined pre- and post-intervention. Results showed that children of parents in the intervention group had higher scores on the working memory task post-intervention than did controls ($p < .001$). This

suggests that the UBB intervention may be an effective intervention for improving children's working memory but not for improving children's behaviour (Weisleder et al., 2018)

The final study identified as examining the impact of a parenting program on children's self-regulation also examined both social-emotional and cognitive outcomes. Somech and Elizur (2012) investigated whether a parenting program called Hitkashrut could reduce conduct problems in young children. This program involved 14, two-hour group parenting sessions with a focus on building communication skills and strategies to manage difficult behaviour. 140 parents were randomly assigned to receive Hitkashrut, and 69 parents were assigned to a minimal support group where parents received only two sessions of Hitkashrut. Children's behaviour was measured using the ECBI. For cognitive functioning, the Children's Behaviour Questionnaire (CBQ) was used to assess children's effortful control, including their inhibitory control and attention.

Somech and Elizur (2012) found that children whose parents took part in Hitkashrut had fewer conduct problems and greater effortful control at post-intervention compared to pre-intervention ($p < .001$, $d = 0.76$ and $p < .001$, $d = 0.47$ respectively). No significant changes from pre- to post-intervention were found for children whose parents took part in the minimal support group. These results indicate that Hitkashrut effectively improved both child behaviour and cognitive functioning (Somech & Elizur, 2012).

In summary, seven of the nine studies that examined parenting programs found positive impacts on children's social-emotional functioning including reductions in externalising behaviour such as aggression. Of the two studies to examine the impact of parenting programs on children's cognitive functioning, both found positive effects on children's executive functioning. These findings suggest that parenting programs may be effective ways to improve children's self-regulation. It should be noted however that all nine studies were rated as having a high risk of bias due to the reliance on parent report. As

parents were engaged in these interventions, it is possible that their reports of their child's behaviour may have been subject to expectancy bias. This should be taken into consideration when interpreting the results of these studies.

Mindfulness-based interventions

Three of the 37 included studies investigated the impact of mindfulness-based interventions on children's self-regulation. The characteristics of these three studies are presented in Table 5. The risk of bias assessment conducted for each of these studies is presented in Table 6.

Two of these studies by Jackman et al. (2019) and Zelazo et al. (2018) examined the impact of mindfulness interventions on cognitive aspects of children's self-regulation. Jackman et al. (2019) examined the effect of the OpenMind program on children's executive functioning. OpenMind (OM; Jackman, 2016) uses daily meditation, gratitude practices and yoga to promote social and emotional learning in children. One hundred and sixty-three children were randomly assigned to OM, with a further 120 children assigned to a play-based curriculum, called High Scope. Teachers implemented the OM program in the classroom for a period of a year. Teachers and parents of the children were also encouraged to engage in meditation each day. The Head Toes Knees Shoulders (HTKS) task was used to assess children's inhibitory control, attention and working memory. This task requires children to respond in the opposite way to what they are told. A Go/No Go task was also used to assess inhibitory control. Finally, the Behaviour Rating Inventory of Executive Function - Preschool version (BRIEF-P) was used to further assess participants' executive functioning (Jackman et al., 2019).

Results showed that children who received OM improved significantly at the HTKS from pre- to post-intervention compared to those who received the High Scope curriculum (p

Table 5*Characteristics of Studies with Mindfulness-Based Interventions*

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Jackman et al. (2019) USA	283 children M age = 3.66, SD = 0.5	OpenMind	High Scope Curriculum	n/a	Inhibitory control Working memory Attention Cognitive flexibility	n/a	HTKS BRIEF-P
Kim et al. (2020) Korea	83 children All 3 years of age at baseline	OpenMind	BAU	Emotion regulation	n/a	ERC	n/a
Zelazo et al. (2008) USA	218 children M age = 4.75, SD = 0.31	Mindfulness and Reflection Literacy Group	BAU	n/a	Inhibitory control Working memory Attention Effortful control	n/a	HTKS Peg Tapping task MEFS CBRS

Note. SE = Social-Emotional, Cog = Cognitive, n/a = not applicable, ERC = Emotion Regulation Checklist, BAU = Business as Usual, HTKS = Head Toes Knees Shoulders, BRIEF-P = Behaviour Rating Inventory of Executive Function Preschool version, CBRS = Child Behaviour Rating Scale (CBRS), MEFS = Minnesota Executive Function Scale

Table 6*Risk of Bias Assessment for Studies with Mindfulness-Based Interventions*

Author	Risk of Bias							Overall Risk
	Random Sequence Generation	Allocation Concealment	Blinding Outcome Assessor	Outcome	Incomplete Outcome Data	Selective Reporting	Other Bias	
			SE outcomes	Cog. outcomes				
Jackman et al. (2019)	?	?	n/a	High	?	Low	Low	High
Kim et al. (2020)	High	?	High	n/a	Low	Low	Low	High
Zelazo et al. (2018)	Low	?	n/a	Low	Low	Low	Low	Low

Note. Low = Low Risk, High = High risk, ? = unclear risk, SE = social-emotional, Cog. = cognitive, n/a = not applicable

= .018) (Jackman et al., 2019). Both groups showed improvements in scores on the Go/No Go task over time. However, there were no significant differences over time in inhibitory self-control and overall executive functioning, as measured by the BRIEF-P for either group. Furthermore, children in the OM condition had decreased cognitive flexibility scores on the BRIEF-P post-intervention compared to children in the High Scope condition (Jackman et al., 2019).

It is possible that improvements in HTKS and Go/No Go scores, but not BRIEF-P scores may be due to the nature of these assessments. The HTKS task and the Go/No Go task

are objective measures of executive functioning. On the other hand, the BRIEF-P was completed by teachers who were also implementing the intervention and therefore were not blind to the children's group assignment (Jackman et al., 2019). As a result, their assessments of children's executive functioning may have been biased due to the knowledge of children's group assignment. There was also a high rate of teacher turnover during this study. This means it is possible that the different teachers may have completed the BRIEF measure pre- and post-intervention, making it more difficult to determine any changes in children's executive functioning. Due to the subjective nature of the BRIEF-P and the high rate of teacher turnover in Jackman et al. (2019), the risk of bias for this study was assessed to be high. In addition, there was a lack of information provided regarding random sequence generation, allocation concealment and the handling of missing data, further adding to the risk of bias.

The second study to examine cognitive functioning as an outcome was conducted by Zelazo et al. (2018). In this study, children were assigned to one of three conditions: mindfulness and reflection, a literacy group, or to business as usual. There were 72 children assigned to the mindfulness condition, 76 to the literacy group and a further 68 to business as usual. Those assigned to mindfulness and reflection engaged in a variety of mindfulness activities for 24 minutes a day for six weeks. Children's cognitive functioning was examined using the HTKS task, the Child Behaviour Rating Scale (CBRS), a peg-tapping task and the Minnesota Executive Function Scale (MEFS). Results showed no statistical differences in scores on the CBRS, the peg-tapping task or the MEFS between groups at post-intervention. There was also no significant effect of intervention on scores on the HTKS task at post-intervention, although the mindfulness group did have significantly higher scores on the HTKS at follow-up compared to the literacy and control groups. These results indicate that the mindfulness intervention may not be effective in improving children's executive

functioning initially, but may show promise at improving executive functioning in the weeks after the intervention has concluded (Zelazo et al., 2018). The overall risk of bias in Zelazo et al. (2018) was assessed to be low.

The final study identified that investigated the impact of mindfulness on self-regulation was conducted by Kim et al. (2020). This study examined the effectiveness of the OM program for improving pre-schoolers' emotion regulation. Forty-two children took part in OM each day at school with a further 41 children receiving the standard school curriculum to form a control group. The adaptive regulation and lability/negativity subscales of the ERC were completed by classroom teachers to assess children's emotion regulation. Results showed that children in the intervention condition had improved adaptive regulation at post-intervention compared to baseline ($p < .01$, $d = 0.40$). However, the children in the control group also showed significant improved adaptive regulation from baseline to post-intervention ($p < .01$, $d = 0.70$), with further analysis indicating these scores were higher for the control group at post-test than the scores of children in the intervention condition ($p < .001$, $\eta^2 = 0.16$) (Kim et al., 2020).

Children in the control condition were also found to have lower lability/negativity scores at post-intervention than children in the intervention condition ($p < .001$, $\eta^2 = 0.31$). Despite the control group having better adaptive regulation and lability/negativity scores at post-intervention, further analyses at six months post-intervention and one year post-intervention showed significant decreases in lability/negativity scores for the intervention group indicating less emotion dysregulation over time. The control group, on the other hand, had increasing lability/negativity scores at six months post and one year post-intervention. Children in the intervention condition also showed an increasing trend for adaptive regulation scores at both follow-up time points, while those in the control group showed a pattern of decreasing adaptive regulation scores (Kim et al., 2020).

These results suggest that, over time, children in the OM group had greater improvements in emotion regulation than those in the control condition. The OM program may therefore be an effective program for improving children's emotion regulation, but the effects may not be immediate (Kim et al., 2020). It is important to note, however, that the risk of bias in Kim et al. (2020) was assessed to be high. There were significant differences between the control and intervention groups on baseline measures. Children in the control group had significantly higher scores on the adaptive regulation subscale and lower scores on the lability/negativity subscale of the ERC at baseline, indicating they had better emotion regulation at baseline than those in the intervention condition. This indicates possible issues with the randomisation process that may have biased the outcomes of the study. There was also no information provided regarding allocation concealment. Furthermore, emotion regulation of participants was assessed by teachers. As teachers were implementing the intervention, it is possible that their ratings of children's emotion regulation may have been biased.

Overall, it is difficult to determine the effect of mindfulness-based interventions on children's social-emotional and cognitive functioning due to the poor quality of studies identified in this review. While Jackman et al. (2019) and Kim (2020) found positive impacts of mindfulness on aspects of children's self-regulation, both studies had methodological issues which may have impacted the findings of the studies. Only the study by Zelazo et al. (2018) was identified as having a low risk of bias. Although this study showed that mindfulness may improve children's executive functioning over time, more research is needed to confirm the efficacy of mindfulness interventions for improving cognitive aspects of children's self-regulation.

Play-based interventions

Six studies were identified that examined the effect of play-based interventions on children's social-emotional and cognitive functioning. The characteristics of these studies are presented in Table 7. The risk of bias assessment for each study is presented in Table 8.

Three studies by Blair and Raver (2014), Blair et al. (2018) and Solomon et al. (2018) examined the Tools of the Mind program. The Tools of the Mind program uses play activities such as role-playing in groups and activities which involve movement and the use of symbols to promote self-regulation and abstract thinking in young children (Barnett et al., 2008). Teachers play an important role in scaffolding children's thinking by supporting them to develop play plans (Barnett et al., 2008). This might include helping a child to think about the role they will play or what will happen next in a role-play with other children.

Blair and Raver (2014) examined whether Tools of the Mind could increase children's self-regulation and academic ability. Children were randomly assigned to receive Tools or were assigned to business as usual. Three tasks were used to assess children's inhibitory control and cognitive flexibility. Children's accuracy scores and their reaction times on these tasks were then combined to create executive functioning composites. Working memory was also assessed, however, this was only examined at post-test. Results showed that children in the Tools condition had faster reaction times on the three tasks at post-test compared to those in the control condition ($p < .05$, effect size = 0.12). There was no effect of the intervention on children's accuracy on the three tasks (Blair & Raver, 2014).

A further study by Solomon et al. (2018), found that Tools of the Mind improved children's executive functioning post-intervention but only for children who had higher ratings of hyperactivity at baseline. Children were assigned to receive either Tools of the Mind or another play-based intervention called Playing to Learn. Executive functioning was examined using the HTKS task and the Day/Night task, which assesses interference control.

Table 7*Characteristics of Studies with Play-Based Interventions*

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Blair et al. (2014) USA	759 Children M age = not listed	Tools of the Mind	BAU	n/a	EF	n/a	DCCS Hearts and Flowers Task Flanker task
Blair et al. (2018) USA	759 children M age = 5.75, SD = 0.3	Tools of the Mind	BAU	Aggression Self-regulation Emotion regulation Behaviour problems	n/a	TSCRS SDQ ERC	n/a
Healey & Healey (2019) NZ	65 children M age = 3.8 SD = 0.55	ENGAGE	Triple P	Hyper-activity Aggression	Attention problems Inhibitory control	BASC-2	HTKS NEPSY
Keown et al. (2020) NZ	213 children M age = 4.38 SD = 0.24	RLPL intervention	BAU	Behavioural Self-regulation	Inhibitory control Attention Working memory Cognitive flexibility	CBRS	DCCS HTKS

Note. SE = Social-Emotional, Cog = Cognitive, n/a = not applicable, EF = Executive Functioning, ERC = Emotion Regulation Checklist, BAU = Business as Usual, ENGAGE = Enhancing Neurobehavioural Gains with the Aid of Games and Exercise, RPLP = Red Light Purple Light, TSCRS = Teacher Social Competence Rating Scale, DCCS = Dimensional Change Card Sort, SDQ = Strengths and Difficulties Questionnaire, NEPSY = Developmental Neuropsychological Assessment Battery, CBRS = Child Behaviour Rating Scale

Table 7 continued

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Solomon et al. (2018) Canada	256 children M age = 3.8	Tools of the Mind	Playing to Learn	Aggression	Inhibitory control Attention Working memory	SCBE-30	HTKS Day/Night task
Williford et al. (2017) USA	470 Children M age = 4.05, SD = 0.56	Banking Time Child Time	BAU	Problem behaviour Behaviour control	n/a	ECBI Obs. SESBI-R	n/a

Note. SE = Social-Emotional, Cog = Cognitive, n/a = not applicable, EF = Executive Functioning, ERC = Emotion Regulation Checklist, BAU = Business as Usual, ENGAGE = Enhancing Neurobehavioural Gains with the Aid of Games and Exercise, RPLP = Red Light Purple Light, TSCRS = Teacher Social Competence Rating Scale, DCCS = Dimensional Change Card Sort, SDQ = Strengths and Difficulties Questionnaire, NEPSY = Developmental Neuropsychological Assessment Battery, CBRS = Child Behaviour Rating Scale, SESBI-R = Sutter-Eyberg Student behaviour Inventory revised, Obs. = Observation

No intervention effects were found for scores on either task. However, among children who were rated as having greater hyperactivity at baseline, those who took part in Tools of the Mind showed greater improvement on the HTKS task than those who took part in Playing to Learn. Solomon et al. (2018) also investigated whether Tools of the Mind would reduce children's aggression levels but no statistical differences in aggression levels from pre- to post-intervention were found for either group.

