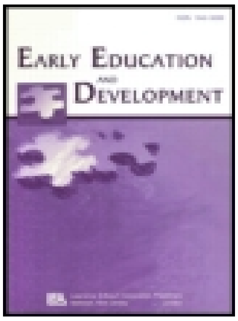

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ABSTRACT

Research Findings: Young children develop numeracy competencies during interactions with more knowledgeable others. Such interactions typically occur in the home numeracy environment (HNE). In this study a nonintensive intervention procedure was developed to improve both the HNE and numerical competencies. All parents of 113 Australian children (age 4 years, 5 months, on average at the beginning of the study) were invited to participate in a 2-part intervention that included attending 1 group meeting at which information regarding the HNE was provided and participating in an additional individual session that introduced them to the principles of counting. The HNE and children's numerical competencies were assessed before and after the intervention. Participating and nonparticipating families did not differ on any of the study variables at the beginning of the study, yet not only did the intervention group significantly improve their HNE, but children in this group also showed significantly greater numerical competency development compared with the nonparticipating group. *Practice or Policy*: Results indicate that less intensive interventions can have effects on the HNE and children's numerical competencies. Consequently, even on small budgets interventions should be undertaken.

Supporting pupils' learning of mathematical processes and rules is a major task for teachers in school. However, children develop early mathematical competencies well before schooling starts, and children's early mathematical thinking is among the best predictors for later academic achievement in school and a better predictor than either early reading or early attention skills (Butterworth, 2005; Claessens, Duncan, & Engels, 2009; Duncan et al., 2007). Early learning of mathematical competencies occurs informally, such as when children interact with their parents at home, and experiences in the home environment influence the development of children before and after formal schooling starts (e.g., Niklas & Schneider, 2013, 2014).

This is acknowledged by the Early Years Learning Framework for Australia, which describes families as children's first educators (Department of Education, Employment and Workplace Relations (2009). The Early Years Learning Framework for Australia explicitly articulates that children should be supported to "demonstrate an increasing understanding of measurement and number using vocabulary to describe size, length, volume, capacity and names of numbers" and to "use language to communicate thinking about quantities to describe attributes of objects and collections, and to explain mathematical ideas" (p. 40).

Despite the provision of guidelines such as the Early Years Learning Framework for Australia, few attempts have been undertaken to support parents in creating a favorable home numeracy environment (HNE) for their children, and few interventions targeting the family and a child's numeracy learning exist (e.g., Starkey & Klein, 2000). However, such support is justified. Many parents are

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found to do relatively little to encourage their children's mathematics learning and often show an uncertainty about how to approach mathematical content at home, thus mainly concentrating on literacy learning at home (Ginsburg, Duch, Ertle, & Noble, 2012). This study introduces a non-intensive intervention in the HNE and explores the effects on both the HNE and children's numerical abilities.

The development of children's numerical abilities

Although children are born with innate abilities (Gelman & Butterworth, 2005), what children learn is determined by their interactions with people, objects, and events in their environment. Children need to be taught about numbers and provided with multiple opportunities to engage in such thinking, in a nonintensive playful manner, supported by contingent discussion that incorporates purposeful pauses for children to think (Cohrssen, Church, & Tayler, 2014). Such engagement can help children to refine numerical understandings and enhance their competency for engaging in more advanced thinking.

An important and basic numerical ability that children need to master to be successful later on in school is to count verbally (e.g., Stock, Desoete, & Roeyers, 2009). However, mastery of specific counting principles underpins children's ability to engage in broader mathematical thinking (Gelman & Gallistel, 1978). These counting principles include the ability (a) to tag one object with one count without skipping or double-counting an object; (b) to use the number words in a consistently correct order, knowing enough number words to count each object in the set; (c) to recognize that when the first two principles are applied accurately the last number word has a special significance in that it signifies the total number of objects counted (cardinal principle); (d) to recognize that anything (visible and invisible) can be counted so long as the first three principles are applied; and finally (e) to recognize that the order in which objects are counted does not matter so long as the first three principles are applied. Between 3 and 6 years of age children develop the ability to correctly map number words to objects, and they demonstrate growing understanding of these counting principles even for larger number sets up to 40 (Butterworth, 2005).

