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Helping Parents Support Their Preschool Children's Learning and Development Through SMS Messages: An Australian Pilot Study

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Abstract
Families are children's first and most important teachers. However, their ability to support children's learning and development at home varies due to knowledge, skills, and confidence. Family interventions aimed at increasing parents' skills are labour-intensive and expensive. In contrast, text messages are low-cost and scalable. Text messages can provide bite-sized bits of information that remind parents of activities they can do in their everyday lives to support learning. Our pilot study replicated two studies from the United States of America (USA) using text messages to increase children's language and literacy development. A mixed methods approach comprising a pre- to post-design and survey was used. Approximately 70 families with preschool children in the Australian Capital Territory received three text messages weekly for 18 weeks. Families were randomly assigned to either the language and literacy group or the control group that received general child development messages. Measurement of the impact of text messages on children's language and literacy skills was not feasible due to COVID-19 constraints. We were able to measure parent knowledge and perceptions of the pilot project pre- and post-text messages. Parent knowledge in both groups moved in the right direction, and approximately 90% of parents reported that the text messages were useful and would recommend the program to other parents. Parents found both sets of texts equally valuable. Our study included highly educated and high-income families, while previous research in the USA were comprised of disadvantaged families. Our findings suggest that text messages about early language and literacy, and general child development are useful to all families.

Keywords Text messages · SMS · Language development · Child development · Early childhood

Introduction

According to the Australian early development census (AEDC), only 54.8% of children in their first year of formal schooling are developmentally on track in all five domains of early childhood development (Department of Education, Skills & Employment, 2022). The AEDC data is collected every three years using the Australian version of the Canadian early development instrument (AvEDI). The five domains are comprised of Physical health and well-being, Social competence, Emotional maturity, Language and cognitive skills and Communication skills and general knowledge. Teachers complete the instrument based on their knowledge and observations of the children. As the AEDC is a population-based measure, results are published at a community rather than an individual level. The percentage of children who were developmentally vulnerable on one or more domains was 22%, while the percentage of children who were developmentally vulnerable on two or more domains was 11.4%. In both cases, there was an increase in the proportion of children developmentally vulnerable from the 2018 data. In the Australian Capital Territory (ACT), the proportion of children who are not on track in the five domains has increased since the AEDC began in 2009. This contrasts with other states and territories where the proportion of children who are not on track has declined or remained stable since the census began (see Fig. 1).

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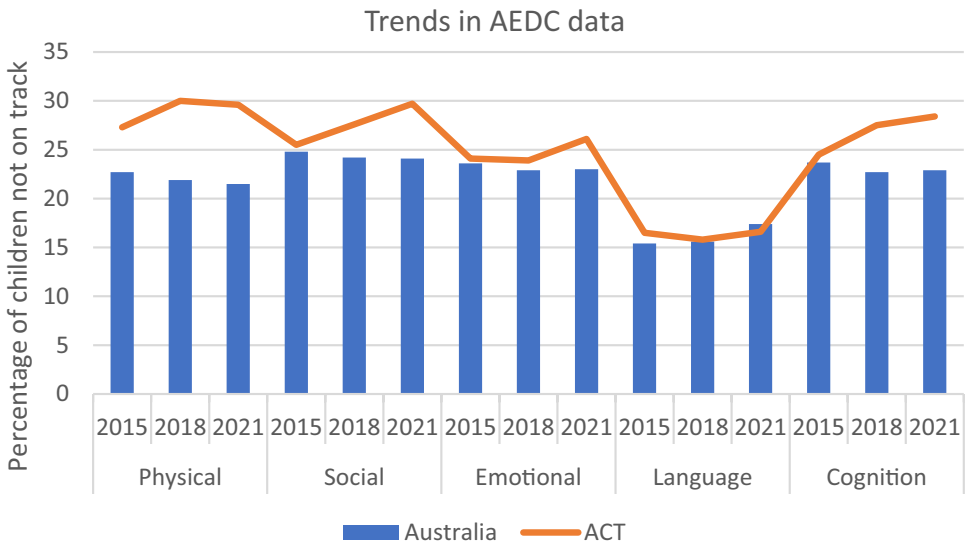

Fig. 1 Histogram showing AEDC trends nationally and in the ACT

The most AEDC data (Department of Education & Employment, 2022) identified 16.6% of children in the ACT as not being developmentally on track for language and cognitive skills, an increase of 3.1% compared with 2012 data. For communication skills and general knowledge, 28.3% of ACT children were reported to be developmentally vulnerable or at risk. This is higher than the national average of 22.9% and matches well with parent report data, with approximately 25% of parents of 4 – 5 year-old children having concerns about their child's communication skills (Harrison et al., 2009). Children who start school behind their peers in their oral language and emergent literacy skills usually stay behind (Spira et al., 2005). Early language difficulties can thus have far-reaching effects and have been associated with lower academic achievement, lower functional literacy skills, poorer vocational prospects and mental ill-health (Law et al., 2009).

Families as Children's First Teachers

Families are children's first and most important teachers; children's learning begins long before they arrive at school. Research has shown that families vary in their ability to support children's learning at home. Children's early language exposure impacts later linguistic skills, cognitive abilities and academic achievement (Romeo et al., 2018). Turn-taking conversations or interactions have been found to be more important than simple vocabulary and word exposure. Children who engage in more conversational turns with positive and responsive adult conversation partners reach language milestones earlier, have higher cognitive functioning, have better social skills and display fewer emotional and behavioural problems (Gilkerson et al., 2017).