This is in contrast to findings from Blair et al. (2018) who found that children who received Tools of the Mind had lower levels of aggressive behaviour and fewer behavioural problems post-intervention compared to children in the control group ($p = .005$, effect size = -0.19 and $p = .001$, effect size = -0.19). Children in the intervention condition also had better

Table 8*Risk of Bias Assessment for Studies with Play-Based Interventions*

Author	Risk of Bias							Overall Risk
	Random Sequence Generation	Allocation Concealment	Blinding Outcome Assessor	Outcome	Incomplete Outcome Data	Selective Reporting	Other Bias	
			SE	Cog.				
Blair et al. (2014)	Low	?	n/a	Low	Low	Low	Low	Low
Blair et al. (2018)	Low	?	High	n/a	Low	Low	Low	High
Healey et al. (2019)	Low	Low	High	Low	Low	Low	Low	High
Keown et al. (2020)	Low	Low	High	Low	Low	Low	Low	High
Solomon et al. (2018)	Low	?	High	Low	Low	Low	Low	High
Williford et al. (2017)	Low	?	High	n/a	Low	Low	Low	High

Note. Low = Low Risk, High = High risk, ? = unclear risk, SE = social-emotional outcomes, Cog. = cognitive outcomes, n/a = not applicable

self-regulation and emotion regulation post-intervention compared to controls, as measured by the Teacher Social Competence Rating Scale (TSCRS) and the ERC ($p = .009$, effect size = 0.16 and $p = .004$, effect size = 0.18 respectively; Blair et al., 2018). Overall, these studies

show mixed results in regard to the impact of the Tools of the Mind program on both cognitive and social-emotional aspects of self-regulation.

In terms of risk of bias, both Blair et al. (2018) and Solomon et al. (2018) were rated as high due to the reliance on teacher reports of children's behaviour. As teachers were implementing the Tools curriculum, their ratings of children's behaviour may have been influenced by the knowledge of group assignments. However, it should be noted that the study by Solomon et al. (2018) also included measures of children's cognitive functioning that did not require assessors to make a judgement on participants' performance. The overall risk of bias in Blair and Raver (2014) was deemed to be low.

Healey and Healey (2019) and Keown et al. (2020) both examined the impact of play-based interventions on children's social-emotional and cognitive functioning. Healey and Healey (2019) examined whether ENGAGE could be as effective as Triple P for reducing disruptive behaviour problems in young children. Sixty-five participants were first assigned to a waitlist or non-waitlist group. Those in the non-waitlist group were then assigned to receive the ENGAGE intervention or were assigned to receive standard Triple P. Those in the waitlist group received either ENGAGE or Triple P following the waitlist period. A total of 29 participants received ENGAGE and 31 participants received Triple P. Participants were all rated as having clinical levels of hyperactivity on the BASC-2 prior to beginning the study. ENGAGE involved the teaching of games to parents and children over a five-week period. The teaching occurred during group sessions lasting a period of one and a half hours each. These games were common childhood games that had been modified to target children's self-regulation. Children's behaviour was assessed by parents and teachers using the BASC-2. Cognitive functioning was examined using the HTKS task and the Statue, Comprehension of Instructions, and Visuomotor precision subtests from the Developmental Neuropsychological

Assessment (NEPSY) battery. These tasks assessed working memory and inhibitory control (Healey & Healey, 2019).

Healey and Healey (2019) found that children in both groups had reduced levels of hyperactivity, aggression and attention problems at post-test compared to baseline (all $p < .001$ with large effect sizes), as rated by parents. For teacher ratings, the results were more inconclusive. Significant improvements in teacher-rated hyperactivity and aggression were found post-intervention for those in Triple P, however, these improvements were also found from the waitlist to baseline phase. Similar results occurred for hyperactivity levels. Children who received ENGAGE also showed improved teacher-rated hyperactivity post-intervention, however, improvements were also found from the waitlist to baseline period. This makes it difficult to determine if the improvements at post-intervention are related to the effects of the ENGAGE and Triple P interventions (Healey & Healey, 2019).

For cognitive outcomes, children in the Triple P group showed significant improvements from baseline to post-intervention on the Comprehension of Instructions task ($p < .01$, Hedge's $g = -1.00$) (Healey & Healey, 2019). However, there were also significant improvements on this task from the waitlist to baseline period, making it difficult to determine if the improvements at post-intervention were due to the intervention. No other effects of the intervention on cognitive functioning were found. Overall, results indicate that ENGAGE can be as effective as Triple P for improving children's disruptive behaviour, but these interventions may not be as effective for improving children's cognitive functioning (Healey & Healey, 2019). The risk of bias was assessed to be high for social-emotional outcomes, given that parents were not blind to participants' group assignments. However, for cognitive outcomes, the risk of bias was assessed to be low due to the inclusion of objective assessments. The risk of bias across the remaining domains was assessed to be low.

The study by Keown et al. (2020) assessed social-emotional and cognitive aspects of children's self-regulation before and after receiving the RLPL program. This program involved group-based games which utilised music and movement, and that targeted cognitive aspects of self-regulation such as inhibitory control and attention. Games were played twice a week for 30 minutes over an eight week period. The games' instructions became increasingly more complex over time as the children began to grasp the targeted self-regulatory skills. One hundred and seven children were assigned to receive RLPL, and 105 children were assigned to receive the usual school curriculum. Children's behavioural self-regulation was assessed using the Child Behaviour Rating Scale (CBRS). Cognitive functioning was assessed using the HTKS task and the DCCS (Keown et al., 2020).

Results showed that children in the RLPL condition had better scores on the DCCS at post-intervention compared to children in the control condition ($p = .026$). No statistical differences were found between groups on scores on the HTKS task and the CBRS. These results suggest that the RLPL may improve aspects of children's cognitive functioning, particularly cognitive flexibility and attention, as assessed by the DCCS (Keown et al., 2020). The risk of bias for this study was considered low across all domains, except for the blinding of outcome assessment domain for social-emotional outcomes. As these outcomes were rated by teachers who also implemented the intervention, these outcomes may have been open to bias.

The final study to investigate the impact of play on children's self-regulation was conducted by Williford et al. (2017). Children were assigned to receive one of three interventions: Banking Time (BT), Child Time (CT) or business as usual. One hundred and sixty-eight children were assigned to BT, 152 children to CT and a further 151 to business as usual. In BT, children took part in one-on-one play sessions with their kindergarten teacher for 10 to 15 minutes a day. During this time, teachers were asked to allow the child to lead

the play session. Teachers were also asked to narrate what the child did during these sessions and talk about any emotions that were present to help strengthen the relationships with their students. In CT, the children spent the same amount of time with their teacher, but teachers were allowed to decide how they would spend the time with their students. Children's behaviour before and after the interventions were examined using the ECBI, an observational assessment, and the Sutter-Eyberg Student Behaviour Inventory-Revised (SESBI-R) (Williford et al., 2017).

Results showed that children who were assigned to BT had decreased problem behaviour scores at post-test compared to children who were assigned to the control group, as reported by teachers ($p < .01$, effect size = - 0.29) (Williford et al., 2017). There were no differences in teacher-rated problem behaviour scores between children in CT and the control groups. Children in CT, however, did have significant reductions in parent-rated problem behaviour at post-intervention compared to children in the control group ($p = .05$, effect size = - 0.22). No differences between groups were found on the observational assessment of children's behaviour. These results suggest that both BT and CT may be an effective intervention for improving children's behaviour (Williford et al., 2017). It should be noted that although parents were blind to their child's group assignment, teachers were not blinded as they were implementing the intervention. It is therefore possible that their ratings of their students' behaviour may have been open to bias.

Overall, three out of five studies that examined social-emotional aspects of self-regulation found positive effects of play-based interventions. Of the four studies which examined cognitive outcomes, three found positive impacts of play on children's cognitive functioning. These results suggest that play-based interventions may be effective at improving both social-emotional and cognitive aspects of children's self-regulation.

Social-emotional learning programs

Four studies by Bierman et al. (2008), Fishbein et al. (2016), Izard et al. (2008) and Schell et al. (2015) examined the impact of social-emotional learning (SEL) programs on children's self-regulation. SEL programs focus primarily on promoting emotion regulation and pro-social skills in children (Lawson et al., 2018). The characteristics of these four studies and assessments regarding the risk of bias are presented in Table 9 and Table 10, respectively.

Both Izard et al. (2008) and Schell et al. (2015) examined the impact of SEL programs on social-emotional functioning in children. Izard et al. (2008) used an emotion-based prevention (EBP) program to investigate the effect on children's behaviour and emotion regulation. Children assigned to receive the EBP program were taught about emotions through puppet shows and story reading. Children's emotion regulation at baseline and post-intervention was assessed by teachers using the emotion regulation and lability/negativity subscales of the ERC. The Caregiver-Teacher Report Form (C-TRF) was also used to assess children's aggression levels (Izard et al., 2008).

Izard et al. (2008) found that, post-intervention, children in the intervention condition had lower scores on the lability/negativity scale on the ERC compared to baseline ($p < .01$, $d = 0.45$). Children who received the EBP program also had reduced aggression levels post-intervention ($p < .001$, $d = 0.45$). These effects were not found for children in the control condition. It is not known what impact the intervention had on children's scores on the emotion regulation subscale of the ERC. Izard et al. (2008) found significant differences between groups in scores on the emotion regulation subscale at pre-test and therefore did not further analyse this outcome. The lack of further analysis on this subscale controlling for these differences suggests that selective reporting may have occurred. The selective reporting domain in the risk of bias assessment for this study was therefore assessed to be high.

Table 9*Characteristics of Studies with Social-Emotional Learning Programs*

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Bierman et al. (2008) USA	356 Children M age = 4.49, SD = 0.31	Head Start Research Based Intervention	BAU	n/a	Working memory Inhibitory control Cognitive flexibility	n/a	Backward word span task Peg tapping task Observation DCCS task Walk a line slowly task
Fishbein et al. (2016) USA	327 children (specific age not listed)	PATHS	BAU	Aggression Hyperactivity Emotion Regulation	Attention Working memory Inhibitory control	Social Competence Scale TOCA-R ADHD Rating Scale	Delay of gratification task Peg tapping task Go/No Go task
Izard et al. (2008) USA	191 Children M age = 3.89, SD = 0.55	Emotion-Based Prevention Program	BAU	Emotion regulation Aggression	n/a	ERC CTRF	n/a
Schell et al. (2015) Germany	221 children M age = 5.20, SD = 0.45	Lubo from Outer Space	BAU	Externalising behaviour	n/a	C-TRF PBSQ	n/a

Note. SE = Social-Emotional, Cog = Cognitive, n/a = not applicable, PATHS = Promoting Alternative Thinking Strategies BAU = Business as Usual, DCCS = Dimensional Change Card Sort, ADHD = Attention Deficit/Hyperactivity Disorder, TOCA-R = Teacher Observation of Child Adaptation Revised, ERC = Emotion Regulation Checklist, PBSQ = Preschool Social Behaviour Questionnaire, C-TRF = Caregiver-Teacher Report Form

Table 10*Risk of Bias Assessment for Studies with Social-Emotional Learning Programs*

Author	Risk of Bias							Overall Risk
	Random Sequence Generation	Allocation Concealment	Blinding Outcome Assessor	Outcome	Incomplete Outcome Data	Selective Reporting	Other Bias	
			SE	Cog.				
Bierman et al. (2008)	?	?	n/a	Low	?	Low	Low	?
Fishbein et al. (2016)	?	?	High	Low	?	Low	Low	High
Izard et al. (2008)	?	?	High	n/a	Low	High	Low	High
Schell et al. (2015)	Low	?	High	n/a	Low	Low	Low	High

Note. Low = Low Risk, High = High risk, ? = unclear risk, SE = social-emotional outcomes, Cog. = cognitive outcomes, n/a = not applicable

The fact that teachers implemented the intervention as well as reported on outcomes also resulted in the blinding of outcome assessment domain to be rated as high. Further details about how random allocation was generated and how allocation to groups was concealed were also missing from this study. These domains were therefore deemed to be unclear with regard to the risk of bias. Overall, the results of Izard et al. (2008) should be interpreted with caution as there is a high likelihood that bias may have occurred.

Schell et al. (2015) also examined the impact of an SEL program on children's behaviour. One hundred and twenty-six children were assigned to receive the SEL intervention, 'Lubo from Outer Space', and 95 children were assigned to business as usual. Lubo from Outer Space consisted of lessons focused on promoting social skills, emotion knowledge and emotion regulation in children. Participants' externalising behaviour was examined using the Preschool Social Behaviour Questionnaire (PBSQ) and the C-TRF. Children in the control group were found to have significantly lower scores on both measures at baseline, therefore further analyses were adjusted for pre-intervention values. After adjusting for these differences, no significant differences between groups at post-intervention were found for either measure of externalising behaviour, suggesting that the Lubo from Outer Space program was not effective in reducing externalising behaviour in pre-school aged children (Schell et al., 2015). The overall risk of bias in this study was assessed to be high, due to the lack of blinding of teachers assessing children's behaviour.