By the time children start preschool, they demonstrate a wide range of mathematical ability, reflecting in part the variability with which parents incorporate number talk into their conversations with children (Levine, Whealton Suriyakham, Rowe, Huttenlocher, & Gunderson, 2010). This variability in children's early informal education persists and is reflected in a wide range of cognitive skills as children start school (Gould, 2012; Schneider, Niklas, & Schmiedeler, 2014). Children with lower levels of competency start school at a disadvantage and are unlikely to close the gap unless supported by a highly targeted intervention (Chien et al., 2010; Entwisle & Alexander, 1990; Gersten, Jordan, & Flojo, 2005; Mazzocco & Thompson, 2005).

The HNE and children's numerical abilities

The home learning environment provides many opportunities for parents to support their children's increasing competencies, and in particular the so-called HNE has an impact on early numeracy competencies (cf. Niklas, 2015). For instance, parents who count items in sets of visible objects support children's acquisition of the cardinal principle between the ages of 1 and 3 years, particularly when the sets contain four or more objects, even when socioeconomic status and other talk-related variables are controlled (Gunderson & Levine, 2011). Children from low-income families often find verbal addition and subtraction challenging yet perform nonverbal addition and subtraction tasks at the same level as their peers from middle-income families (Jordan, Huttenlocher, & Levine, 1994). Such findings reflect the important role that language and specific instruction play at home in supporting children's conceptual understanding and modelling the words children need to articulate their thinking.

In addition, the frequency with which games that require mathematical thinking are played during the preschool years predicts later mathematical achievement in school (Niklas & Schneider, 2012, 2014). The basis for the effects of playing games with mathematical content is the structure of such games: For instance, dice games repeat simple counting and adding procedures systematically, whereas card games often provide information about number symbols and number words. In addition, such game-like learning opportunities are fun for most children, leading to greater motivation and less tiredness and inattention. Both aspects of the home learning environment, indirect teaching and direct teaching, which occurs, for example, when parents explain counting principles or point out number symbols and learning, seem to play an important role in the development of children's mathematical competencies (LeFevre, Polyzoi, Skwarchuk, Fast, & Sowinski, 2010; Niklas & Schneider, 2014; Skwarchuk, Sowinski, & LeFevre, 2014).

A key implication of these findings is that the home learning environment should be a prime target for intervention not only because it is the child's primary learning environment but also because it can be more easily manipulated than other family characteristics, such as the socio-economic status. Several studies have focused on family literacy programs, showing that interventions in the home literacy environment are successful in enhancing children's literacy abilities (e.g., Sénéchal & Young, 2008). However, little research has yet investigated the impact of supporting mathematical competencies in the home learning environment (e.g., Sheldon & Epstein, 2005; Starkey & Klein, 2000). For instance, Sheldon and Epstein (2005) showed that practices that were implemented through school–family partnerships and that encouraged families to support Grade 3 to Grade 9 children's mathematical learning at home were associated with higher proportions of students who scored at or above proficiency in mathematics. In a study by Starkey and Klein (2000) a fairly intensive intervention that lasted for 4 months was successful in supporting the mathematical thinking of Head Start children ages 4–5 years old.

In addition, playful interventions outside the home have been shown to be successful in enhancing preschool and first-grade children's mathematical abilities (Cohrssen, Tayler, & Cloney, 2014; Fuchs et al., 2013; Ramani & Siegler, 2008). For instance, Ramani and Siegler (2008) played a simple board game with numbers and a die for about 1 hr in total over a period of 2 weeks. While playing, the 5-year-old children were required to name the numbers their token moved across. Compared with a control group playing the same game with colors and colored dice instead of numbered dice, children in the intervention group showed significantly greater improvement on various numeracy tasks, and they maintained that higher level at a follow-up assessment 9 weeks later. Such playful interventions are clearly applicable in the family context.