Positive and responsive maternal linguistic input is strongly predictive of increased language skills in toddlers and preschoolers (Down et al., 2015; Hudson et al., 2015; Law et al., 2017; Levickis et al., 2014, 2018). Maternal responsiveness behaviours include: expansions (repeating part of the child's utterance and adding new words), imitations (repeating the child's utterance), interpretations (responding verbally to interpret what they think the child is communicating, using context as clues), labelling (providing labels for items or actions directly related to what the child is doing), supportive directives (directing or commanding a child to do something relevant to their current focus of attention), and responsive questions (asking a 'wh' question directly relevant to the child's current focus or actions) (Levickis et al., 2014). Higher maternal self-efficacy scores and higher self-reported developmental knowledge have also been positively correlated with children's expressive and receptive language scores (Alper et al., 2021).

Text Messages to Support Family Interactions with Children

Caregiver-led speech and language interventions have also demonstrated positive impacts on parental responsiveness and the use of language modelling techniques (e.g., Roberts & Kaiser, 2011; Te Kaat-van den Os et al., 2017). These changes to caregiver communication style also result in increased social interaction (Ferjan Ramírez et al., 2019) and positive growth in children's language development (Roberts & Kaiser, 2011). There is, therefore, a need to develop public health, preventative approaches to enable families to actively promote language and early literacy skill development with their children, particularly those who are at risk of developing language or learning difficulties (Law et al., 2013).

Family interventions to increase parents' skills in supporting their children's language and learning can be

labour-intensive and expensive. In contrast, text messages are low-cost and scalable. Text messages are non-intrusive and can provide bite-sized bits of information and activity suggestions available for engagement when convenient. A recent systematic review investigating the use of text messages in health promotion found that text messaging is an effective tool for influencing caregiver behaviour and child outcomes in health (Richardson et al., 2021). The use of text messaging in education is espoused by Castleman (2015), who posits that parents, teachers and administrators can improve educational outcomes by nudging children into more desirable activities and behaviours. Text messages have been used successfully in all levels of education (see Cabell et al., 2019; Doss et al., 2019). Both teachers and families are positive about using text messages to enhance family and school connections and further child outcomes in early childhood settings (Snell et al., 2020).

Digital consumer trends indicate that 92% of Australians have access to Smartphones, an increase of 3% from 2018 (Deloitte, 2021). Meanwhile, 47% of respondents indicated that they use instant messaging apps at least once per day (Deloitte, 2021). Text messages have been used with families in Australian research to reduce the sedentary behaviour of children 2–4 years of age (Downing et al., 2018), improve the weight and dietary outcomes of children aged 4–11 years (Chai et al., 2021), improve clinic attendance in Aboriginal children with otitis media (Phillips et al., 2014), increase breastfeeding rates (Gallegos et al., 2014), support men transitioning to fatherhood (Fletcher et al., 2017), and support fathers of children on the autism spectrum (May et al., 2022).

A growing number of studies have investigated using text messages in the United States early childhood and elementary educational settings. An early study examined whether daily text messages could increase parental engagement in learning activities with their young children (Hurwitz et al., 2015). In this study, parents of children enrolled in Head Start programs who were assigned to the treatment group received daily messages with parent–child activity suggestions targeted to the child's age or words of encouragement for 6 weeks. These text messages changed themes each week and focused on literacy, mathematics, science etc. At the end of the intervention, parents in the treatment group reported engaging in more learning activities with their child than parents who did not receive the messages. Uptake of the suggested activities varied across the sample, but more than 90% engaged with some, most, or all of the activities. Parents who received the messages were very positive about receiving messages. No child measures were taken to assess whether the messages had effects on child functioning or outcomes, nor was there a pretest survey for parents.

In another study, text messages were used to ameliorate learning losses over the summer and increase reading activity in first through fourth graders (Kraft & Monti-Nussbaum, 2017). Parents randomly assigned to the treatment group received 18 messages over the two summer months, while parents in the control group received messages about school-related summer events. The messages used "Pro-tips" focused on resources, ideas and signals that families could use. Children's reading comprehension was measured three times during the next school year. The authors found positive effects on reading comprehension for third and fourth graders whose parents had received the project messages but not for first and second graders. It seems reasonable to suggest that younger children were still learning to read, while the older children were more fluent and able readers to begin with, and benefited more from the generic messages.

Text Messages to Increase Preschool Language and Literacy Development

Two studies (Cabell et al., 2019; York et al., 2019) have investigated using text messages to increase preschool children's literacy development in everyday family activities. In the study by York et al. (2019), families in the treatment group received three texts a week over 8 months; focusing predominantly on literacy skills, using a Fact, Tip and Growth pattern. Families in the control group received a placebo text approximately once a fortnight related to kindergarten enrolment procedures or required vaccinations. They found preschool children whose families received the treatment texts had higher literacy screening scores than children in the control group. Parents reported engaging more in home literacy activities and found the texts useful. York et al. followed the preschool cohort into school to explore the use of differentiated and personalised text messages in Kindergarten (Doss et al., 2019). Families in the differentiated treatment group received different Tip and Growth text messages according to their child's literacy levels as measured by parent reports initially and later by reading scores administered by classroom teachers. Control group families received one text a fortnight with general school district information. They found children whose families received the personalised texts were 63% more likely to move up a reading level.

Cabell et al. (2019) extended the work of York et al. (2019) by sending more actionable text messages and having a more robust treatment comparison group. The intervention group received actionable literacy and language messages with an activity and sample script. In contrast, the comparison group received the same number of information-based texts, focusing on health and well-being over 25 weeks. Unexpectedly they found that the comparison group had better literacy outcomes at the end of the study. There was a significant interaction where children who started preschool with relatively higher literacy skills benefited from the

language and literacy text messages, while children entering with lower skills appeared to benefit from the health messages. The authors presented several reasons for this, including that parental responsiveness to basic needs may have resulted in better academic performance. For example, messages on healthy sleep habits may have led to the child sleeping more and having better attention and memory. Both of these studies targeted disadvantaged families.