The final two studies by Bierman et al. (2008) and Fishbein et al. (2016) examined the impact of the Promoting Alternative Thinking Strategies (PATHS) curriculum on social-emotional and cognitive aspects of children's self-regulation. Bierman et al. (2008) investigated whether the Head Start Research-Based Developmentally Informed (REDI) intervention could effectively improve children's cognitive functioning. The REDI intervention incorporated the PATHS curriculum along with specific activities for promoting language skills such as shared reading. Kindergarten children were assigned to receive the REDI intervention or were assigned to business as usual. Children's working memory, inhibitory control and cognitive flexibility skills were examined using the DCCS task, a peg tapping task, a backward working memory span task and a task requiring participants to walk a line slowly. Assessors also rated children's ability to maintain focus and regulate their behaviour during these tasks. Bierman et al. (2008) also examined aspects of social-emotional

functioning, however, these were not assessed both pre- and post-intervention so are not reported in this review.

Results showed no effects of the intervention on children's performance on the peg tapping, working memory span and walk a line slowly tasks (Bierman et al., 2008). Children who received the REDI intervention were rated as having greater attention skills and greater ability to regulate behaviour during the assessment tasks, compared to those in the control condition ($p < .05$, effect size = 0.28). There was also a marginally significant effect of the intervention on children's performances on the DCCS task, with children in the REDI condition showing greater improvements in scores ($p = .06$, effect size = 0.20). These results suggest that the REDI intervention may support the development of children's executive functioning (Bierman et al., 2008).

However, the risk of bias in Bierman et al. (2008) was assessed to be unclear, so these results should be interpreted with caution. No information was provided on how random assignment was conducted nor on how allocation to groups was concealed. There was also no information provided regarding the handling of incomplete data, despite not all children completing post-intervention assessments. It is therefore difficult to determine if any selection bias or attrition bias occurred.

The final study by Fishbein et al. (2016) investigated the effect of PATHS on kindergarten children's social-emotional and cognitive functioning. Children assigned to the PATHS condition received lessons twice a week, whilst those assigned to the control condition had lessons as per the usual school curriculum. The social-emotional outcomes measured included aggression, hyperactivity and impulsivity associated with ADHD, and emotion regulation. These outcomes were assessed using items from the Teacher Observation of Child Adaptation-Revised (TOCA-R), the ADHD Rating Scale and the emotion regulation subscale of the Social Competence Scale, respectively. The ADHD Rating Scale was also

used to assess participants' attention levels. Further cognitive outcomes were assessed using a peg-tapping task, a Go/No Go task and a task that required children to delay gratification (Fishbein et al., 2016).

Results showed that children in the PATHS condition had greater reductions in aggression and impulsivity at post-intervention compared to children in the control group ($p < .001$ and $p < .01$ respectively) (Fishbein et al., 2016). Children who received PATHS also had increased emotion regulation post-intervention compared to those in the control group ($p < .001$). For cognitive outcomes, children in the intervention condition had improved attention and greater improvement in scores on the peg-tapping task post-intervention than those in the control group ($p < .01$ and $p < .05$ respectively). No differences were found between groups on the Go/No Go task or the delay of gratification task post-intervention. These results suggest that PATHS may be an effective intervention for improving preschool-aged children's social-emotional functioning and aspects of cognitive functioning (Fishbein et al., 2016).

However, all social-emotional outcomes in this study were assessed by teachers, who also implemented the PATHS intervention. It is, therefore, possible that these reports of children's social-emotional functioning may be biased due to the knowledge of children's group assignment. The risk of bias is low for cognitive outcomes, however, as these assessments did not involve judgements to be made about children's performance. It is also important to note that Fishbein et al. (2016) did not provide details with regards to how randomisation and allocation concealment was carried out, nor on how incomplete data was handled. It is therefore difficult to further assess the risk of bias in this study.

In sum, two out of three studies that examined the impact of SEL interventions on children's social-emotional functioning found positive effects. These positive effects included reduced aggression and impulsivity and increased emotion regulation. It should be noted,

however, that these studies were identified to be a high risk of bias due to poor methodologies and lack of blinding of outcome assessments. Of the two studies which examined cognitive outcomes, both found positive impacts of SEL interventions on children's executive functioning. Again, these results should be interpreted with caution as both of these studies lacked important information regarding random allocation generation, allocation concealment and the handling of incomplete data making it difficult to determine the risk of bias.

Professional development for teachers

Three studies by Raver et al. (2011), Pianta et al. (2017) and Yoshikawa et al. (2015) focused on the professional development of kindergarten teachers for improving their student's social-emotional and cognitive functioning. The characteristics of these studies are presented in Table 11 and the risk of bias assessment for each study is presented in Table 12.

Raver et al. (2011) investigated the impact of the Chicago School Readiness Project (CSRP) on children's academic achievement and self-regulation. The study took place in kindergartens that received funding for Head Start, a program aimed at promoting school readiness in children from lower socio-economic areas (Office of Head Start, 2020). The CSRP involved providing teachers with strategies to manage classroom behaviour and support children's self-regulation. Children's executive functioning and effortful control were examined using the Preschool Self-Regulation Assessment (PSRA). The PSRA assessor report was also completed to assess children's attention and impulse control (Raver et al., 2011).

Results showed that children of teachers who received the CSRP had higher scores on tasks assessing executive functioning post-intervention compared to those whose teachers were in the control group ($p < .05$, effect size = 0.37) (Raver et al., 2011). Children of teachers in the intervention condition were also rated as having greater attention and impulse

Table 11*Characteristics of Studies with Professional Development for Teachers*

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Pianta et al. (2017) USA	1, 407 Children (218 Teachers) Children aged 4	PD Course with MTP coaching Course without MTP coaching	No PD with MTP coaching No PD or MTP	n/a	Inhibitory control	n/a	Peg tapping task
Raver et al. (2011) USA	543 children M age = 4.11, SD = 0.66	CSRP	BAU	n/a	Attention Inhibitory control Effortful control	n/a	PSRA
Yoshikawa et al. (2015) Chile	1033 Children M age = 4.46, SD = 0.31	UBC	Reduced version of UBC	Self-regulation Problem behaviour	n/a	EDI TOCA SCS TOQ	n/a

Note.. SE = Social-Emotional, Cog = Cognitive, n/a = not applicable, EF = Executive Functioning, MTP = My Teaching Partner, BAU = Business as Usual, PD = Professional Development, CSRP = Chicago School Readiness Project, UBC = Un Buen Comienzo (A Good Start), EDI = Early Development Instrument, TOCA = Teacher Observation of Child Adaptation, TOQ = Task Orientation Questionnaire, SCS = Social Competence Scale

control skills compared to children whose teachers were in the control condition ($p < .05$, effect size = 0.43). There were no differences in effortful control found. Although these results suggest that the CSRP program effectively improved children's executive functioning, the results should be interpreted with caution. The overall risk of bias for Raver et al. (2011) was assessed to be unclear, due to a lack of information regarding allocation concealment and

Table 12*Risk of Bias Assessment for Studies with Professional Development for Teachers*

Author	Risk of Bias							Overall Risk
	Random Sequence Generation	Allocation Concealment	Blinding Outcome Assessor	Outcome	Incomplete Outcome Data	Selective Reporting	Other Bias	
			SE outcomes	Cog. outcomes				
Pianta et al. (2017)	Low	?	n/a	Low	Low	Low	Low	Low
Raver et al. (2011)	Low	?	n/a	Low	?	Low	Low	?
Yoshikawa et al. (2015)	Low	Low	High	n/a	Low	Low	Low	High

Note. Low = Low Risk, High = High risk, ? = unclear risk, SE = social-emotional, Cog. = cognitive, n/a = not applicable

the handling of incomplete data. It is therefore difficult to determine whether any bias has occurred that may have influenced the outcomes of the study.

A further study by Pianta et al. (2017) found similar results, however, the effects were not seen immediately post-intervention. Pianta et al. (2017) examined the impact of a two-phase teacher training intervention on children's school readiness, including their cognitive functioning, language, and literacy skills. Teachers were assigned to receive a professional

development course focused on supporting relationships between teachers and their students or were assigned to a control group. Two hundred and eighteen teachers received the course, and 209 teachers were assigned to the control group. The following year, teachers were then assigned to receive a second intervention, called MyTeachingPartner (MTP) coaching, or were assigned to a second control group. Teachers in the MTP coaching condition received support and feedback from coaches on how to improve their interactions with their students. Children's inhibitory control was assessed using a pencil tap task (Pianta et al., 2017).

Results showed no effect of the intervention on children's inhibitory control immediately post the coaching phase (Pianta et al., 2017). In the year following the coaching intervention, however, children whose teachers had received MTP coaching the year before performed significantly better on the peg tapping task compared to children of teachers who were in the coaching control group ($p < .01$, $d = 0.24$). These results suggest that professional development of teachers may improve children's inhibitory control over time (Pianta et al., 2017). The overall risk of bias in this study was assessed to be low.

The final study to examine the impact of professional development of teachers on children's self-regulation was conducted by Yoshikawa et al. (2015). Sixty-six teachers in this study were assigned to receive Un Buen Comienzo (UBC), a training program focused on promoting strategies to improve children's social-emotional and language development, and 53 teachers were assigned to receive a reduced version of the UBC program with fewer resources and workshops. The full UBC group included 1033 children and the reduced UBC condition included 843 children. Social-emotional aspects of children's self-regulation were assessed using items drawn from the Early Development Instrument, the Teacher Observation of Child Adaptation, the Social Competence Scale-Teacher Version and the Task Orientation Questionnaire. Exploratory and confirmatory factor analyses were then conducted to create a self-regulation and low problem behaviour factor (Yoshikawa et al., 2015).

Results showed only a marginally significant difference between groups on scores on the self-regulation and low problem scale at post-test, with children whose teachers received the full UBC program having greater self-regulation and reduced problem behaviours ($p < .10$, $d = .16$) (Yoshikawa et al., 2015). These results suggest that further research on the UBC program is needed to determine whether it can effectively improve children's social-emotional functioning. It is important to note that the risk of bias in Yoshikawa et al. (2015) was assessed to be high due to the lack of blinding of outcome assessment. Children's social-emotional outcomes were assessed by teachers and parents, with teachers also taking part in the intervention. It is not known whether parents were blinded to the group assignment of their children's teachers, further adding to the risk of possible bias in the reporting of children's social-emotional functioning.

In summary, there appears to be promising evidence that professional development of teachers may be an effective way to support the growth of children's executive functioning. Of the two studies which examined cognitive outcomes, both found positive impacts on children's executive functioning over time. With regard to social-emotional functioning, the only study to examine social-emotional outcomes found only marginally significant improvements in children's self-regulation. More evidence is therefore needed to determine the effectiveness of professional development of teachers for improving preschool student's social-emotional functioning.

Multi-method interventions

Ten of the 37 identified studies examined interventions with multiple components, such as teaching parents skills to promote children's self-regulation as well as directly teaching children. The characteristics of these studies are presented in Table 13. The risk of bias assessments for these studies are presented in Table 14. Seven studies by Graziano and Hart (2016), Hart et al. (2019), Landry et al. (2017), Landis et al. (2019), Landry et al. (2017)

Table 13*Characteristics of Studies with Multi-Method Interventions*

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Duncan et al. (2018) USA	125 Children M age = 5.27, SD = 0.32	B2K + RLPL	B2K	n/a	Global EF	n/a	HTKS
Graziano & Hart (2016) USA	45 Children M age = 5.16, SD = 0.33	STP-PreK STP-PreK Enhanced	School Readiness Parenting Program	Emotion regulation Externalising behaviour	Working memory Global EF	BASC-2 ERC	AWMA HTKS BRIEF
Hart et al. (2019) USA	45 Children M age = 5.16, SD = 0.40	8 week STP-PreK 4 week STP-PreK	School Consultation	Emotion regulation Externalising behaviour	Working memory Global EF	BASC-2 ERC	AWMA HTKS BRIEF

Note. SE = Social-Emotional, Cog = Cognitive, n/a = not applicable, B2K = Bridge to Kindergarten, RLPL = Red Light Purple Light, EF = Executive Functioning, ERC = Emotion Regulation Checklist, BAU = Business as Usual, DCCS = Dimensional Change Card Sort, BASC-2 = Behaviour Assessment Scale for Children – 2nd edition, HTKS = Head Toes Knees Shoulders, AWMA = Automated Working Memory Assessment, STP-PreK = Summer Treatment Program for Pre-Kindergarteners, BRIEF = Behaviour Rating Inventory of Executive Function

Table 13 continued

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Howard et al. (2020) Australia	473 Children M age = 4.40, SD = 0.38	PRSIST	BAU	Behavioural self-regulation	Global EF	CSRBQ CBRS	HTKS PRSIST Assessment Early Years Toolbox
Larmar et al. (2006) Australia	135 Children M age = 4.33, SD = 0.48	Early Impact Intervention	Waitlist Control	Hyperactivity Conduct problems	n/a	SDQ	n/a
Landis et al. (2019) USA	49 Children M age = 4.52	STP-PreK with adaptive version of Cogmed working memory training	STP-PreK with non-adaptive CogMed working memory training	ADHD symptoms Externalising behaviour	Working memory Global EF	DBDRS BASC-2	AWMA HTKS BRIEF
Landry et al. (2017) USA	431 children M age = 4.37	TEEM with PALS	TEEM with no PALS	Aggression	Effortful control	SCBE-30	CBQ Gift delay-wrap task Gift Delay-Bow Task Bear/Dragon Task

Note. SE = Social-Emotional, Cog = Cognitive, n/a = not applicable, EF = Executive Functioning, ERC = Emotion Regulation Checklist, BAU = Business as Usual, BASC-2 = Behaviour Assessment Scale for Children – 2nd edition, HTKS = Head Toes Knees Shoulders, AWMA = Automated Working Memory Assessment, STP-PreK = Summer Treatment Program for Pre-kindergarteners, PRSIST = Preschool Situational Self-Regulation Toolkit = PRSIST, BRIEF = Behaviour Rating Inventory of Executive Function, CSRBQ = Child Self-Regulation and Behaviour Questionnaire, CBRS = Child Behaviour Rating Scale, SDQ = Strengths and Difficulties Questionnaire, DBDRS = Disruptive Behaviour Disorder Rating Scale, ADHD = Attention Deficit Hyperactivity Disorder