Research focus

The impact of the HNE on precursors of numeracy acquisition has been explored in several studies (e.g., Anders et al., 2012; Dearing et al., 2012; Kleemans, Peeters, Segers, & Verhoeven, 2012), and a first intensive family intervention study successfully improved preschool children's numerical abilities (Starkey & Klein, 2000). Most research on supporting children's mathematical competencies has been conducted either outside the home (e.g., Fuchs et al., 2013; Ramani & Siegler, 2008) or in the context of formal schooling with older children (e.g., Sheldon & Epstein, 2005). Although non-intensive interventions have proven to be effective for the home literacy environment and preschool children's literacy competencies (e.g., Niklas & Schneider, 2015), we do not know whether a nonintensive intervention may also be sufficient to improve the HNE provided by the family and to enhance the mathematical competencies of young children living in these environments.

To explore this question, we commenced a study in one local government area in the city of Melbourne, Australia, to investigate the impact of a targeted nonintensive intervention. It was designed to increase the quality of numeracy interactions in the home learning environment by equipping a subsample of parents with knowledge of (a) the importance of the HNE and (b) the principles of counting. We explored the extent to which interventions that increase the purposefulness with which parents engage in numeracy-based activities with their children in the home environment impact on children's performance on assessment activities in the year before elementary school. We assumed that an intervention of this nature may be sufficient to increase the quality of the HNE and better support children's numerical competencies compared with families not participating in the intervention.

Method

Sample

All 113 participating preschoolers attended one of four child care centers located in different parts of the local government area. After approval from local government was obtained, formal consent to conduct the study was obtained from the respective center coordinators, directors, and teachers. Each family registered as using the various early childhood settings was invited to participate in the study. Members of the research team were on hand to obtain consent from parents and caregivers and to answer questions at morning drop-off and afternoon pick-up times at the start of the academic year.

Boys (58.4%) outnumbered girls (41.6%) in the sample, with a mean age of approximately 4 years and 5 months (SD = 3.9 months) at Time 1 (T1). About 9% of the sample spoke a language other than English as the main language at home. In 38.5% of the sample, at least one of the parents or the child was born outside Australia, most often in China, England, Malaysia, or Ireland. However, when participants born in a country in which English is an official language are excluded from the migrant group, the overall percentage decreases to about 22%.

The first-round assessment of children took place in the Kinder rooms during February and March (T1), and the second-round assessment took place between mid-July and mid-September (Time 2 [T2]). Each round of assessment took approximately 5–6 weeks to complete. Multiple assessment tasks were used, and those relevant for the analyses are briefly described here.

Seven children left their centers between T1 and T2. This subsample of seven children did not differ significantly from the remaining children in regard to sex, age, migration background, main language, parental education, household income, or HNE (t tests; $p > .05$). However, dropouts showed lower scores on the numerical tasks, $t(111) = 3.13$, $p < .05$.

Assessment of numerical abilities

Counting

This subtest included six items: (a) verbal counting ("Show me how far you can count"); (b) naming the number word that comes immediately after a spoken number word; (c) naming any number that comes after the spoken number word; (d) naming the number word that comes immediately before a spoken number word; (e) naming any number word that comes before the spoken number word; and (f) counting backward from 10 and, as a dropback activity, counting backward from 5. If they counted up to 31 correctly children got 4 points, for each of the eight numbers that come before or after a spoken number word that children correctly named they got 0.5 points, and for correctly counting backward from 10 children received 3 points, adding up to a maximum of 11 points.

Number values

Children were presented with the numerals 1 to 10 in numerical sequence on a number strip. In addition, five cards were laid out face up in front of the children. On each card were stick figure drawings of children, with three, five, six, eight, or 10 children on each card. This subtest included five items: (a) The researcher pointed to and named the numeral 5 and then asked the child to identify which picture card belonged to number 5. Subitems (b) and (c) required the child to identify the cards with eight children and 10 children. Subitems (d) and (e) operated differently: The child was shown the picture cards with three and then six children and asked to indicate how many children were on each picture card by naming and/or pointing at the numeral on the strip of numbers. For each correctly solved item the child got 1 point, adding up to a maximum of 5 points. All items were added to an overall sum score of numerical abilities that showed good reliability (Cronbach's α = .83 at T1 and T2, r_{tt} = .68).