More recently, Snell et al. (2022) investigated using text messages to support child vocabulary learning and home-school connection. There was no classroom intervention; however, all teachers were mandated by the district to read three books a day from their libraries of curriculum-recommended books and used the Creative Curriculum as curriculum guidelines. As such, children in the study were exposed to the same read-aloud books and vocabulary. The treatment group received weekly messages with vocabulary words taught in class and possible activities and information related to the words over a 5 month period. The control group received business-as-usual messages from the teacher. Children's vocabulary was measured pre- and post-intervention. The results showed that the children in the intervention group learned significantly more words than children in the control group according to Target Word Assessments but not in the standardised test.

Scheepers et al. (2021) conducted similar research, measuring emergent literacy skills before and after a 20 week text message intervention in South Africa, using a mHealth literacy resource called CareUp. In this instance, findings indicated that the experimental group and the control group were comparable with no significant differences in performances in any subtests. The researchers pointed to usage data indicating that 81% of the parents that received the application used it less than 50% of the active days. If the application was not opened regularly, the reminder and activity automatically stopped. To this end, recommendations included both that parents may need additional support in the program, and that text messages should continue regardless of parents' usage.

In Australia, Barratt-Pugh et al. (2022) investigated influences to recruitment and parent attrition to a literacy-based text messaging program for parents with a child at Kindergarten in Western Australia (WA). Kindytext, designed to promote key early childhood literacy skills, focuses on concepts about print, oral language and phonological awareness and symbols and pattern systems. Their findings indicated that teacher involvement in the program may be a crucial factor in enabling parents to access texting programs. Additionally, once parents were connected to the program, their results demonstrated an 80% retention result in the 30-week program, with the highest parent attrition occurring in the first 7 weeks. Accordingly, they reiterated support for the appropriateness of a model of three texts per week.

The aims of this pilot study were threefold: first, to replicate the York et al. (2019) and Cabell et al. (2019) studies with an Australian sample; second, to examine the efficacy of the messages to improve parent's knowledge of language and literacy and child development; and third, to explore the receptivity of educational text messages by parents.

Method

Mixed methods with a quasi-experimental pre-post-test design and survey were used to explore the feasibility and acceptability of text messaging as a means of providing information and increasing parent capacity to support their child's language and literacy skills or general development. We use the term parents to include caregivers, kinship carers, grandparents, foster carers, and others.

Sample

Due to COVID-19, there was a moratorium on research in the public school system, reducing the reach of our recruitment strategy. In the ACT, the Education Directorate provides universal preschool education (15 h of funded preschool). We approached all eight Catholic schools and three independent schools in the ACT and all early childhood education and care (ECEC) centres in two regions that offered a preschool program to advertise the study. Approximately half of the schools and centres advertised the study. From these schools and ECEC centres 80 parents agreed to participate in the study and receive text messages (n = 41 in the language group and n = 39 in the child development group). A total of 48 parents (60% response rate) completed the pre-test survey (24 in the language and literacy group and 24 in the child development group). Six parents opted out of receiving messages during the intervention leaving 74 parents in the study. Fifty-one parents (67% response rate) completed the post-test survey (26 in the language and literacy group and 25 in the child development group).

Measures

The parent survey included demographic questions, global items about knowledge and confidence and specific knowledge questions related to either language development or child development. There were 15 parent knowledge questions for the language and literacy group and 14 parent knowledge questions for the child development group. These items were based on a survey developed by Suskind et al. (2016) measuring parent knowledge of young children's cognitive ability, language acquisition and mathematics learning and how parent engagement and media use affects children's development. The current survey was modified in three

ways: (1) to be more suited to the Australian context, (2) to be appropriate to the preschool age of the children, and (3) to match the text message topics. Despite these adaptions, the survey items were reflective of current research (Suskind et al., 2016). The research team included an early childhood academic, speech pathologist, occupational therapist, preschool teacher and early childhood preservice teacher. Two sets of questions were developed. The language items were related to oral language, reading, phonological awareness, letters and sounds, writing, and vocabulary. The child development items were related to sleep, screen time and physical activity, play, and self-regulation/school readiness. These topics aligned with the text message topics for both groups. A five-point Likert scale was used with all items having the same response categories strongly disagree, disagree, neither agree nor disagree, agree and strongly agree. Each item was scored as either correct or not correct by collapsing the agree, strongly agree and disagree and strongly disagree into two categories. Neutral responses were scored as not correct. A total score was calculated by the total number of correct responses.

In the post-survey, nine additional items asked parents about their acceptability of, and engagement with, the text messages they received. There were both Likert-scale and qualitative items. These questions included how many messages they read, how useful the messages were, how many of the messages gave them ideas that they used with their child, whether they clicked on any of the links to websites, and if they did, whether they read the information, whether they would recommend the program to other preschool parents and the reasons for their response, how the program could be improved and any other comments about the program. Questions relating to number of messages read, ideas used and weblinks followed were used as a blunt measure of implementation fidelity.

Ethics

Ethics approval to conduct this research was obtained from the University of X Human Research Ethics Committee (11,614). Online consent to participate in the research was gained from all participants. As a result of the reduced target sample, it was decided to pilot the messages and focus on parent perceptions and knowledge rather than make comparisons between the two groups. No child measures were taken despite having ethics approval to do so.

Procedure

Families agreed to receive three text messages a week for 18 weeks. Families were randomly assigned to either the language or child development group. Messages were scheduled Monday, Wednesday and Friday of each week at 2:30 pm. In week one of the program, parents were asked to complete a short online survey via a link in one of the messages. At the end of Week 18, parents were asked to complete another survey. The questions were the same at both times, with additional items about the text messages and their usefulness in the second survey. The surveys took between five to ten minutes to complete.