Table 13 continued

Author	Sample	Intervention	Comparison	Outcomes		Measures	
				SE	Cog	SE	Cog
Pears et al. (2013) USA	192 children in foster care M age = 5.26, SD = 0.34	KITS	Foster Care Comparison	Behaviour regulation Emotion regulation	Inhibitory control	CBQ CBCL ERC BRIEF (emotional control subscale)	BRIEF Go/No-Go Task Flanker Task
Ray et al. (2020) Finland	802 Children M = 5.19, SD = 1.05	Increased Health and Wellbeing in Preschools intervention (DAGIS)	BAU	Emotion regulation	Cognitive self- regulation	CSBQ	CSBQ
Upshur et al. (2013) USA	341 Children M = 3.90, SD = 0.68	Second Step Preschool/ Kindergarten Kit	Creative Curriculum	Behaviour problems	n/a	SESBI-R	n/a

Note. SE = Social-Emotional, Cog = Cognitive, n/a = not applicable, EF = Executive Functioning, TEEM = The Early Education Model, PALS = Playing and Learning Strategies, KITS = Kids in Transition to School, BAU = Business as Usual, ERC = Emotion Regulation Checklist, BRIEF = Behaviour Rating Inventory of Executive Function, CBCL = Child Behaviour Checklist, CBQ = Children's Behaviour Questionnaire, SCBE-30 = Social Competence and Behaviour Evaluation, CBSQ = Child Social Behaviour Questionnaire, SESBI-R = Sutter-Eyberg Student Behaviour Inventory-Revised

Table 14*Risk of Bias Assessment for Studies with Multi-Method Interventions*

Author	Risk of Bias							Overall Risk
	Random Sequence Generation	Allocation Concealment	Blinding Outcome Assessor	Outcome	Incomplete Outcome Data	Selective Reporting	Other Bias	
			SE outcomes	Cog. outcomes				
Duncan et al. (2018)	High	?	n/a	Low	Low	Low	Low	High
Graziano & Hart (2016)	Low	?	High	High	Low	Low	Low	High
Hart et al. (2019)	Low	Low	High	High	?	Low	Low	High
Howard et al. (2020)	Low	Low	Low	Low	Low	Low	Low	Low
Larmar et al. (2006)	Low	?	High	n/a	Low	Low	Low	High
Landis et al. (2019)	Low	?	Low	Low	Low	Low	Low	Low

Note. Low = Low Risk, High = High risk, ? = unclear risk, SE = social-emotional, Cog. = cognitive, n/a = not applicable

Table 14 continued

Author	Risk of Bias							Overall Risk
	Random Sequence Generation	Allocation Concealment	Blinding Outcome Assessor	SE outcomes	Cog. outcomes	Incomplete Outcome Data	Selective Reporting	Other Bias
Landry et al. (2017)	?	?	High	Low		Low	Low	Low
Pears et al. (2013)	Low	?	High	High		Low	Low	Low
Ray et al. (2020)	Low	?	High	High		Low	Low	Low
Upshur et al. (2013)	Low	?	High	n/a		Low	Low	Low

Note. Low = Low Risk, High = High risk, ? = unclear risk, SE = social-emotional, Cog. = cognitive, n/a = not applicable

Pears et al. (2013) and Ray et al. (2020) examined the impact of multi-method interventions on both children's social-emotional and cognitive functioning.

Graziano and Hart (2016), Hart et al. (2019), and Landis et al. (2019) all examined the impact of the Summer Treatment Program for Pre-Kindergarteners (STP- PreK) on children's self-regulation. The STP-PreK involved both parent training and classroom components to promote self-regulation. Parent training was aimed at promoting effective behavioural management strategies and supporting the development of positive relationships between

parents and their children. Parents attended 90-minute groups sessions once a week for an eight week period. The classroom curriculum included social skills training, games to increase children's executive functioning skills, activities to promote academic skills and a point-based system to modify children's behaviour in the classroom.

In Graziano and Hart (2016), participants were assigned to one of three versions of STP-PreK: parenting training only, standard STP-PreK, or STP-PreK enhanced. Standard STP-PreK included only the point-based system for behaviour modification, the academic skills components and parent training, while STP-PreK enhanced also included the components focused on executive functioning and social skills training. Children's emotion regulation and levels of externalising behaviour were examined before and after the intervention using the BASC-2 and ERC. For cognitive outcomes, children's working memory abilities were assessed using the Automated Working Memory Assessment (AWMA). Children's global executive functioning was assessed using the HTKS task and the BRIEF. Results showed that levels of externalising behaviour improved significantly from baseline to post-intervention for children in all three conditions, all with large effects sizes. However, there were no significant differences between groups at post-intervention. Scores on the ERC also improved for all three groups from baseline to post-intervention, with children in the parent training only condition having higher post-intervention scores on the emotion regulation subscale compared to those in the STP-PreK or STP-PreK enhanced conditions ($p = .041$) (Graziano & Hart, 2016).

For the cognitive outcomes, children in all three conditions had improved scores on the AWMA, HTKS and the BRIEF from baseline to post-intervention (Graziano & Hart, 2016). Children in the enhanced STP-PreK condition had significantly higher scores on the AWMA at post-intervention compared to those in the other two conditions ($p < .05$). Children in the enhanced condition, as well as the standard STP-PreK condition, also had

greater scores on the HTKS task at post-intervention compared to those in the parent training only condition ($p < .05$). No differences in BRIEF scores between groups at post-intervention were found. These results suggest that, while all three interventions may improve children's social-emotional and cognitive functioning, the standard and enhanced versions of the STP-PreK program may provide further benefits to children's executive functioning (Graziano & Hart, 2016).

A further study by Hart et al. (2019) examined whether the length of the STP-PreK has an effect on children's social-emotional and cognitive functioning. Participants were assigned to receive an eight-week version of STP-PreK, a four-week version of STP-PreK or were assigned to a school consultation condition. School consultation consisted of sessions between parents, teachers, and a behavioural consultant to discuss strategies to manage difficult behaviour in the classroom and at home. Children's behaviour, emotion regulation, and executive functioning were assessed using the same measures as in Graziano and Hart (2016).

Results showed that children who received both the four-week and eight-week versions of STP-PreK had lower post-intervention scores on the BASC-2 compared to those in the school consultation condition ($p < .001$) (Hart et al., 2019). However, there were no differences in scores at post-intervention between those who received the four-week program and the eight-week program. Only children who received the four-week program showed improved teacher-rated emotion regulation from pre- to post-intervention ($g = -0.89$, $p < .01$). Children in both versions of STP-PreK showed improved working memory and executive functioning from pre- to post-intervention compared to those who received the school consultation intervention. Again, no differences in post-intervention scores between those in the four-week program and those in the eight-week program were found. These results

suggest that both the four-week and eight-week versions of the STP-PreK program may effectively improve children's social-emotional and cognitive functioning (Hart et al., 2019).

Landis et al. (2019) examined whether the addition of Cogmed Working Memory Training (CWMT) to STP-PreK provided any additional benefits to children's self-regulation skills. CWMT is a computer-based program aimed at increasing children's working memory capabilities. Children at risk of developing externalising behaviour problems were assigned to receive either STP-PreK with adaptive CWMT or STP-PreK with non-adaptive CWMT. In adaptive CWMT, the task increased in difficulty as children's performance improved, whereas the task remained on the easiest level in non-adaptive CWMT. Children's behaviour was examined using the Disruptive Behaviour Disorder Rating Scale (DBDRS) and the BASC-2. Working memory capabilities and global executive functioning were examined using the AWMA, HTKS task and the BRIEF. Results showed that both groups improved on all measures of behaviour and executive functioning from pre- to post-intervention. No differences between groups at post-intervention on any measures of behaviour and executive functioning were found. These results indicate that CWMT did not provide any additional benefits to children's self-regulation, beyond what STP-PreK already provided (Landis et al., 2019).

Another study by Landry et al. (2017) investigated the impact of professional development for teachers and parent training on children's social-emotional and cognitive functioning. Kindergarten teachers were initially assigned to receive a professional development course called The Early Education Model (TEEM) or to receive no professional development course. TEEM involved 14, two-hour coaching sessions every second week as well as additional online learning. Students and their parents were then assigned to receive the Play and Learning Strategies (PALS) program or to receive handouts with information on various child development topics. The PALS program is a home-based intervention aimed at

promoting positive parent-child interactions. Parents were supported by a coach who helped parents to respond appropriately to their child's needs. Parents received 19, one-hour sessions with the coach over the period of the study. It was hypothesised that the combination of TEEM and PALS together would lead to greater positive impacts on children compared to either intervention alone. Children's cognitive functioning was examined using the attention focusing and inhibitory control scales of the CBQ and three tasks requiring the children to delay gratification and maintain attention. Scores from both scales of the CBQ were combined to create a composite score of effortful control. Children's levels of aggression were also assessed pre- and post-intervention using the SCBE-30 (Landry et al., 2017).

Landry et al. (2017) found that children whose parents received PALS had greater parent-rated effortful control at post-intervention compared to children who did not receive PALS, regardless of whether their teacher had received TEEM or not ($p = .003$, $d = 0.15$). Children whose parents received PALS were also better able to delay gratification than children who did not receive PALS. No differences in aggression or teacher-rated effortful control were found between groups. These results did not support the hypothesis that both interventions together would be more beneficial than either intervention alone (Landry et al., 2017).

Additional studies by Pears et al. (2013), Ray et al. (2020) and Howard et al. (2020) found mixed effects of multi-method interventions on children's social-emotional and cognitive functioning. Pears et al. (2013) examined the impact of the Kids in Transition to School (KITS) program on children in foster care. The KITS program focused on promoting children's literacy skills as well as their prosocial skills. The program involved group activities for children as well as a parent training component that aimed to support parents with children's problem behaviours. Children's social-emotional and cognitive functioning was assessed using a variety of assessments, including computer-based assessments of

executive functioning and parent-report measures of behaviour and emotion regulation. The results of these assessments were pulled together to form a latent variable of self-regulation. Results showed that at post-intervention, children who had taken part in the KITS program had greater self-regulation skills compared to those who did not ($p < .001$, effect size = 0.18). This suggests that the KITS program effectively improved the self-regulation of children in foster care (Pears et al., 2013).

Ray et al. (2020) investigated the effectiveness of a home and preschool based program aimed at increasing children's self-regulation skills, physical exercise and healthy eating. Children were assigned to receive the intervention for 23 weeks or were assigned to a control group. Children's emotional self-regulation and cognitive self-regulation were assessed using the Child Social Behaviour Questionnaire (CSBQ). No statistical differences were found in emotional or cognitive self-regulation from pre- to post-intervention for either group, suggesting that the intervention had no impact on children's social-emotional and cognitive functioning (Ray et al., 2020).

Similar results were found by Howard et al. (2020), who investigated the impact of the Preschool Situational Self-Regulation Toolkit (PRSIST) Program on children's social-emotional and cognitive functioning. The PRSIST program consisted of professional development for teachers alongside games aimed at promoting children's self-regulation. No impact of the intervention was found on children's performances on the HTKS task, scores on the Child Self-Regulation and Behaviour Questionnaire and CBRIS or on an observational assessment of children's cognitive and behavioural self-regulation. There was, however, a positive impact of intervention on children's executive functioning as assessed by tasks from the Early Years Toolbox. Children in the intervention condition had greater executive functioning at post-intervention compared to those in the control condition ($p = .029$, $\eta_p^2 = 0.016$). These results suggest that the PRSIST may show promise at improving children's

executive functioning, but more research is needed to further assess the efficacy of this intervention (Howard et al., 2020).

A further two studies by Larmar et al. (2006) and Upshur et al. (2013) examined the impact of multi-method interventions on social-emotional outcomes only. Larmar et al. (2006) investigated the Early Intervention (EI) program which involved both parent training and professional development for teachers to reduce the risk of conduct problems in preschool-aged children. Children whose parents and teachers received the EI program were found to have reduced hyperactivity and level of conduct problems, as rated by teachers ($p < .05$). However, no differences were found between groups on parent-rated hyperactivity and conduct problems. This may be because parents in this study were less engaged in the EI intervention compared to teachers, with only 34% of parents attending at least one parent training session. This reduced engagement by parents may have made it difficult to detect any impact of the intervention on children's behaviour (Larmar et al., 2006).

The second study by Upshur et al. (2013) found no impact of intervention on children's social-emotional functioning. Children were assigned to receive either the Second Step Preschool/Kindergarten Kit or were assigned to a control group. The Second Step Preschool/Kindergarten Kit consisted of classroom lessons aimed at promoting emotion regulation. The intervention also involved parent sessions which focused on teaching the importance of recognising emotions and increasing their children's social skills. Children's behaviour before and after the intervention was assessed using the SESBI-R. Results showed that children in the intervention condition had lower scores on the SESBI-R at post compared to those in the control condition ($p < .05$, $d = -0.29$). However, after adjusting for baseline differences between groups, this result was no longer significant. These results suggest the Second Step Preschool/Kindergarten Kit may not be an effective intervention for improving children's behaviour (Upshur et al., 2013).

Finally, one study by Duncan et al. (2018) assessed children's cognitive functioning as an outcome of their study. Duncan et al. (2018) examined the impact of the Bridge to Kindergarten (B2K) program paired with the game-based RLPL intervention on children's executive functioning. The B2K program involved classroom lessons and group activities that focused on the development of literacy, maths, and social-emotional skills. Children were randomly assigned to receive either the Bridge to Kindergarten (B2K) program alongside the RLPL intervention or received the B2K program only. Children's executive functioning was examined using the HTKS task. Results showed that children who received both B2K and the RLPL intervention showed greater improvement on the HTKS task, indicating improved executive functioning ($p = .01$; Duncan et al., 2018). However, these results must be interpreted with caution. There was no information provided on how random assignment was carried out. As there were significant differences between groups on baseline scores on the HTKS task, this suggests an issue with the randomisation process that may have impacted the outcomes of this study.