Primary caregivers' participation

During the periods of assessments, the primary caregivers (subsequently referred to as *parents*) were requested to complete surveys about child and family characteristics and the home learning environment. Parents were requested to report on various aspects of the HNE (see the Appendix). The HNE was measured by 10 questions that focused on numeracy activities at home (e.g., "How often do you play games with your child that involve dice?"), everyday numeracy interactions (e.g., "How often does your child participate in counting or measuring ingredients when cooking?"), the value attached to mathematics at home (e.g., "Mathematics or being able to calculate is regarded as important at home"), and parents' teaching of mathematical concepts (e.g., "At home I often explain to my child how to do simple sums or how to divide, for example, apples among people or a cake into pieces"). Each item was rated on a 5-point scale (e.g., *several times a week* to *never*, or *very true* to *not true*). Values of 4 to 0 were accordingly assigned. A total of 93 parents returned the survey at T1, and the sum score was a reliable measure of the HNE (Cronbach's α = .77), with a mean score of 25.2 (*SD* = 6.5) and observed values ranging from 5 to 40.

A total of 70 parents returned the survey at T2 (Cronbach's α = .71, r_{tt} = .60). In addition to the questions on the HNE, parents who took part in the intervention were asked to answer whether they planned to change their HNE after the intervention session, taking the information provided into account. Further, parents in the intervention group were asked at T2 how often the dice game was used and whether the information received changed the way they had approached numeracy activities at home.

Intervention

Immediately after completion of the baseline child assessments, the parents of participating children were invited to attend one parent evening held after hours at each of the four Early Childhood Education and Care centers. Of the 113 children participating in the study, the parents of 37 children attended the information session. At each parent evening, the lead researchers delivered a 30-min PowerPoint presentation that (a) discussed the importance of supporting children's numeracy skills in the home environment in general, (b) provided a handout that offered suggestions about how to support these emerging skills in a purposeful manner, and (c) invited those parents present to take part in an individualized session with their child at a later date that included playing a dice game—an invitation that all parents accepted. Parents who did not attend the parent evening were not invited to take part in the individualized session and were not provided with the dice game. Suggestions on the handout included the demonstration that people frequently use mathematical thinking and language in their everyday lives (e.g., counting steps when climbing the stairs, talking about and comparing prices in the supermarket); notes about playing games that use dice, numbers, or involving sums; and teaching numbers.

The individualized sessions lasted approximately 30 min and were held within 3 weeks of the parent evenings at the Early Childhood Education and Care settings. Here, a member of the research team, one child, and the parent played a dice-based counting game that the child was able to keep. During the game, each parent received coaching on supporting the child's emerging mastery of the counting principles (Gelman & Gallistel, 1978). The dice game, played by two or more people with one, two, or three dice (depending on the child's counting skills), requires each player to roll a die, identify the number rolled, and then count out a corresponding number of colored counters from a pile in the center of the table. At the end of one round, each player compares the quantity of counters he or she has "won," creating opportunities to rehearse counting skills and for conversations about concepts such as more than, less than, and the same as. The game may proceed to two or more rounds. One or two dice may be used at the same time, requiring the child to count up to 6 or to 12. Using two dice creates opportunities for counting on and supports conversations about doubling. A third die has numerals in place of dots. Any objects, large or small, could replace colored counters. In addition to the dice game, a handout with information about the counting principles was provided to parents at the end of the session. Parents were encouraged to use the game and the information provided from then onward.

For the purposes of this study, the intervention group included those 37 children and their families who attended the parent evening and in addition participated in the individualized session. The nonintervention group included those 76 children whose parents did not attend the parent evening and were consequently not invited to take part in an individualized session with a member of the research team. The study design was not experimental, as families self-selected into these groups. However, participating and nonparticipating children and families did not differ significantly in child age, sex, main language, migration background, or parental education level (*t* tests; $p > .05$). In addition, at T1 they did not differ in mathematical abilities, HNE, or the importance of schooling or further studying after finishing school that parents reported for their children (*t* tests; $p > .05$).