The messages were adapted from Cabell et al. (2019) and York et al. (2019) and used York's TIP, FACT, FACT format. The research team ensured the messages were appropriate for Australian audiences and aligned with current guidelines such as the Australian 24 h Movement Guidelines for the Early Years (birth to 5 years): An Integration of Physical Activity, Sedentary Behaviour, and Sleep (Department of Health & Aged Care, 2017). There were six topics in the language development group, each with 2–4 groups of messages, that were rotated during the 18 weeks. In contrast, the control group maintained 5 topics with 3–5 groups of messages that were rotated throughout the 18 week cycle (see Fig. 2 for examples of the text messages). The control group differed insofar that a link to a website was included in the final tip message of each topic to give parents further information if they so desired.

Quantitative Analysis

Non-parametric inferential analyses were performed using IBM SPSS Statistics version (Version 29). Non-parametric methods were chosen given the sample size per group ($n < 30$) and non-normal distribution of data. Chi-square statistics were used to measure (i) between-group differences in knowledge and confidence at each time point; (ii) within-group differences in knowledge and confidence across time points; (iii) between-group differences in perceptions of text message usefulness, provision of new ideas and the likelihood of clicking an embedded link; and (iv) between-group differences in whether participants would recommend the program to others. Mann–Whitney U was used to explore differences in specific content knowledge accuracy scores related to group assignment or English as an additional language or dialect (EAL/D) status. Kruskall-Wallis was used to explore the association between specific content knowledge accuracy scores and multi-category individual participant factors such as education level, income, self-reported knowledge and self-reported confidence. For Kruskall-Wallis tests, p values were set at 0.01 to adjust for multiple comparisons.

Qualitative Analysis

Reflexive thematic analysis (RTA) was used (Braun & Clarke, 2022) to identify themes and contrasting experiences across all survey responses. RTA's flexibility offers an inductive analysis approach and generation of central, organising

Language and literacy texts

Teaching letters and sounds (Set 1)

FACT: Letters are the building blocks of written language. Children need to know the letters to learn how to read and write.

TIP: Pointing to the letters when you read a book to your child helps them get ready to read. Say, 'I see an S. Do you see any letters you know?'

TIP: When reading a book, stop and say, "What letter is this?" If your child needs some help, offer a choice, 'Is it P or R?' If they get it wrong say 'Good try, but this letter is R.'

Vocabulary messages (Set 2)

FACT: Children need exposure to new words 12 times for the words to become part of their vocabulary. Books are great for exposing children to words that we don't use in everyday conversations.

TIP: In order to expand your child's vocabulary, give more details. For example, when talking about an animal, identify its features: nose, fur, whiskers, claws, paws and mane.

TIP: Explain the meaning of new words and give them opportunities to use the words in conversations. For example, 'Amused means you think something is funny. I am amused when the dog chases it tail. When are you amused?'

Child development texts

Screens and physical activity messages (Set 2)

FACT: Too much time spent on screens can be harmful to your child's development. Limit time watching TV or playing with phones, computers, or tablets to 1 hour or less a day.

TIP: Supervise your child's use of devices. Encourage the use of all screens in areas with adults. Make bedrooms screen-free zones.

TIP: Watch TV programs or play computer games/apps with your child. Children learn best with their families.

Play messages (Set 3 with link for further information)

FACT: Play is the 'work' of a child. It is important to allow your child to have long uninterrupted episodes of play.

TIP: Did you know that pretend play (or make-believe play) helps children develop their thinking, language, social and emotional skills? Pretend play also helps children play for longer duration. You can help you child engage in pretend play by providing basic props or role playing with them.

TIP: Play can occur during everyday activities such as during bath time or driving in the car. Consider making tasks and chores into games too! For more great ideas on play please visit the play and learn together website at www.playandlearntogether.com.au

Fig. 2 Examples of text messages for language and literacy and child development groups

themes across the collected survey qualitative responses (Braun & Clarke, 2022). The third author, less involved with the design and delivery of the project, completed the analysis and maintained a conscious curiosity throughout the analysis to enhance analysis quality (Braun & Clarke, 2022). Multiple readings generated codes that were collated into clusters of meaning to construct candidate themes. Thematic mapping in discussion with the first author was used to explore candidate themes and increase reflexivity visually. Finally, central organising themes were established.

Results

Demographics

The majority of respondents in both groups, pre and post intervention, identified with English as their primary language. Respondents in both groups also tended to be highly educated (Bachelor level qualifications or above) and reported high household incomes ($90,001 and above) (see Table 1).

Most parents considered themselves both knowledgeable about language and general child development (depending on the group they were in) and confident in supporting their children's learning in both pre- and post-surveys. There were no significant differences between the groups on self-reported knowledge or confidence pre-intervention (knowledge Chi-square = 1.63, p = 0.44; confidence Chi-square = 2.59, p = 0.46). Eighty percent or more of parents rated themselves as somewhat or extremely knowledgeable and confident (see Table 2).

Survey Scores

There were no statistically significant differences between the two groups on any demographic variable (sex, EAL/D status, education P1, education P2 or income). There was a statistically significant difference between the two groups on their survey accuracy scores pre-intervention, with the child development group demonstrating higher knowledge scores than the language group. This difference was maintained post-intervention and cannot be explained by any other baseline differences between groups (see Table 3).