Overall, there were mixed findings with regard to the impact of multi-method interventions on children's social-emotional functioning. Five studies that examined at least one aspect of social-emotional functioning found positive intervention effects. On the other hand, four studies found no impact of multi-method programs on social-emotional aspects of children's self-regulation. In terms of cognitive outcomes, the findings of this review were more conclusive, with seven of the eight studies that examined cognitive functioning finding positive intervention effects. It should be noted, however, that the majority of these studies were rated as having a high risk of bias. This was largely due to a lack of blinding of outcome assessors which were often completed by teachers and parents taking part in the intervention. This lack of blinding means it is possible assessors' reports of children's self-regulation may have been influenced by the knowledge of participants' group assignment.

Discussion

This systematic review aimed to examine whether self-regulation interventions improve preschool-aged children's cognitive and social-emotional functioning. The review also aimed to investigate any specific intervention effects of different types of self-regulation interventions. The literature was systematically searched for studies that examined the effectiveness of interventions for improving pre-schoolers social-emotional and cognitive functioning.

Overall, this review shows promising evidence that both cognitive and social-emotional functioning of preschool-aged children may be improved through intervention. Sixteen of the 22 studies that examined cognitive aspects of self-regulation found positive effects of intervention on at least one aspect of children's cognitive functioning. These positive effects included improved inhibitory control, attention, and working memory post-intervention. In terms of social-emotional outcomes, a total of 30 studies examined at least one social-emotional aspect of self-regulation. Of these, 19 (63%) found intervention effects on children's social-emotional functioning. Reductions in externalising behaviour such as aggression, hyperactivity and impulsivity were the most common findings across studies that examined social-emotional aspects of self-regulation.

In terms of the effects of specific types of interventions, the present review suggests that parenting programs may effectively improve social-emotional aspects of pre-schoolers' self-regulation. The majority of studies that examined parenting programs found that these interventions reduced externalising behaviour and improved children's emotion regulation. The confidence in these results is limited, however, due to the lack of blinding of those assessing children's social-emotional outcomes in these studies. While the perspectives of teachers and parents are important, the lack of blinding means there is a possibility that the assessments of children's social-emotional functioning may have been open to bias.

Despite the risk of bias, the finding that parenting programs may improve children's self-regulation does align with theories of self-regulation development. Social theories of self-regulation development posit that self-regulation develops through parenting practices, such as warm, nurturing and problem-focused responses from parents (e.g. Morris et al., 2007; Roskam et al., 2014). Strategies to help parents develop warm and responsive relationships with their children are key elements to parenting programs such as Triple P (Sanders, 1999) and TIK (Havighurst et al., 2009). It is therefore logical that these interventions would improve children's self-regulation.

Play-based interventions also showed promising impacts on both cognitive and social-emotional aspects of children's self-regulation. Although many of the social-emotional outcomes were assessed by those unblinded to participants' group assignment, objective measures were used to assess children's cognitive functioning. This means there can be more confidence that the positive impacts of play on children's cognitive functioning are in fact due to the interventions in the included studies. Many of the play-based interventions in this review consisted of group-based games or activities, allowing children to observe the behavioural responses of other children whilst practising their own self-regulatory skills. As behaviour is often learned through observation (Bandura, 1971), this may be one mechanism through which play interventions improved participants' self-regulation.

The use of scaffolding may also be a reason why children's self-regulation improved after engaging in play-based interventions. Teachers engaged in the Tools of the Mind program, for example, utilise scaffolding to support children's thinking during role-playing (Barnett et al., 2008). Scaffolding has been linked to increases in children's use of private speech, which in turn, has been associated with increased organisation of children's cognitive functioning (Fernyhough & Fradley, 2005). This may be a further mechanism through which play interventions improved cognitive aspects of pre-schoolers' self-regulation.

This review also suggests that multi-method interventions may be effective for improving cognitive aspects of children's self-regulation. This may be because these interventions targeted multiple mechanisms through which self-regulation develops. For example, many of the interventions had components that focused on promoting positive parent-child (or teacher-child) relationships as well as a focus on games for children's executive function development. Given that positive parenting practices have been shown to promote executive functioning (e.g. Roskam et al., 2014), and that children learn many self-regulatory skills through play (Whitebread et al., 2009), it makes sense that interventions that target both these areas would effectively improve children's self-regulation. However, due to the lack of blinding of outcome assessors in these studies, the confidence in these findings may be limited.

The present review shows poor evidence that physical activity-based interventions are effective for improving preschool-aged children's self-regulation. Neither Burkart et al. (2018) nor Xu et al. (2018) found positive impacts on children's executive functioning. This could be because the sample sizes in both studies were relatively small, meaning small effects on children's executive functioning may not have been able to be detected. Burkart et al. (2018) did find positive impacts of physical activity on social-emotional functioning. However, the measures used to assess these outcomes were open to bias, reducing the credibility of these results. It is possible that other physical activity interventions may be effective at improving children's self-regulation, given the findings of past reviews on physical activity interventions for the preschool age group (e.g. Wood et al., 2020). However, only two studies that met inclusion criteria were identified in the present review.

More evidence is also needed to confirm the effectiveness of interventions that target the professional development of teachers. Although these interventions showed promise at improving children's cognitive functioning, only marginally significant impacts on social-

emotional functioning were identified. Given only three studies of professional development programs were identified in this review, more research is needed to confirm the efficacy of these interventions for improving pre-schoolers' self-regulation.

Although the majority of studies which examined SEL interventions found positive impacts on social-emotional and cognitive outcomes, the quality of these studies was poor. Common methodological issues included a lack of information regarding random sequence generation, allocation concealment and the handling of incomplete data. The poor quality makes it difficult to conclude whether the SEL interventions in these studies were effective or not. Similarly, the lack of high-quality studies that examined mindfulness-based interventions makes it difficult to confirm the effectiveness of these interventions for children's self-regulation, despite the positive intervention effects found in this review. It is important to note however that past reviews of mindfulness and SEL interventions have found positive effects on children's self-regulation (e.g. Blewitt et al., 2018; Sun et al., 2021). If higher-quality studies were identified in the present review, it is possible that similar conclusions may have been made regarding the effectiveness of these two types of self-regulation interventions.

The results of the present review build on previous systematic reviews of self-regulation interventions by providing evidence as to the effectiveness of self-regulation interventions for the preschool age group specifically. Although past reviews by Blewitt et al. (2018) and Wood et al. (2020) reviewed the effect of self-regulation interventions on the preschool age group, these reviews examined specific types of interventions. In addition, past reviews that examined the effectiveness of multiple types of self-regulation interventions did not focus specifically on the preschool age range (e.g., Pandey et al. 2018). The present review extends on these studies by providing an evidence base for the types of self-regulation interventions that may be effective for the preschool age group.

Clinical and practical implications

The findings of this review may be useful in the designing of future self-regulation interventions for pre-schoolers. The results highlighted the components of interventions that may be most effective for improving self-regulation. Interventions that targeted positive parenting practices and children's play appeared to have more evidence of their effectiveness at improving pre-schoolers' self-regulation compared to other interventions. Developers of self-regulation interventions may therefore wish to include parenting and play elements to maximise the impact of the intervention on children's self-regulation.

Inclusion of the family into self-regulation interventions may also make these interventions more culturally responsive. Whānau, or family, plays an important role in the development and wellbeing of Māori (Durie, 1994; Rameka et al., 2017). The importance of family relationships has already been acknowledged in the early childhood education curriculum, Te Whāriki (Ministry of Education, 2017). The principles within the curriculum should be incorporated into additional programs that are implemented in early childhood centres such as self-regulation interventions. Encouraging Māori whānau to participate in discussions about the development of new self-regulation interventions, for example, would ensure that these interventions reflect the cultural needs of the community in which they are being developed.

The cost of interventions should also be taken into consideration when developing new self-regulation interventions. Although programs that target parenting practices appear to be effective in promoting children's self-regulation, these interventions may be more costly. The parenting programs included in this review tended to require parents to attend weekly group sessions for up to two hours. Many of the multi-method interventions in this review also required a high level of engagement from parents, with parents required to attend group parenting sessions for up to two hours a week for eight weeks. This level of engagement may

not be realistic for some parents, particularly those who work full time. Furthermore, while parents were directly implementing the program with their children, the initial teaching of parents was often conducted by a specialist trainer. The hiring of specialist staff is an additional cost that may make parenting-based programs more expensive to implement than other interventions.

On the other hand, play-based interventions may be more cost-effective self-regulation interventions. The RLPL intervention, for example, requires games to be played only twice a day for 30 minutes, meaning that games can easily be incorporated into the current early childhood curriculum. Many of the games involved in the RLPL intervention also require equipment that can be easily accessed in early childhood centres such as musical instruments, meaning no additional resource costs for the implementation of the intervention. Similarly, the games played in the ENGAGE intervention build upon common childhood games and require few additional resources to implement. The integration of games targeting executive functioning skills into current early childhood curriculums may therefore be a useful and inexpensive way to support the development of children's cognitive functioning in the preschool environment

This review also has implications for the training of psychologists and early childhood educators. Given that positive parenting practices were identified as being important components for promoting pre-schoolers' self-regulation, it is important that psychologists are trained to support parents with effective parenting skills. This means that psychologists should have access to training in parenting programs such as Triple P and Incredible Years in order to support clients with developing positive parent-child relationships. Early childhood educators should also be informed of the best ways to support their student's self-regulation. As play-based interventions may be a cost-effective way to promote the development of pre-schoolers' self-regulation, early childhood educators should be provided access to training in

interventions such as Tools of the Mind, ENGAGE or RLPL. These interventions, particularly ENGAGE and RLPL, may easily be incorporated into the existing early childhood curriculum as they require few resources and do not require large amounts of time to implement. Both ENGAGE and RLPL have also been studied in the New Zealand context, suggesting these interventions are effective for improving the self-regulation of New Zealand children.

Limitations

There are several limitations of the present review. One limitation is that a meta-analysis was not conducted. A meta-analysis would have provided stronger evidence as to the effectiveness of self-regulation interventions for preschool-aged children. However, the broad nature of the inclusion criteria for this review meant that included studies were highly heterogeneous. The types of interventions used varied greatly, as did the social-emotional and cognitive outcomes being assessed. The way in which these outcomes were assessed were also diverse across studies included in this review. Given the diversity in the included studies, conducting a meta-analysis would have been inappropriate.

A second limitation of the present review is the lack of high-quality studies found in the searching of databases. In particular, the lack of quality studies examining mindfulness and SEL interventions made it difficult to form conclusions regarding the effectiveness of these self-regulation interventions. Furthermore, a high proportion of studies included in this review failed to blind outcome assessors. In many cases, this was due to the outcome assessors being teachers or parents who were also taking part in or leading the intervention, making it impractical to blind them. This lack of blinding means that many of the outcomes used to assess children's self-regulation, particularly measures of social-emotional functioning, were open to bias, reducing the credibility of the results. Future research of self-regulation interventions should therefore aim to include more objective measures of

children's self-regulation or use assessors who can be blinded to children's group assignment. This would mean more confidence could be given as to whether the impacts of an intervention are truly related to the intervention and not due to biased assessments of children's self-regulation.

Furthermore, the results of this systematic review may also be limited by the inclusion of parent and teacher-led interventions only. Although this was done in order to provide an evidence base for sustainably resourced interventions, it does mean that any effective self-regulation interventions where the direct implementation with children was conducted by researchers or specialist trainers were excluded. Although such interventions may be more expensive to implement, given the cost of hiring specialist staff, they may still be effective interventions for improving children's self-regulation.

The results may also be limited by the inclusion of studies published in English only. This means studies in other languages that may have found positive effects of self-regulation interventions were not included in this review. A large proportion of studies in the present review were also conducted in Western countries, which may reduce the generalisability of the findings to other populations. In addition, there were no interventions included in this review that had a bicultural approach to promoting children's self-regulation. Given our bicultural society in New Zealand, self-regulation interventions that have been informed by Māori values and ways of being are needed. It is evident that cultural connectedness has important implications for Māori children's social-emotional development, educational success and sense of identity (Kukutai, 2020; Macfarlane et al., 2014). It is therefore important that self-regulation interventions, particularly those developed for use in our education systems incorporate the values and knowledge of Māori culture. This would ensure that the cultural needs of all children are met. This could be achieved by consulting with Māori educators and parents to ensure interventions are culturally responsive. Research such

as that conducted by Rameka et al. (2017) provides a good example of culturally responsive practices being used in early childhood education centres. Developers of self-regulation interventions for early childhood centres may wish to incorporate the principles and practices outlined in Rameka et al. (2017) to enhance the cultural inclusivity of their interventions.

Future research

Although this review found positive impacts of intervention on both social-emotional and cognitive aspects of pre-schoolers' self-regulation, the review focused largely on short-term impacts. Given the importance of early self-regulation skills for future outcomes such as academic achievement, health, and social functioning (e.g. McClelland et al., 2007; Moffitt et al., 2011), future reviews may wish to examine whether interventions can lead to sustained improvements in pre-schoolers' self-regulation. Further research should also examine whether there are any specific types of self-regulation interventions that are more effective than others at improving pre-schoolers' long-term self-regulation skills.

Future research may also wish to investigate whether specific types of interventions are more effective for different populations of children, such as those with ADHD. Some of the included studies in this review did include participants with clinical levels of ADHD symptoms. However, the present review did not specifically examine which type of intervention was most effective for this population. ADHD is a common childhood disorder and given the impacts of ADHD on children's later academic achievement and social functioning (e.g. Arnold et al., 2020; Merrill et al., 2020), it is important that those with ADHD are supported to develop self-regulation skills.