Results

Table 1 provides an overview of the correlations between all variables as well as descriptive statistics for HNE and numerical abilities.

Boys in the sample were older than girls ($M = 53.3$ vs. 51.7 months, respectively), and older children showed greater performance on the mathematical tasks. Migration background was not significantly associated with the other variables, but children with a migration background showed a tendency to score lower on the mathematical tasks at T2. Finally, HNE at T1 was significantly associated with children's numerical abilities at T2. No significant association of HNE and numerical abilities measured at the same time was found, but the correlation between measures ($r = .17$) indicated a small effect size that remained nonsignificant because of the small sample size. In addition, both numerical abilities and HNE improved between T1 and T2 for the whole sample.

In a second step, we analyzed whether the intervention had some effect on the HNE. Here we checked whether parents in the intervention group planned to change their HNE after the intervention, and they were asked at T2 how often the dice game was used and whether the information received had changed the way parents approached numeracy activities at home. The majority of parents (about 85%) who took part in the intervention sessions reported having used the dice game at least once a month, with about a third of them indicating at least weekly usage.

Table 1. Correlational analyses of the study variables and descriptive statistics for age, HNE, and numerical abilities.

Variable	1	2	3	4	5	6	7	M (SD)
1. Age in months	—	.199*	.021	−.091	.081	.271**	.187†	52.65 (3.93)
2. Sex[a]		—	.127	.079	.136	−.022	−.125	
3. Migration background[b]			—	.147	.086	−.023	−.188†	
4. HNE, T1				—	.603***	.174†	.270*	26.49 (5.81)
5. HNE, T2					—	.060	.173	29.40 (5.02)
6. Numerical abilities, T1						—	.676***	8.42 (4.12)
7. Numerical abilities, T2							—	10.95 (3.71)

Note. HNE = home numeracy environment; T1 = Time 1; T2 = Time 2.
[a]0 = female, 1 = male. [b]0 = both parents born in Australia, 1 = at least one parent born outside Australia.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

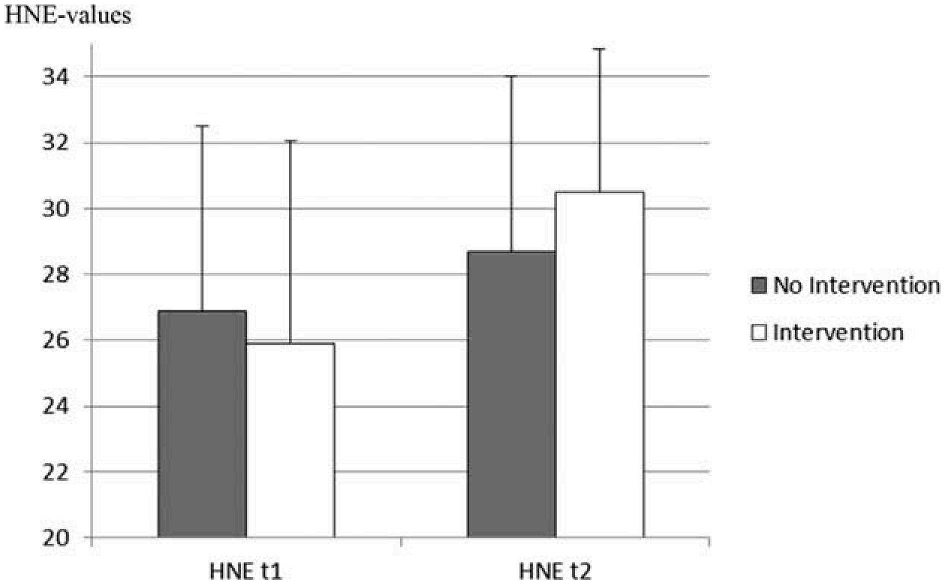

Figure 1. Home numeracy environment (HNE) before and after the intervention for the intervention and nonintervention groups. t1 = Time 1; t2 = Time 2.