There were no significant associations between parent self-ratings of knowledge or confidence, EAL/D status, parent education or income, and survey scores in either group pre-intervention and no significant associations between parent self-ratings of confidence, EAL/D status, parent education or income for either group post-intervention. Kruskall-Wallis revealed a significant association between parent self-ratings of knowledge and survey

Table 1 Language, education and income demographics

	Language group pre-test (n = 24)	Language group post-test (n = 26)	Child development pre-test (n = 24)	Child development post-test (n = 25)
EAL/D status				
No	19 (79%)	23 (88%)	20 (83%)	21 (84%)
Yes	5 (21%)	3 (12%)	4 (17%)	4 (16%)
Education Parent 1				
Masters/PhD	6 (25%)	6 (23%)	8 (33%)	8 (32%)
Bachelor's degree	14 (58%)	19 (73%)	10 (42%)	12 (48%)
TAFE	1 (4%)	0 (0%)	6 (25%)	5 (20%)
Year 12	2 (8%)	1 (4%)	0 (0%)	0 (0%)
Year 10	1 (4%)	0 (0%)	0 (0%)	0 (0%)
Education Parent 2				
Masters/PhD	4 (17%)	5 (19%)	1 (4%)	1 (4%)
Bachelor's degree	14 (58%)	17 (65%)	10 (42%)	12 (48%)
TAFE	3 (13%)	2 (8%)	11 (46%)	10 (40%)
Year 12	2 (8%)	2 (8%)	1 (4%)	1 (4%)
Year 10	1 (4%)	0 (0%)	0 (0%)	0 (0%)
N/A	0 (0%)	0 (0%)	1 (4%)	1 (4%)
Income categories				
$180,000 +	10 (42%)	14 (54%)	14 (58%)	15 (60%)
$90,001–$180,000	11 (46%)	11 (42%)	8 (33%)	9 (36%)
$37,001–$90,000	1 (4%)	1 (4%)	2 (8%)	0 (0%)
Less than $37,000	1 (4%)	0 (0%)	0 (0%)	1 (4%)
Not specified	1 (4%)	–	–	–

scores post-intervention when both groups were considered together. This association was maintained only for the Language group when post hoc comparisons were performed for each group separately. Those who self-rated as extremely knowledgeable achieved higher survey scores than those who rated their knowledge level as neutral (Kruskall-Wallis = − 12.33, p = 0.04) or not at all knowledgeable (Kruskall-Wallis = − 19.83, p = 0.02). However, when adjusting the p-value to 0.01 to account for multiple comparisons, the association was no longer significant (Table 4).

Item Analysis

Responses on the parent knowledge items, while not statistically significant, showed movement in the anticipated direction. That is, for the majority of items, there were higher scores post-survey than pre-survey (see Figs. 3 and 4).

Implementation Fidelity

The majority of respondents (76.5%, n = 39) reported reading all of the text messages and 17.6% (n = 9) reported

Table 2 Parent self-reports of knowledge of language development and child development and confidence in supporting their children's learning

	Language group pre-test (n = 24)	Language group post-test (n = 26)	Child development pre-test (n = 24)	Child development post-test (n = 25)
How knowledgeable are you about child development and learning?				
Extremely knowledgeable	4 (17%)	3 (12%)	3 (13%)	6 (24%)
Somewhat knowledgeable	15 (63%)	18 (69%)	19 (79%)	18 (72%)
Neutral	4 (17%)	3 (12%)	2 (8%)	0
Not very knowledgeable	0	1 (4%)	0	1 (4%)
Not at all knowledgeable	1 (4%)	1 (4%)	0	0
How confident are you in supporting your child's development and learning?				
Extremely confident	4 (17%)	6 (23%)	3 (13%)	5 (20%)
Somewhat confident	16 (67%)	18 (69%)	20 (83%)	19 (76%)
Neutral	3 (13%)	1 (4%)	1 (4%)	0
Not very confident	1 (4%)	1 (4%)	0	1 (4%)
Not at all confident	0	0	0	0

Table 3 Survey accuracy scores for language and child development groups pre- and post-intervention

Timepoint	Group		Test	Significance
	Language mean rank	Child development mean rank	Mann–Whitney U statistic	
Pre-intervention	17.42 (n = 24)	31.35 (n = 24)	458.00	< 0.001
Post-intervention	21.88 (n = 26)	30.28 (n = 25)	432.00	0.04

There were no changes to self-reported knowledge or confidence from pre- to post-intervention for either the language group (knowledge: Chi square = 2.84, p = 0.59, confidence: Chi square = 1.44, p = 0.70) or the child development group (knowledge: Chi square = 4.01, p = 0.26; confidence: Chi square = 2.51, p = 0.47)

Table 4 Association between survey scores and demographic factors, self-reported knowledge and self-reported confidence

	Pre-intervention		Post-intervention	
	Kruskall-Wallis statistic	Significance (p)	Kruskall-Wallis statistic	Significance (p)
Self-reported knowledge	2.88	0.24	11.04	0.03*
Self-reported confidence	4.37	0.22	3.19	0.36
Income	7.54	0.06	3.64	0.30
Education P1	6.96	0.14	3.44	0.33
Education P2	5.37	0.25	2.51	0.47
	Mann–Whitney U	Significance (p)	Mann–Whitney U	Significance (p)
EAL/D	194.5	0.65	203.0	0.44

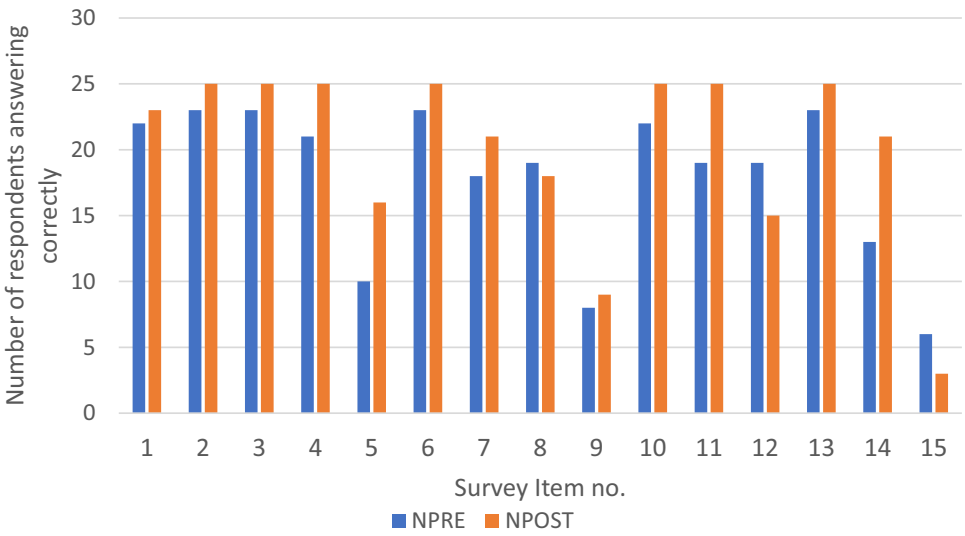

Fig. 3 Correct responses per survey item pre- and post-intervention for the language group