In addition, future research may wish to examine whether current self-regulation interventions are culturally responsive to Māori. As previously stated, cultural connectedness is important for the development of children's social-emotional development and sense of identity (Kukutai, 2020; Macfarlane et al., 2014). Only two studies in the current review were

conducted in the New Zealand context, and although some Māori participants were included, neither study utilised bicultural approaches in their respective interventions. Thus, it is difficult to determine whether these self-regulation interventions are culturally responsive to Māori. Consultation with Māori during the development of future self-regulation interventions may help to create culturally responsive interventions.

Conclusion

Overall, this review adds to the current literature on self-regulation interventions by providing promising evidence as to the effectiveness of self-regulation interventions for the pre-school age group. It also provides direction as to what types of interventions may be effective for promoting different aspects of pre-schoolers' self-regulation. Parenting programs appear to be effective interventions for increasing social-emotional aspects of kindergarten-aged children's self-regulation, while multi-method and play-based interventions appear to be effective at improving cognitive aspects of self-regulation. Additional research is needed to determine whether SEL, physical activity and mindfulness-based interventions can effectively improve social-emotional and cognitive aspects of pre-schoolers' cognitive functioning. The results of this review may be used to inform parents and early childhood educators of the ways in which they can help support pre-schoolers' self-regulation development.

References

- Aghaie Meybodi, F., Mohammadkhani, P., Pourshahbaz, A., Dolatshahi, B., & Havighurst, S. (2019). Improving parent emotion socialization practices: Piloting Tuning in to Kids in Iran for children with disruptive behavior problems. *Family Relations: An Interdisciplinary Journal of Applied Family Studies*, 68(5), 596-607.
<https://doi.org/10.1111/fare.12387>
- Aldao, A., & Nolen-Hoeksema, S. (2012). The influence of context on the implementation of adaptive emotion regulation strategies. *Behaviour Research and Therapy*, 50(7), 493-501. <https://doi.org/https://doi.org/10.1016/j.brat.2012.04.004>
- Altszuler, A. R., Page, T. F., Gnagy, E. M., Coxe, S., Arrieta, A., Molina, B. S., & Pelham, W. E., Jr. (2016). Financial dependence of young adults with childhood ADHD. *Journal of Abnormal Psychology*, 44(6), 1217-1229.
<https://doi.org/http://dx.doi.org/10.1007/s10802-015-0093-9>
- Álvarez-Bueno, C., Pesce, C., Cavero-Redondo, I., Sánchez-López, M., Martínez-Hortelano, J. A., & Martínez-Vizcaíno, V. (2017). The effect of physical activity interventions on children's cognition and metacognition: A systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, 56(9), 729-738.
<https://doi.org/https://doi.org/10.1016/j.jaac.2017.06.012>
- American Psychiatric, A. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed.). American Psychiatric Association.
- Arnold, L. E., Hodgkins, P., Kahle, J., Madhoo, M., & Kewley, G. (2020). Long-term outcomes of ADHD: Academic achievement and performance. *Journal of Attention Disorders*, 24(1), 73-85. <https://doi.org/10.1177/1087054714566076>
- Bandura, A. (1971). *Social learning theory*. General Learning Press.
<https://go.exlibris.link/y5Wkr4Mf>

- Barnett, W. S., Jung, K., Yarosz, D. J., Thomas, J., Hornbeck, A., Stechuk, R., & Burns, S. (2008). Educational effects of the Tools of the Mind curriculum: A randomized trial. *Early Childhood Research Quarterly*, 23(3), 299-313.
<https://doi.org/10.1016/j.ecresq.2008.03.001>
- Baumeister, R. F., Tice, D. M., & Vohs, K. D. (2018). The strength model of self-regulation: Conclusions from the second decade of willpower research. *Perspectives on Psychological Science*, 13(2), 141-145. <https://doi.org/10.1177/1745691617716946>
- Beeghly, M., Perry, B. D., & Tronick, E. (2016). Self-regulatory processes in early development. In *The Oxford handbook of treatment processes and outcomes in psychology: A multidisciplinary, biopsychosocial approach*. (pp. 42-54). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199739134.001.0001>
- Best, J. R. (2010). Effects of physical activity on children's executive function: Contributions of experimental research on aerobic exercise. *Developmental Review*, 30(4), 331-351.
<https://doi.org/https://doi.org/10.1016/j.dr.2010.08.001>
- Bierman, K. L., Nix, R. L., Greenberg, M. T., Blair, C., & Domitrovich, C. E. (2008). Executive functions and school readiness intervention: Impact, moderation, and mediation in the Head Start REDI program. *Development and Psychopathology*, 20(3), 821-843. <https://doi.org/10.1017/S0954579408000394>
- Blair, C., McKinnon, R. D., & Daneri, M. P. (2018). Effect of the Tools of the Mind kindergarten program on children's social and emotional development. *Early Childhood Research Quarterly*, 43, 52-61.
<https://doi.org/10.1016/j.ecresq.2018.01.002>
- Blair, C., & Raver, C. C. (2014). Closing the achievement gap through modification of neurocognitive and neuroendocrine function: Results from a cluster randomized controlled trial of an innovative approach to the education of children in kindergarten.

PloS One, 9(11), e112393.

<https://doi.org/https://dx.doi.org/10.1371/journal.pone.0112393>

Blewitt, C., Fuller-Tyszkiewicz, M., Nolan, A., Bergmeier, H., Vicary, D., Huang, T., McCabe, P., McKay, T., & Skouteris, H. (2018). Social and emotional learning associated with universal curriculum-based interventions in early childhood education and care centers: A systematic review and meta-analysis. *JAMA Network Open* 1(8), e185727-e185727. <https://doi.org/10.1001/jamanetworkopen.2018.5727>

Bodrova, E., & Leong, D. (2007). *Tools of the Mind: the Vygotskian approach to early childhood education* (2nd ed.). Pearson/Merrill Prentice Hall.

<https://go.exlibris.link/pHC198QT>

Braungart-Rieker, J. M., & Stifter, C. A. (1996). Infants' responses to frustrating situations: continuity and change in reactivity and regulation. *Child Development*, 67(4), 1767-1779. <https://doi.org/https://doi.org/10.1111/j.1467-8624.1996.tb01826.x>

Burkart, S., Roberts, J., Davidson, M. C., & Alhassan, S. (2018). Behavioral effects of a locomotor-based physical activity intervention in preschoolers. *Journal of Physical Activity and Health*, 15(1), 46-52. <https://doi.org/10.1123/jpah.2016-0479>

Campbell-Sills, L., Barlow, D. H., Brown, T. A., & Hofmann, S. G. (2006). Effects of suppression and acceptance on emotional responses of individuals with anxiety and mood disorders. *Behaviour Research and Therapy*, 44(9), 1251-1263.

<https://doi.org/https://doi.org/10.1016/j.brat.2005.10.001>

Carlson, S. M., & Wang, T. S. (2007). Inhibitory control and emotion regulation in preschool children. *Cognitive Development*, 22(4), 489-510.

<https://doi.org/https://doi.org/10.1016/j.cogdev.2007.08.002>

Chimiklis, A. L., Dahl, V., Spears, A. P., Goss, K., Fogarty, K., & Chacko, A. (2018). Yoga, mindfulness, and meditation interventions for youth with ADHD: Systematic review

and meta-Analysis. *Journal of Child and Family Studies*, 27(10), 3155-3168.

<https://doi.org/10.1007/s10826-018-1148-7>

Cochrane. (2014). Data Collection Form for Intervention Reviews: RCTS only. In: Cochrane Collaboration.

Colcombe, S. J., Erickson, K. I., Scalf, P. E., Kim, J. S., Prakash, R., McAuley, E., Elavsky, S., Marquez, D. X., Hu, L., & Kramer, A. F. (2006). Aerobic exercise training increases brain volume in aging humans. *The Journals of Gerontology: Series A*, 61(11), 1166-1170. <https://doi.org/10.1093/gerona/61.11.1166>

Connell, S., Sanders, M. R., & Markie-Dadds, C. (1997). Self-directed behavioral family intervention for parents of oppositional children in rural and remote areas. *Behavior Modification*, 21(4), 379-408.
<http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med4&NEWS=N&AN=9337598>

Cowan, N. (2014). Working memory underpins cognitive development, learning, and education. *Educational Psychology Review*, 26(2), 197-223.
<https://doi.org/10.1007/s10648-013-9246-y>

Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., Yanasak, N. E., Allison, J. D., & Naglieri, J. A. (2011). Exercise improves executive function and achievement and alters brain activation in overweight children: A randomized, controlled trial. *Health Psychology*, 30(1), 91-98. <https://doi.org/10.1037/a0021766>

Denissen, J. J. A., Thomaes, S., & Bushman, B. J. (2018). Self-regulation and aggression: Aggression-provoking cues, individual differences, and self-control strategies. In *The Routledge international handbook of self-control in health and well-being*. (pp. 330-339). Routledge/Taylor & Francis Group.

- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64(1), 135-168.
<https://doi.org/10.1146/annurev-psych-113011-143750>
- Duncan, J. (2001). An adaptive coding model of neural function in prefrontal cortex. *Nature Reviews Neuroscience*, 2(11), 820-829. <https://doi.org/10.1038/35097575>
- Duncan, R. J., Schmitt, S. A., Burke, M., & McClelland, M. M. (2018). Combining a kindergarten readiness summer program with a self-regulation intervention improves school readiness. *Early Childhood Research Quarterly*, 42, 291-300.
<https://doi.org/10.1016/j.ecresq.2017.10.012>
- Durie, M. (1994). *Whaiora: Maori health development*. Oxford University Press.
<https://go.exlibris.link/B456ycnd>
- Eisenberg, N., Cumberland, A., & Spinrad, T. L. (1998). Parental socialization of emotion. *Psychological Inquiry*, 9(4), 241-273. https://doi.org/10.1207/s15327965pli0904_1
- Eisenberg, N., & Fabes, R. A. (1994). Mothers' reactions to children's negative emotions: Relations to children's temperament and anger behavior. *Merrill-Palmer Quarterly*, 40(1), 138-156. <http://www.jstor.org/stable/23087912>
- Eisenberg, N., Fabes, R. A., & Murphy, B. C. (1996). Parents' reactions to children's negative emotions: Relations to children's social competence and comforting behavior [<https://doi.org/10.1111/j.1467-8624.1996.tb01854.x>]. *Child Development*, 67(5), 2227-2247. <https://doi.org/https://doi.org/10.1111/j.1467-8624.1996.tb01854.x>
- Eisenberg, N., Gershoff, E. T., Fabes, R. A., Shepard, S. A., Cumberland, A. J., Losoya, S. H., Guthrie, I. K., & Murphy, B. C. (2001). Mother's emotional expressivity and children's behavior problems and social competence: Mediation through children's regulation. *Developmental Psychology*, 37(4), 475-490. <https://doi.org/10.1037/0012-1649.37.4.475>

- Erdmann, K. A., & Hertel, S. (2019). Self-regulation and co-regulation in early childhood – development, assessment and supporting factors. *Metacognition and Learning*, 14(3), 229-238. <https://doi.org/10.1007/s11409-019-09211-w>
- Erskine, H. E., Norman, R. E., Ferrari, A. J., Chan, G. C. K., Copeland, W. E., Whiteford, H. A., & Scott, J. G. (2016). Long-term outcomes of Attention-Deficit/Hyperactivity Disorder and Conduct Disorder: A systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, 55(10), 841-850. <https://doi.org/https://doi.org/10.1016/j.jaac.2016.06.016>
- Feldman, R. (2009). The development of regulatory functions from birth to 5 years: Insights from premature infants. *Child Development*, 80(2), 544-561. <https://doi.org/https://doi.org/10.1111/j.1467-8624.2009.01278.x>
- Fernyhough, C., & Fradley, E. (2005). Private speech on an executive task: relations with task difficulty and task performance. *Cognitive Development*, 20(1), 103-120. <https://doi.org/https://doi.org/10.1016/j.cogdev.2004.11.002>
- Fishbein, D. H., Domitrovich, C., Williams, J., Gitukui, S., Guthrie, C., Shapiro, D., & Greenberg, M. (2016). Short-term intervention effects of the PATHS curriculum in young low-income children: Capitalizing on plasticity. *The Journal of Primary Prevention*, 37(6), 493-511. <https://doi.org/10.1007/s10935-016-0452-5>
- Flook, L., Smalley, S. L., Kitil, M. J., Galla, B. M., Kaiser-Greenland, S., Locke, J., Ishijima, E., & Kasari, C. (2010). Effects of mindful awareness practices on executive functions in elementary school children. *Journal of Applied School Psychology*, 26(1), 70-95. <https://doi.org/10.1080/15377900903379125>
- Frey, K. S., Hirschstein, M. K., & Guzzo, B. A. (2000). Second Step: Preventing Aggression by Promoting Social Competence. *Journal of Emotional and Behavioral Disorders*, 8(2), 102-112. <https://doi.org/10.1177/106342660000800206>