Less than 15% of parents reported having used it rarely, and none reported having never used it. Of the intervention parents, 89% planned to change their HNE to incorporate the information they were provided, and 86.2% indicated that they actually had adapted their approach to numeracy activities at home.

We then analyzed the variance with repeated measurements for overall HNE to test for differences between the participating and nonparticipating groups in the development of the HNE. The impact of the intervention on the HNE was statistically significant, $F(1, 55) = 4.72$, $p < .05$, $\eta^2 = .08$. As can be seen from Figure 1, both groups improved their HNEs, and there were no statistically significant differences in HNE between the groups at T1 or T2. However, both groups differed significantly in their development of the HNE, with the intervention group showing a difference of about 4.5 points in comparison with less than 2 points in the nonintervention group (medium effect size).

As a further step, an analysis of variance with repeated measurements for mathematical ability was conducted with child age and sex as control variables (repeated measures analysis of covariance). There was a significant effect for time, $F(1, 102) = 6.00$, $p < .05$, $\eta^2 = .06$, showing that children gained additional mathematical competencies on average between T1 and T2. No significant effects were found for the interactions between both age and sex with time ($p > .05$), but a statistically significant interaction (small effect size) between time and intervention group was found, $F(1, 102) = 4.05$, $p < .05$, $\eta^2 = .04$. The intervention group showed a significantly greater gain in mathematical competencies between T1 and T2. Figure 2 presents the development of numerical abilities for both groups controlled for sex and age.

As can be seen in Figure 2, children in both groups improved their mathematical abilities. However, after starting at about the same level, the children in the intervention group clearly showed a greater gain in competencies. Consequently, on average these children ended up scoring 1 point higher on the mathematical tasks at T2 than children from nonparticipating families, $t(107) = -1.68$, $p < .10$, $d = .34$.

Discussion

Mathematical competencies play a major role in everyday life, and good numeracy skills are prerequisites in many professions (Duncan et al., 2007; Geary, 2000). Children have the capacity to acquire deep and broad understandings of mathematical concepts before the age of 5 years

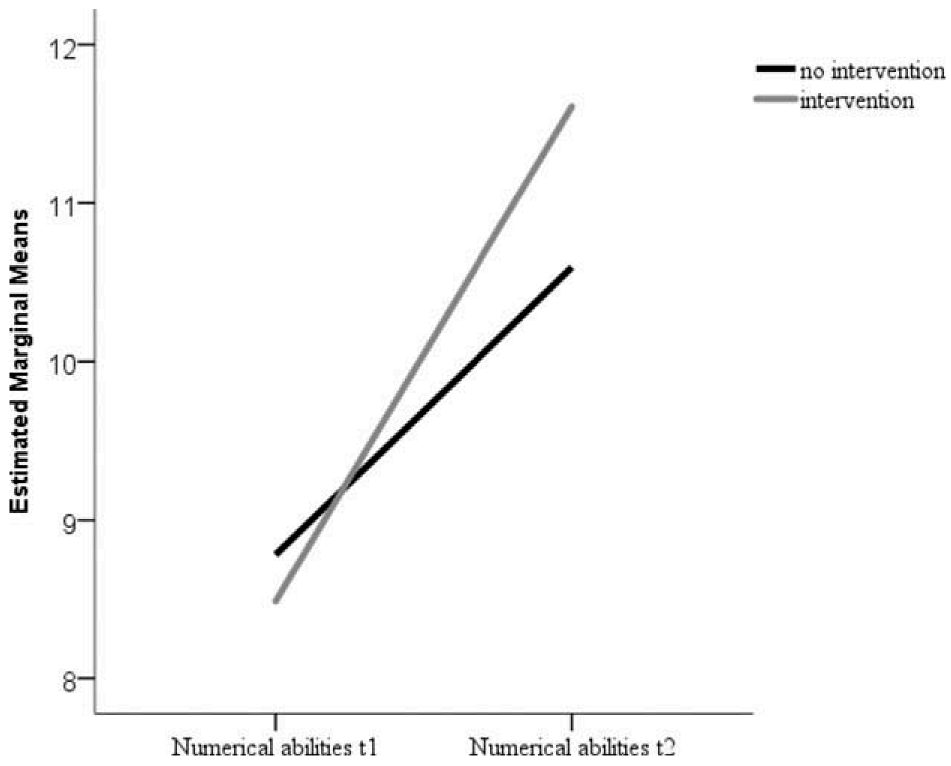

Figure 2. Development of numerical abilities between Time 1 (t1) and Time 2 (t2) for intervention and nonintervention groups controlled for child age and sex.