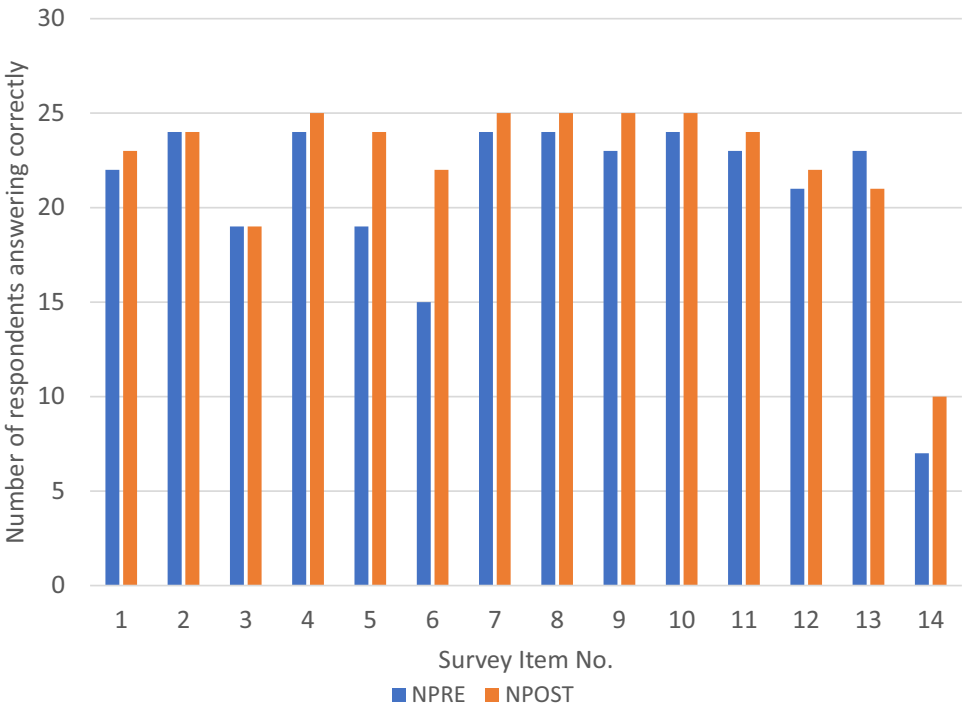

Fig. 4 Correct responses per survey item pre- and post-intervention for the child development group

reading nearly all of them. Only two respondents indicated they had read half (n = 1) or hardly any (n = 1) of the text messages. Similarly, most respondents reported having implemented the ideas provided by the text messages with their children. 45% of respondents (n = 23) reported using about half of the ideas in the messages, 31.4% (n = 16) reported using nearly all the ideas, and 11.8% (n = 6) of respondents reported using all of the ideas offered by the text messages over the course of the intervention.

Usefulness of the Text Messages

The post-survey revealed that the majority of parents valued the text messages and would recommend the program to other preschool parents. Approximately 90% of parents reported that the messages were somewhat or extremely useful and would recommend the program to others [88% (n = 23) of the language group and 92% (n = 23) of the child development group]. There were no significant differences between groups with respect to the proportion

of respondents who found the text messages useful (Chi square = 5.46, p = 0.14), the number of text messages read by respondents (Chi square = 4.94, p = 0.18), the number of new ideas presented in the text messages and implemented by respondents (Chi square = 2.14, p = 0.71), nor the number of respondents per group who reported that they would recommend the program to others (Chi square = 0.18, p = 0.67). There were no significant individual covariates that predicted whether or not a respondent found the text messages useful (see Table 5).

Qualitative Responses

The qualitative responses within the post-survey across the responses were predominantly positive about the program. Responses appeared to meet saturation as similar responses were reported amongst respondents. All responses from both groups were combined, coded and clustered into three central organising themes illustrating respondents' acceptability and gains in knowledge:

1. Parent knowledge
2. Meeting diverse parent needs
3. Text messages were helpful

Codes are used when presenting quotes from parent responses. For example, L5 is the fifth respondent from the language group, while CD2 is the second respondent from the child development group.

Parent Knowledge

Increasing parent knowledge and subsequent interaction with their children was a research objective and was evident in post-survey responses. This theme identified two subthemes 'I have knowledge' and 'It has increased my knowledge'. Within 'I have knowledge', respondents acknowledged the benefits of being reminded about their knowledge and reminded to interact with their children; for example, CD23 valued 'prompts to remind me of things to do'. Others commented that the strategies were 'common sense' (CD16, L21 and L25) yet acknowledged the benefits of the program: 'but on the other hand, some were very insightful' (L25). Of interest was that three respondents felt the program would benefit other parents more than themselves: 'great for parents who have less knowledge about child development' (CD21), 'I knew some of the factual information already, but some parents would not have the same level of knowledge and would strongly benefit' (CD25), 'I believe this program would be hugely beneficial for [other] families' (CD19).