- Gay, G. (2010). *Culturally responsive teaching: theory, research, and practice* (2nd ed.). Teachers College. <https://go.exlibris.link/1pRNH9QD>
- Graziano, P. A., & Hart, K. (2016). Beyond behavior modification: Benefits of social–emotional/self-regulation training for preschoolers with behavior problems. *Journal of School Psychology, 58*, 91-111. <https://doi.org/10.1016/j.jsp.2016.07.004>
- Gross, J. J. (1998). Antecedent- and response-focused emotion regulation: Divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology, 74*(1), 224-237. <https://doi.org/10.1037/0022-3514.74.1.224>
- Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry, 26*(1), 1-26. <https://doi.org/10.1080/1047840X.2014.940781>
- Hammond, S. I., Müller, U., Carpendale, J. I. M., Bibok, M. B., & Liebermann-Finestone, D. P. (2012). The effects of parental scaffolding on preschoolers' executive function. *Developmental Psychology, 48*(1), 271-281. <https://doi.org/10.1037/a0025519>
- Hart, K. C., Maharaj, A. V., & Graziano, P. A. (2019). Does dose of early intervention matter for preschoolers with externalizing behavior problems? A pilot randomized trial comparing intensive summer programming to school consultation. *Journal of School Psychology, 72*, 112-133. <https://doi.org/10.1016/j.jsp.2018.12.007>
- Havighurst, S. S., Wilson, K. R., Harley, A. E., Kehoe, C., Efron, D., & Prior, M. R. (2013). 'Tuning into kids': Reducing young children's behavior problems using an emotion coaching parenting program. *Child Psychiatry and Human Development, 44*(2), 247-264. <https://doi.org/10.1007/s10578-012-0322-1>
- Havighurst, S. S., Wilson, K. R., Harley, A. E., & Prior, M. R. (2009). Tuning in to kids: an emotion-focused parenting program—initial findings from a community trial [<https://doi.org/10.1002/jcop.20345>]. *Journal of Community Psychology, 37*(8), 1008-1023. <https://doi.org/https://doi.org/10.1002/jcop.20345>

- Healey, D., & Healey, M. (2019). Randomized controlled trial comparing the effectiveness of structured-play (ENGAGE) and behavior management (TRIPLE P) in reducing problem behaviors in preschoolers. *Scientific Reports*, 9(1), 3497.
<https://doi.org/10.1038/s41598-019-40234-0>
- Healey, D. M., & Halperin, J. M. (2015). Enhancing Neurobehavioral Gains with the Aid of Games and Exercise (ENGAGE): Initial open trial of a novel early intervention fostering the development of preschoolers' self-regulation. *Child Neuropsychology*, 21(4), 465-480. <https://doi.org/10.1080/09297049.2014.906567>
- Heatherton, T. F., & Baumeister, R. F. (1996). Self-regulation failure: Past, present, and future. *Psychological Inquiry*, 7(1), 90-98.
https://doi.org/10.1207/s15327965pli0701_20
- Heatherton, T. F., & Wagner, D. D. (2011). Cognitive neuroscience of self-regulation failure. *Trends in Cognitive Sciences*, 15(3), 132-139.
<https://doi.org/https://doi.org/10.1016/j.tics.2010.12.005>
- Herbert, S. D., Harvey, E. A., Roberts, J. L., Wichowski, K., & Lugo-Candelas, C. I. (2013). A randomized controlled trial of a parent training and emotion socialization program for families of hyperactive preschool-aged children. *Behavior Therapy*, 44(2), 302-316. <https://doi.org/10.1016/j.beth.2012.10.004>
- Higgins, J. P. T., Altman, D. G., Gøtzsche, P. C., Jüni, P., Moher, D., Oxman, A. D., Savović, J., Schulz, K. F., Weeks, L., & Sterne, J. A. C. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ*, 343, d5928.
<https://doi.org/10.1136/bmj.d5928>
- Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, 16(3), 174-180.
<https://doi.org/https://doi.org/10.1016/j.tics.2012.01.006>

- Holsen, I., Smith, B. H., & Frey, K. S. (2008). Outcomes of the social competence program second step in Norwegian elementary schools. *School Psychology International*, 29(1), 71-88. <https://doi.org/10.1177/0143034307088504>
- Howard, S. J., Vasseleu, E., Batterham, M., & Neilsen-Hewett, C. (2020). Everyday practices and activities to improve pre-school self-regulation: Cluster RCT evaluation of the PRSIST program. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.00137>
- Hughes, C. H., & Ensor, R. A. (2009). How do families help or hinder the emergence of early executive function? *New Directions for Child and Adolescent Development*, 2009(123), 35-50. <https://doi.org/10.1002/cd.234>
- Humphrey, N., Barlow, A., Wigelsworth, M., Lendrum, A., Pert, K., Joyce, C., Stephens, E., Wo, L., Squires, G., Woods, K., Calam, R., & Turner, A. (2016). A cluster randomized controlled trial of the Promoting Alternative Thinking Strategies (PATHS) curriculum. *Journal of School Psychology*, 58, 73-89. <https://doi.org/https://doi.org/10.1016/j.jsp.2016.07.002>
- Inzlicht, M., Werner, K. M., Briskin, J. L., & Roberts, B. W. (2021). Integrating models of self-regulation. *Annual Review of Psychology*, 72(1), 319-345. <https://doi.org/10.1146/annurev-psych-061020-105721>
- Izard, C. E., King, K. A., Trentacosta, C. J., Morgan, J. K., Laurenceau, J. P., Krauthamer-Ewing, E. S., & Finlon, K. J. (2008). Accelerating the development of emotion competence in Head Start children: Effects on adaptive and maladaptive behavior [Article]. *Development and Psychopathology*, 20(1), 369-397. <https://doi.org/10.1017/S0954579408000175>

- Jackman, M. (2016). OpenMind—a mindfulness-based social emotional learning program for pre-K children: daily practice activities. *Port St. Lucie: Little Lotus Therapy and Consulting*.
- Jackman, M. M., Nabors, L. A., McPherson, C. L., Quaid, J. D., & Singh, N. N. (2019). Feasibility, acceptability, and preliminary effectiveness of the OpenMind (OM) program for pre-school children. *Journal of Child and Family Studies*, 28(10), 2910-2921. <https://doi.org/10.1007/s10826-019-01506-5>
- Jacques, S., & Zelazo, P. D. (2001). The Flexible Item Selection Task (FIST): A measure of executive function in preschoolers. *Developmental Neuropsychology*, 20(3), 573-591. https://doi.org/10.1207/S15326942DN2003_2
- Jones, L. B., Rothbart, M. K., & Posner, M. I. (2003). Development of executive attention in preschool children. *Developmental Science*, 6(5), 498-504. <https://doi.org/https://doi.org/10.1111/1467-7687.00307>
- Keown, L. J., Franke, N., & Triggs, C. M. (2020). An evaluation of a classroom-based intervention to improve executive functions in 4-year old children in New Zealand. *Early Childhood Education Journal*, 48(5), 621-631. <https://doi.org/10.1007/s10643-020-01023-x>
- Kim, E., Jackman, M. M., Jo, S.-H., Oh, J., Ko, S.-Y., McPherson, C. L., Hwang, Y.-S., & Singh, N. N. (2020). Effectiveness of the mindfulness-based OpenMind-Korea (OM-K) preschool program. *Mindfulness*, 11(4), 1062-1072. <https://doi.org/10.1007/s12671-020-01337-2>
- Kong, M. M. Y., & Au, T. K. F. (2018). The Incredible Years parent program for Chinese preschoolers with developmental disabilities [Article]. *Early Education and Development*, 29(4), 494-514. <https://doi.org/10.1080/10409289.2018.1461987>

Kukutai, T. (2020). Family structure and change in early childhood and the wellbeing of tamariki Māori. *New Zealand Population Review*, 46, 70-99.

http://canterbury.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwfV1LS8QwEA4-DnoRn_hYJac9bZe-aw6LiLgoursH9yBeljSZwKKm0lZBb_4Ff5M_zEnSgizopS3kkmYmk-8L880QEOvV931uICVl2KpMkFZxBEABGyFwKoTIlMql8YZs3_BK9kq9WgqN5jbTReylx4v0_ZQ922AObtAaN1vsMw2r5PsAd1TNJ30izqx6CId_0lUAOb4q-dGueox31R6MDmTkhyPV4_NB9Q58Y3-JHoVQF9cBfJqsh-rrVE09GbbCPo5C5LEmTGcbYvevlYm_WTHKYfmoAnjuvhptkowGa9Nx5xhZZAr1N1lodcrVD7lzPC-oqyL6WQLmW1AmB6VxTMKWPqWhLH9tRRIVU3PblgCceLRSt-TOS7cc5HX1_FuV8l0yHl9OLK69pseDpJGWeaecnOVerSnMpOdJVJFBlikNgmWBSgMwlQoAAo1AcSYHbO2eC-VHCGcczT0V7-IuFhn1CE85jSBEMGSVtyBAGKARTCSSxFDwKggPSMYsxs0Ug8b1gi8P_h4_IemIrr376JAVXBk4bhNDjfedWLPgc3IT_ABChLjy

Kusché, C. A., & Greenberg, M. (1994). *The PATHS curriculum*. Channing-Bete Co.

Landis, T. D., Hart, K. C., & Graziano, P. A. (2019). Targeting self-regulation and academic functioning among preschoolers with behavior problems: Are there incremental benefits to including cognitive training as part of a classroom curriculum? [Article]. *Child Neuropsychology*, 25(5), 688-704.

<https://doi.org/10.1080/09297049.2018.1526271>

Landry, S. H., Miller-Loncar, C. L., Smith, K. E., & Swank, P. R. (2002). The role of early parenting in children's development of executive processes. *Developmental Neuropsychology*, 21(1), 15-41. https://doi.org/10.1207/S15326942DN2101_2

- Landry, S. H., Zucker, T. A., Williams, J. M., Merz, E. C., Guttentag, C. L., & Taylor, H. B. (2017). Improving school readiness of high-risk preschoolers: Combining high quality instructional strategies with responsive training for teachers and parents. *Early Childhood Research Quarterly*, 40, 38-51.
<https://doi.org/10.1016/j.ecresq.2016.12.001>
- Larmar, S., Dadds, M. R., & Shochet, I. (2006). Successes and challenges in preventing conduct problems in Australian preschool-aged children through the Early Impact (EI) program. *Behaviour Change*, 23(2), 121-137. <https://doi.org/10.1375/bech.23.2.121>
- Lawson, G. M., McKenzie, M. E., Becker, K. D., Selby, L., & Hoover, S. A. (2018). The core components of evidence-based social emotional learning programs. *Prevention Science*, 20(4), 457-467. <https://doi.org/10.1007/s11121-018-0953-y>
- Leyland, A., Rowse, G., & Emerson, L.-M. (2019). Experimental effects of mindfulness inductions on self-regulation: Systematic review and meta-analysis. *Emotion*, 19(1), 108-122. <https://doi.org/10.1037/emo0000425>
- Lourie, M. (2016). Bicultural education policy in New Zealand. *Journal of Education Policy*, 31(5), 637-650. <https://doi.org/10.1080/02680939.2016.1159339>
- Lumeng, J. C., Miller, A. L., Horodyski, M. A., Brophy-Herb, H. E., Contreras, D., Lee, H., Sturza, J., Kaciroti, N., & Peterson, K. E. (2017). Improving self-regulation for obesity prevention in Head Start: A randomized controlled trial. *Pediatrics*, 139(5), 1-9.
<http://ezproxy.canterbury.ac.nz/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2017-34822-002&site=ehost-live>
- Lutz, J., Herwig, U., Opialla, S., Hittmeyer, A., Jäncke, L., Rufer, M., Grosse Holtforth, M., & Brühl, A. B. (2014). Mindfulness and emotion regulation—an fMRI study. *Social*

Cognitive and Affective Neuroscience, 9(6), 776-785.

<https://doi.org/10.1093/scan/nst043>

Macfarlane, A. H., Webber, M., Cookson-Cox, C., & McRae, H. (2014). *Ka Awatea: an iwi case study of Māori students' success*. Te Rū Rangahau, Māori Research laboratory, College of Education, University of Canterbury. <https://go.exlibris.link/YSZghQxg>

Mak, C., Whittingham, K., Cunningham, R., & Boyd, R. N. (2018). Efficacy of mindfulness-based interventions for attention and executive function in children and adolescents—A systematic review. *Mindfulness*, 9(1), 59-78. <https://doi.org/10.1007/s12671-017-0770-6>

Masseti, G. M., Lahey, B. B., Pelham, W. E., Loney, J., Ehrhardt, A., Lee, S. S., & Kipp, H. (2008). Academic achievement over 8 years among children who met modified criteria for Attention-Deficit/Hyperactivity Disorder at 4–6 years of age. *Journal of Abnormal Child Psychology*, 36(3), 399-410. <https://doi.org/10.1007/s10802-007-9186-4>

McClelland, M. M., Acock, A. C., & Morrison, F. J. (2006). The impact of kindergarten learning-related skills on academic trajectories at the end of elementary school. *Early Childhood Research Quarterly*, 21(4), 471-490. <https://doi.org/https://doi.org/10.1016/j.ecresq.2006.09.003>

McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*, 43(4), 947-959. <https://doi.org/10.1037/0012-1649.43.4.947>

Merrill, B. M., Molina, B. S. G., Cox, S., Gnagy, E. M., Alszuler, A. R., Macphee, F. L., Morrow, A. S., Trucco, E. M., & Pelham, W. E. (2020). Functional outcomes of young adults with childhood ADHD: A latent profile analysis [Article]. *Journal of*

Clinical Child & Adolescent Psychology, 49(2), 215-228.

<https://doi.org/10.1080/15374416.2018.1547968>

Ministry of Education. (2017). *Te Whāriki. He whāriki mātauranga mō ngā mokopuna o Aotearoa: Early childhood curriculum*. Wellington, New Zealand

Ministry of Education. (2020). *Ngā Haeata o Aotearoa: Ka Hikitia 2019 Report*. Wellington, New Zealand

Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H., Houts, R., Poulton, R., Roberts, B. W., Ross, S., Sears, M. R., Thomson, W. M., & Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences*, 108(7), 2693-2698.

<https://doi.org/10.1073/pnas.1010076108>

Montroy, J. J., Bowles, R. P., Skibbe, L. E., McClelland, M. M., & Morrison, F. J. (2016).