(Clements & Sarama, 2007), when age differences in mathematical skills are already apparent (Gould, 2012). During children's early development of numerical abilities the home learning environment is rich with opportunities to support children's emerging numeracy skills in a playful, informal, and authentic manner. Families are children's first educators, and research shows that the home learning environment is closely associated with early child competencies and is a significant predictor of children's cognitive development (e.g., Niklas & Schneider, 2013, 2014).

Interventions targeting the mathematical abilities of children with special educational needs or dyscalculia have proven to be effective (Fischer, Köngeter, & Hartnegg, 2008; Fuchs et al., 2013; Kroesbergen & van Luit, 2003; Swanson & Hoskyn, 1998), as have interventions outside the home targeting community samples (Ramani & Siegler, 2008). However, very few, yet fairly intensive, interventions have targeted families and the home to improve children's numerical competencies (e.g., Starkey & Klein, 2000). In addition, there are some findings that do find a direct link between the HNE and preschoolers' mathematical skills (e.g., Missall, Hojnoski, Caskie, & Repasky, 2015).

The results reported in our study demonstrate that a nonintensive intervention with families may be effective, first, in improving the HNE and, second, in supporting children's developing skills. This finding aligns with the results of Sheldon and Epstein (2005), which showed that school–family partnerships that included providing families with mathematic game packets to play at home, or assigning students mathematical homework that students had to discuss with a family member, were positively associated with students' mathematics achievement tests. The positive impact of our intervention was observed within 20 weeks, potentially changing the children's mathematics learning trajectory. Further research is necessary to explore how families applied the intervention at home in order to increase the quality of the HNE and also to explore the extent to which children's gains in numeracy skills are sustained throughout the year prior to commencing school.

Small effect sizes were found for both the association of the HNE with children's mathematical competencies and the development of children's numerical abilities; however, this is to be expected (Missall et al., 2015; see Niklas & Schneider, 2015, for similar results for literacy competencies). Meta-analyses of intervention studies have pointed out that specific instructions and directed responses and questioning of children contributed to larger effects than other forms of intervention and that short periods of intervention often lead to larger effects than longer interventions (Kroesbergen & Van Luit, 2003; Swanson & Hoskyn, 1998). This aligns with our findings: We supported the parents to use this kind of approach during the dice game.

Research in the context of the home literacy environment and children's literacy competencies found the family migration background to play an important role, in that children without a migration background often not only lived in families providing more favorable learning environments but also showed greater literacy competencies (e.g., Niklas & Schneider, 2013). The association of family background variables and the HNE, however, seems to be less clear cut (e.g., LeFevre et al., 2010; Niklas & Schneider, 2014). In our study, migration background played no significant role in the context of the HNE and the intervention, even when we checked for interaction effects. This finding is supported by other research on Australian samples that found migration background to be far less important in the Australian context than in many other countries (Niklas, Tayler, & Schneider, 2015; Organisation for Economic Co-operation and Development, 2013).

A recent Australian study that controlled for various child and family background variables pointed out that preschool children might be better supported in their development of mathematical competencies by informal care at home than by attending formal early childhood education and care programs (Hildenbrand, Niklas, Cohrssen, & Tayler, in press). This aligns with our results showing the association of the HNE with children's numeracy abilities and the findings in regard to the intervention. Clearly, the HNE is a very important setting for children to develop early numeracy abilities.