The second sub-theme, 'It has increased my knowledge', demonstrated that this program did meet its intended objectives. This was evidenced by the following comments:

- 'This program gave me great hints for engaging in language activities as well as understanding why these activities are so important' (L17)
- 'I have learned a lot from the program' (L17)
- 'As a primary school teacher, I also found information useful professionally for better understanding student needs transitioning to our kindergarten site' (CD12)

Table 5 Individual predictors of usefulness

	Chi square statistic	Significance (p)
Self-reported knowledge	3.82	0.99
Self-reported confidence	6.88	0.65
EAL/D	0.86	0.84
Income	4.41	0.88
Education P1	11.27	0.26
Education P2	8.99	0.44

Meeting Diverse Parent Needs

This theme represents respondents' reported needs of resources to increase their knowledge and capacity, and how to utilise the text messages. Parents valued the text message approach yet had various needs regarding when they could access these and how best to access the information. It also encompasses parents' needs to meet the diversity of their children's learning and support needs. Table 6 illustrates examples of diverse parent needs.

Text Messages Were Helpful

Most respondents found the text messages helpful and reinforced their parenting efforts. Illustrative examples of this included:

- 'Gave me ideas on how to build my son's learning during the year' (L9)
- 'Easy, bite-size tips to support learning and could be brought into the home' (L18)
- 'It did reassure me that I'm doing some things right' (CD16)

Of the six respondents who did not find the text messages helpful, one found the messages moralising and judgemental and they felt the messages made them feel 'guilty and defensive rather than supported' (CD3). Another identified that their child had specific, additional feeding needs (CD15) and the nutrition texts 'made me feel like a poor parent as I could

Table 6 Illustrative quotes of parents' needs for text messages

Topic	Illustrative quotes
Messages parents would like to receive	Give me more specific games to play to enforce the concepts. (L22) Maybe some useful videos for the activities or info….giving more links to resources available…give examples online how to do [it]. (CD5) Maybe a bit more about how and why following the messages. (CD25) Being able to contact you, and other people [who receive the text messages]. (CD8)
How parents want text messages	Ask what schedule (days of the week/time of day) is best to receive messages….Run the program from Easter would have been better timing…would have given more of the year to use. (L16) Even more messages! (L17) Less frequency of messages. (CD15)
Need for personalisation/differentiation in messages	The activities suited my 3 year-old, not my preschool child. (L3) Stream it. Ask where the children are up to with their reading and how comfortable they are and stream to pre-reading and beginning reading. (L3) Not all children are the same….just in my children I can see huge differences. (CD14)

not do any of them with my child.' Some other parents did not like the text format (too brief and too intrusive).

Parents who received the child development text messages were asked what topics they found most useful, while those in the language group were not asked a similar question due to the much narrower focus of topics. Parents could select more than one topic. Messages related to play were reported by parents as the most helpful topic (80%, n = 20), followed by school readiness (60%, n = 15). Sleep was rated as the least helpful topic (16%, n = 4), while nutrition and screen time/physical activity messages were mentioned by approximately a quarter of parents (28% and 24%, respectively). These parents also received links to websites with additional information for each topic. Just over half the parents (52%, n = 13) reported clicking on the links, and all reported reading information on the websites.

Discussion

Findings from this study suggest that text messages aimed at increasing parent knowledge and confidence in supporting their children's language skills and general development were acceptable to our sample of highly educated, high-income and English-speaking Australian parents. The substantive differences in demographic makeup of our respondents compared to those from previous studies (Cabell et al., 2019; Doss et al., 2019; Hurwitz et al., 2015; Kraft & Monti-Nussbaum, 2017; York et al., 2019) is likely due to differences in recruitment strategies. In the aforementioned studies, recruitment was targeted towards low-income areas with high rates of cultural and linguistic diversity, whereas in this study, recruitment occurred via Catholic preschools and private or not-for-profit early childhood education and care centres across the ACT. This may have resulted in selection bias since parents self-selected to participate in the study.

Nevertheless, the general upward trends in parent responses to knowledge items from pre- to post-surveys indicate that the messages can increase high income, educated parent's knowledge and confidence in supporting their children's learning and development, possibly building on their prior education and knowledge. Our study provides evidence that text messages can benefit all families, including those with high education, and enhance knowledge and capacity, not just disadvantaged families, as reported in the two studies this project replicated (Cabell et al., 2019; York et al., 2019). Alternatively, since Kraft and Monti-Nussbaum (2017) demonstrated no effect of SES, these demographic differences between the current study and previous studies may be unimportant.

Parent self-reports of developmental knowledge and confidence in supporting their child's learning in both the pre and post surveys was very high, with more than 80% of parents rating themselves as somewhat or extremely knowledgeable and confident. Given the sample of mostly tertiary educated parents, it is unsurprising to see a high self-rating of knowledge and confidence to support their child's literacy and development. This finding replicates previous research where high self-reports of home learning behaviours in the pre-test caused a ceiling effect (Snell et al., 2022). While we could not show statistical increases in parent knowledge pre- and post-intervention, overall trends in responses showing increased percentages of correct responses post-survey indicate that the text messages may increase parents' knowledge of language and child development. As we were unable to measure children's outcomes due to COVID-19 restrictions, we cannot report on whether increased parent knowledge led to improved child outcomes. Future research will investigate this.

The results from this study showed that most parents thought the text messages were useful, helped them to support their children's development, and would recommend the program to other preschool parents. These findings

align with those of previous studies exploring the feasibility, acceptability, and usefulness of a text messaging program (Doss et al., 2019; Hurwitz et al., 2015; York et al., 2019). Satisfaction with an intervention is defined as a service user's emotional responses to the gap between their wishes for and expectations of the intervention and their perception of what they actually received or gained from it (Gerkensmeyer et al., 2006). In our project, as evident through survey responses, parents provided positive comments about how text messages helped them support their children's development. This finding aligns with previous research where text messages with educational messages were well received by parents (Hurwitz et al., 2015; Kraft & Monti-Nussbaum, 2017). Despite parents in our sample being highly educated, many of them reported that the messages reinforced what they were doing or reminded them of what they already knew to do. This study contributes to the evidence-base demonstrating that providing additional parenting strategies to educated parents enhances their reported satisfaction and prompts them to use the strategies that they know to support their children's development.