The development of self-regulation across early childhood. *Developmental Psychology*, 52(11), 1744-1762. <https://doi.org/10.1037/dev0000159>

Morris, A. S., Silk, J. S., Steinberg, L., Myers, S. S., & Robinson, L. R. (2007). The role of the family context in the development of emotion regulation
[<https://doi.org/10.1111/j.1467-9507.2007.00389.x>]. *Social Development*, 16(2), 361-388. <https://doi.org/https://doi.org/10.1111/j.1467-9507.2007.00389.x>

Murano, D., Sawyer, J. E., & Lipnevich, A. A. (2020). A meta-analytic review of preschool social and emotional learning interventions. *Review of educational research*, 90(2), 227-263. <https://doi.org/10.3102/0034654320914743>

Neudecker, C., Mewes, N., Reimers, A. K., & Woll, A. (2015). Exercise interventions in children and adolescents with ADHD: A systematic review. *Journal of Attention Disorders*, 23(4), 307-324. <https://doi.org/10.1177/1087054715584053>

Nigg, J. T. (2017). Annual Research Review: On the relations among self-regulation, self-control, executive functioning, effortful control, cognitive control, impulsivity, risk-taking, and inhibition for developmental psychopathology. *Journal of Child Psychology and Psychiatry*, 58(4), 361-383.

<https://doi.org/https://doi.org/10.1111/jcpp.12675>

Office of Head Start. (2020). *Head Start Programs*. U.S. Department of Health & Human Services. Retrieved 18th November 2021 from

<https://www.acf.hhs.gov/ohs/about/head-start>

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, 372, n71.

<https://doi.org/10.1136/bmj.n71>

Pandey, A., Hale, D., Das, S., Goddings, A.-L., Blakemore, S.-J., & Viner, R. M. (2018). Effectiveness of universal self-regulation-based interventions in children and adolescents: A systematic review and meta-analysis. *JAMA Pediatrics*, 172(6), 566-575. <https://doi.org/10.1001/jamapediatrics.2018.0232>

Pears, K., Fisher, P., Kim, H., Bruce, J., Healey, C., & Yoerger, K. (2013). Immediate effects of a school readiness intervention for children in foster care. *Early Education & Development*, 24(6), 771-791. <https://doi.org/10.1080/10409289.2013.736037>

Pianta, R., Hamre, B., Downer, J., Burchinal, M., Williford, A., LoCasale-Crouch, J., Howes, C., La Paro, K., & Scott-Little, C. (2017). Early childhood professional development: Coaching and coursework effects on indicators of children's school readiness

[Article]. *Early Education and Development*, 28(8), 956-975.

<https://doi.org/10.1080/10409289.2017.1319783>

Rameka, L., Glasgow, A., Howarth, P., Rikihana, T., Wills, C., Mansell, T., Burgess, F. A., Fiti, S., Kauraka, B., Iosefo, R., Teaching, & Learning Research, I. (2017). *Te whātu kete mātauranga: weaving Māori and Pasifika infant and toddler theory and practice in early childhood education*. Teaching & Learning Research Initiative.

<https://go.exlibris.link/w4bxx04N>

Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F., Bub, K., & Pressler, E. (2011). CSRP's impact on low-income preschoolers' preacademic skills: Self-regulation as a mediating mechanism. *Child Development*, 82(1), 362-378.

<https://doi.org/10.1111/j.1467-8624.2010.01561.x>

Ray, C., Figueredo, R., Vepsäläinen, H., Lehto, R., Pajulahti, R., Skaffari, E., Sainio, T., Hiltunen, P., Lehto, E., Korkalo, L., Sääksjärvi, K., Sajaniemi, N., Erkkola, M., & Roos, E. (2020). Effects of the preschool-based family-involving dagis intervention program on children's energy balance-related behaviors and self-regulation skills: A clustered randomized controlled trial. *Nutrients*, 12(9), 1-19, Article 2599.

<https://doi.org/10.3390/nu12092599>

Razza, R. A., Linsner, R. U., Bergen-Cico, D., Carlson, E., & Reid, S. (2020). The feasibility and effectiveness of mindful yoga for preschoolers exposed to high levels of trauma. *Journal of Child and Family Studies*, 29(1), 82-93. [https://doi.org/10.1007/s10826-](https://doi.org/10.1007/s10826-019-01582-7)

[019-01582-7](https://doi.org/10.1007/s10826-019-01582-7)

Robson, D. A., Allen, M. S., & Howard, S. J. (2020). Self-regulation in childhood as a predictor of future outcomes: A meta-analytic review. *Psychological Bulletin*, 146(4), 324-354. <https://doi.org/10.1037/bul0000227>

- Roskam, I., Stievenart, M., Meunier, J.-C., & Noël, M.-P. (2014). The development of children's inhibition: Does parenting matter? *Journal of Experimental Child Psychology*, 122, 166-182. <https://doi.org/10.1016/j.jecp.2014.01.003>
- Sanders, M. R. (1999). Triple P-Positive Parenting Program: Towards an empirically validated multilevel parenting and family support strategy for the prevention of behavior and emotional problems in children. *Clinical Child and Family Psychology Review*, 2(2), 71-90. <https://doi.org/10.1023/A:1021843613840>
- Sanders, M. R., Kirby, J. N., Tellegen, C. L., & Day, J. J. (2014). The Triple P-Positive Parenting Program: A systematic review and meta-analysis of a multi-level system of parenting support. *Clinical Psychology Review*, 34(4), 337-357. <https://doi.org/10.1016/j.cpr.2014.04.003>
- Savina, E. (2014). Does play promote self-regulation in children? *Early Child Development and Care*, 184(11), 1692-1705. <https://doi.org/10.1080/03004430.2013.875541>
- Savina, E. (2020). Self-regulation in preschool and early elementary classrooms: Why it is important and how to promote it. *Early Childhood Education Journal*. <https://doi.org/10.1007/s10643-020-01094-w>
- Schell, A., Albers, L., von Kries, R., Hillenbrand, C., & Hennemann, T. (2015). Preventing behavioral disorders via supporting social and emotional competence at preschool age. *Deutsches Ärzteblatt International*, 112(39), 647-654. <http://ezproxy.canterbury.ac.nz/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2015-47374-002&site=ehost-live>
- Sheridan, S. M., Knoche, L. L., Edwards, C. P., Bovaird, J. A., & Kupzyk, K. A. (2010). Parent engagement and school readiness: Effects of the getting ready intervention on preschool children's social-emotional competencies. *Early Education and Development*, 21(1), 125-156.

<http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=pnm2&NEWS=N&AN=24683299>

Silkenbeumer, J., Schiller, E.-M., Holodynski, M., & Kärtner, J. (2016). The role of co-regulation for the development of social-emotional competence. *Special Issue: New Approaches to the Study of Early Self-regulation Development*, 2, 16-31.

<https://doi.org/https://doi.org/10.11588/josar.2016.2.34351>

Skibbe, L. E., Montroy, J. J., Bowles, R. P., & Morrison, F. J. (2019). Self-regulation and the development of literacy and language achievement from preschool through second grade. *Early Childhood Research Quarterly*, 46, 240-251.

<https://doi.org/https://doi.org/10.1016/j.ecresq.2018.02.005>

Solomon, T., Plamondon, A., O'Hara, A., Finch, H., Goco, G., Chaban, P., Huggins, L., Ferguson, B., & Tannock, R. (2018). A cluster randomized-controlled trial of the impact of the tools of the mind curriculum on self-regulation in Canadian preschoolers. *Frontiers in Psychology*, 8. <https://doi.org/10.3389/fpsyg.2017.02366>

Somech, L. Y., & Elizur, Y. (2012). Promoting self-regulation and cooperation in pre-kindergarten children with conduct problems: A randomized controlled trial. *Journal of the American Academy of Child & Adolescent Psychiatry*, 51(4), 412-422.

<https://doi.org/10.1016/j.jaac.2012.01.019>

Statistics New Zealand. (2021). *Māori population estimates: At 30 June 2021*. Retrieved from: <https://www.stats.govt.nz/information-releases/maori-population-estimates-at-30-june-2021>

Sun, Y., Lamoreau, R., Samantha, O. C., Horlick, R., & Bazzano, A. N. (2021). Yoga and mindfulness interventions for preschool-aged children in educational settings: A systematic review. *International Journal of Environmental Research and Public Health*, 18(11), 6091. <https://doi.org/http://dx.doi.org/10.3390/ijerph18116091>

- Tamm, L., Epstein, J. N., Loren, R. E. A., Becker, S. P., Brenner, S. B., Bamberger, M. E., Peugh, J., & Halperin, J. M. (2019). Generating attention, inhibition, and memory: A pilot randomized trial for preschoolers with executive functioning deficits. *Journal of Clinical Child and Adolescent Psychology*, 48(Suppl 1), S131-S145.
<https://doi.org/10.1080/15374416.2016.1266645>
- Tang, Y.-Y., Hölzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. *Nature Reviews Neuroscience*, 16(4), 213-225.
<https://doi.org/10.1038/nrn3916>
- Thierry, K. L., Bryant, H. L., Nobles, S. S., & Norris, K. S. (2016). Two-year impact of a mindfulness-based program on preschoolers' self-regulation and academic performance. *Early Education and Development*, 27(6), 805-821.
<https://doi.org/10.1080/10409289.2016.1141616>
- Tominey, S. L., & McClelland, M. M. (2011). Red light, purple light: Findings from a randomized trial using circle time games to improve behavioral self-regulation in preschool. *Early Education and Development*, 22(3), 489-519.
<https://doi.org/10.1080/10409289.2011.574258>
- Tully, L. A., & Hunt, C. (2017). A randomized controlled trial of a brief versus standard group parenting program for toddler aggression. *Aggressive Behavior*, 43(3), 291-303.
<https://doi.org/10.1002/ab.21689>
- Upshur, C., Wenz-Gross, M., & Reed, G. (2013). A pilot study of a primary prevention curriculum to address preschool behavior problems. *The Journal of Primary Prevention*, 34(5), 309-327. <https://doi.org/10.1007/s10935-013-0316-1>
- Webster-Stratton, C. (2001). The incredible years: Parents, teachers, and children training series. *Residential Treatment for Children & Youth*, 18(3), 31-45.
https://doi.org/10.1300/J007v18n03_04

- Webster-Stratton, C., Jamila Reid, M., & Stoolmiller, M. (2008). Preventing conduct problems and improving school readiness: Evaluation of the Incredible Years Teacher and Child Training Programs in high-risk schools. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 49(5), 471-488. <https://doi.org/10.1111/j.1469-7610.2007.01861.x>
- Webster-Stratton, C. H., Reid, M. J., & Beauchaine, T. (2011). Combining parent and child training for young children with ADHD. *Journal of Clinical Child and Adolescent Psychology*, 40(2), 191-203. <https://doi.org/10.1080/15374416.2011.546044>
- Weisleder, A., Mazzuchelli, D. S. R., Lopez, A. S., Duarte Neto, W., Brockmeyer Cates, C., Gonçalves, H. A., Fonseca, R. P., Oliveira, J., & Mendelsohn, A. L. (2018). Reading aloud and child development: A cluster-randomized trial in Brazil. *Pediatrics*, 141(1), 1-12. <https://doi.org/10.1542/peds.2017-0723>
- Whitebread, D., Coltman, P., Jameson, H., & Lander, R. (2009). Play, cognition and self-regulation: What exactly are children learning when they learn through play? *Educational and Child Psychology*, 26(2), 40-52.
- Williford, A. P., LoCasale-Crouch, J., Whittaker, J. V., DeCoster, J., Hartz, K. A., Carter, L. M., Wolcott, C. S., & Hatfield, B. E. (2017). Changing teacher–child dyadic interactions to improve preschool children's externalizing behaviors. *Child Development*, 88(5), 1544-1553. <https://doi.org/10.1111/cdev.12703>
- Wood, A. P., Nocera, V. G., Kybartas, T. J., & Coe, D. P. (2020). Physical activity and cognitive aspects of self-regulation in preschool-aged children: A systematic review. *International Journal of Environmental Research and Public Health*, 17(18), 6576. <https://www.mdpi.com/1660-4601/17/18/6576>

- Xu, W., Zhang, Y., Gao, Z., Zhao, W., Jiang, J., & Li, B. (2018). Effect of mini-trampoline physical activity on executive functions in preschool children. *BioMed Research International*, 2018, 7. <https://doi.org/http://dx.doi.org/10.1155/2018/2712803>
- Yoshikawa, H., Leyva, D., Snow, C. E., Treviño, E., Barata, M. C., Weiland, C., Gomez, C. J., Moreno, L., Rolla, A., D'Sa, N., & Arbour, M. C. (2015). Experimental impacts of a teacher professional development program in Chile on preschool classroom quality and child outcomes. *Developmental Psychology*, 51(3), 309-322. <https://doi.org/10.1037/a0038785>
- Zach, S., Inglis, V., Fox, O., Berger, I., & Stahl, A. (2015). The effect of physical activity on spatial perception and attention in early childhood. *Cognitive Development*, 36, 31-39. <https://doi.org/https://doi.org/10.1016/j.cogdev.2015.08.003>
- Zelazo, P. D., Carlson, S. M., & Kesek, A. (2008). The development of executive function in childhood. In *Handbook of developmental cognitive neuroscience, 2nd ed.* (pp. 553-574). MIT Press.
- Zelazo, P. D., Forston, J. L., Masten, A. S., & Carlson, S. M. (2018). Mindfulness plus reflection training: Effects on executive function in early childhood. *Frontiers in Psychology*, 9(208). <https://doi.org/10.3389/fpsyg.2018.00208>
- Zelazo, P. D., Frye, D., & Rapus, T. (1996). An age-related dissociation between knowing rules and using them. *Cognitive Development*, 11(1), 37-63. [https://doi.org/https://doi.org/10.1016/S0885-2014\(96\)90027-1](https://doi.org/https://doi.org/10.1016/S0885-2014(96)90027-1)
- Zelazo, P. D., Müller, U., Frye, D., Marcovitch, S., Argitis, G., Boseovski, J., Chiang, J. K., Hongwanishkul, D., Schuster, B. V., Sutherland, A., & Carlson, S. M. (2003). The development of executive function in early childhood. *Monographs of the Society for Research in Child Development*, 68(3), i-151. <http://www.jstor.org/stable/1166202>