Limitations

This study has some limitations. First, because of the naturalistic context of this study there was no random assignment and thus no actual control group. There was no waitlist control group that could be used because of the context, limited resources, and a small sample size. Consequently, comparisons were only possible for participating versus nonparticipating families. Hence, there might have been a selection effect. However, we tested for initial differences between the groups, and we controlled for age and sex when comparing children's linguistic development. No statistically significant differences were found between the groups in regard to any study variables, including migration background, parental education, and parental interest in children's schooling at T1, indicating that participating and nonparticipating families were very similar.

Second, the HNE was assessed via self-report. Using a survey poses the risk of perceived social desirability affecting responses. However, previous studies on the home learning environment showed that this kind of assessment procedure often provides reliable data and leads to findings that are closely related to those found through the use of other measures (cf. Burgess, 2002). Still, the results need to be interpreted cautiously.

In addition, not all parents completed surveys. Consequently, analyses regarding the HNE could only be done for a reduced sample. Nonetheless, a significant medium effect of the intervention on the HNE was found, and this result aligns with the findings relating to children's development of numerical abilities that were analyzed for the whole sample.

Strengths

Despite these limitations, this study has several strengths. It is one of the first intervention studies targeting the HNE provided by parents and thus addresses this gap and provides useful information for future research on this topic.

The findings indicate that even nonintensive interventions may help to improve the home learning environment and to support children's mathematical development (cf. Sheldon & Epstein, 2005). Providing parents with general information on the HNE and information about how the principles of counting can be included in everyday interactions with their children may contribute to the provision of a home learning environment more favorable to the development of mathematical competency. Consequently, improvements to the HNE may be effected, even on a small budget. Furthermore, some families may recognize the benefits of a targeted but nonintensive intervention that provides them with support but is not arduous to implement.

As parents interact with their preschool children more frequently and for longer time periods than other adults with whom the children engage, targeted interventions such as the one used in this study may support the advancement of children's numerical abilities, abilities that have been shown to be essential for later achievement (cf. Duncan et al., 2007). Further assessment of children's learning is called for in order to explore the extent to which the gain in competencies is sustained over a longer period of time.

Conclusion

In this study, parents were invited to take part in a two-part intervention. First, parents received information about the important impact of the home environment on children's learning. Second, they received a dice game to play with their child, and the principles of counting were explained to parents during an individual session. Parents who participated in this nonintensive intervention enhanced the HNE to a greater extent than parents who did not participate. In addition, children in the intervention group showed greater gains in mathematical competencies than their peers. If this change persists over time, children's mathematical development should also be influenced more permanently, in turn impacting on their learning trajectory as they commence formal school education. Consequently, even nonintensive interventions in the family may be sufficient to support child development.

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Appendix

Questions on home numeracy environment

How often do you play games with your child that involve dice?
☐ several times a week ☐ once a week ☐ every 2nd or 3rd week ☐ less frequently ☐ never

How often do you play games with your child that require him or her to count?
☐ several times a week ☐ once a week ☐ every 2nd or 3rd week ☐ less frequently ☐ never

How often do you play games with your child that require him or her to do simple sums?
☐ several times a week ☐ once a week ☐ every 2nd or 3rd week ☐ less frequently ☐ never

How often do you talk to your child about measures such as weight, temperature or speed?
☐ several times a week ☐ once a week ☐ every 2nd or 3rd week ☐ less frequently ☐ never

How often does your child count in everyday life (e.g., when preparing the dinner table, counting days or hours until a certain occurrence)?
☐ several times a week ☐ once a week ☐ every 2nd or 3rd week ☐ less frequently ☐ never

How often does your child participate in counting or measuring ingredients when cooking?
☐ several times a week ☐ once a week ☐ every 2nd or 3rd week ☐ less frequently ☐ never

How often does your child participate in weighing or counting grocery items, or paying at the check-out, when you are shopping?
☐ several times a week ☐ once a week ☐ every 2nd or 3rd week ☐ less frequently ☐ never

Tick the appropriate box	not true	less true	somewhat true	true	very true
Mathematics or being able to calculate is regarded as important at home					
My child shows a lot of interest in and loves to learn how to count and calculate					
At home, I often explain my child how to do simple sums or how to divide for examples apples to persons or a cake in pieces					