Consistent with other text messaging interventions (Grutzmacher et al., 2018; Snell et al., 2020), we experienced low attrition levels. Less than 10% of parents opted out of receiving text messages throughout the project. This is much lower than typical dropout rates for other types of interventions. As Cabell et al. (2019) note, text messages are not a panacea for closing the achievement gap (p. 2). Nonetheless, our findings align with Doss et al. (2019) assertion that text messages can provide more than a nudge encouraging parents to engage in behaviours that support their children's learning and development, breaking down the complex task of parenting into achievable increments during everyday activities.

Another important finding from the study was that the control group's messages were just as well received and valued as the language messages. Thus, the control group messages appeared to be an intervention in their own right. In particular, parents found messages related to play and school readiness as the most helpful topics. It is not surprising that preschool parents found the school readiness texts helpful as the intervention occurred during the final two terms of preschool when families are typically enrolling their child in school, engaging in orientation visits or receiving information about starting school. It was unexpected that the play messages would be so highly rated by parents as helpful; we did not ask for further information, so it is difficult to explain this finding. Plausible explanations include a lack of parental knowledge on play, parental interest in play-based learning, or that parents were not aware of the benefits of play.

Qualitative data from parents about text messages align with the extant literature on text messages and give strong directions for future interventions. Several parents asked for more nuanced text messages and different sources of information, such as website links, videos and images. Research also suggests the ability to interact and share through social media could increase parental involvement and children's literacy gains and could be considered in future studies (Kraft & Monti-Nussbaum, 2017). More importantly, previous research by Doss et al. (2019) found that personalised and differentiated literacy text messages led to increased student literacy skills more than generalised text messages; specifically, these effects were concentrated at the tails of the skills distribution, that is, for low and high-achieving students. Parents in the personalised text messages group also responded more positively on measures related to ease of implementation of the strategies (Doss et al., 2019). To this end, our parent feedback also suggests that, optimally, educational text messages should be highly personalised to family and child needs to meet both parent and child knowledge and skills.

An important learning for future projects is to include a clear statement in the information and consent forms and in the introductory messages that the text messages are targeted at typically developing children and may not be appropriate for children with additional needs. We regret causing distress to the two parents who felt undermined by the text messages. Additionally, based on parent comments, we will give parents choices of when they receive the messages (morning, afternoon, or evening) and create a website where the text messages are stored (once they have been sent out), allowing parents to easily retrieve messages and links to further information on the topics within the text messages. This was consistent with the findings of Kraft and Monti-Nussbaum (2017) that design and implementation matters. Families may face any number of barriers to engagement with such a program, including but not limited to, working hours of parents, additional siblings and extra-curricular activities.

Finally, text messages in this study were available only in English which may have led to selection bias if only those parents with sufficient oral and written English language proficiency opted to participate. Given the high percentage of English as a Second Language or Dialect (EAL/D) in Australia, this may have contributed to the limited diversity of the cultural and linguistic backgrounds of the respondents in our study. Future research should consider offering a language preference with the text messages. The READY4K! Project by Doss et al. (2019) and York et al. (2019) offered messages in three languages. The CareUp program studied by Scheepers et al. (2021) was offered in 4 languages to parents. In addition, the Kindytext program in WA deliberately kept texts short and simple, partly because it was available only in English; to this end Barratt-Pugh et al. (2022) recommended personalising text messages through translation.

We will continue with three messages a week based on: very few parents made comments on the number or frequency of text messages and findings from Loeb Cortes et al. (2021) indicate that three messages a week were associated with greater parent satisfaction and parental engagement than one or five messages a week.

This program targeted preschool-aged language, literacy, general child development, and health promotion through interprofessional expertise to develop the text message context. As allied health professionals (particularly speech pathologists and occupational therapists) experience high service demands and long waiting lists within Australia and internationally, this low-cost model could be replicated by others to promote child development and health supports, while they wait for services.

Limitations and Future Directions

The study had several limitations. The sample was small, and there was an over-representation of monolingual English speakers, tertiary educated and high family-income parents. Pre- and post-surveys were not matched and could not be statistically analysed. Although rich, qualitative data was captured in the post-text message surveys, and we appeared to reach data saturation within our small data set, we could not further explore parent's expectations of the program and delve into reasons for dissatisfaction. Our follow-up investigations will measure the impact of the text messages on children's language skills, as intended, have a larger and more representative sample, and match pre- and post-intervention surveys in order to draw more direct comparisons. The two parent knowledge surveys need to be validated, and parent literacy scores compared to children's literacy outcomes to measure whether increased parent knowledge translates into increased children's literacy outcomes. Potential measures of children's general development outcomes should be explored so that the impact of parent knowledge of child development can be compared against actual child development.

Conclusion

Our findings indicate that text messages can be helpful for all families in providing information and activity ideas to improve children's language and literacy development and general child development. Previous interventions seeking to improve children's educational outcomes using text messages have typically targeted disadvantaged families. Our sample of highly educated parents with high incomes found both the language and literacy and general child development text messages useful and would recommend the program to other parents of preschool children. Text messages are a low-cost, acceptable, and readily available intervention that educators and allied health clinicians can use to promote child health and development, including literacy, language and other aspects of development across communities. Future studies will investigate if these messages positively impact children's language and literacy skills in addition to reminding or reassuring parents.

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Declarations

Conflict of interest The authors have no conflicts of interest to disclose.

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