The Impact of Let's Count on Children's Mathematics Learning

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Let's Count is an early mathematics program that has been designed by The Smith Family and the authors to assist educators in early childhood contexts in socially disadvantaged areas of Australia to work in partnership with parents and other family members to promote positive mathematical experiences for young children (3-5 years). A longitudinal evaluation of *Let's Count* was undertaken in 2012-2014 involving 337 children in two treatment groups and 125 children in a comparison group. This paper shares preliminary results from the evaluation. Overall the findings demonstrate that *Let's Count* was effective.

Introduction

Children's dispositions towards learning mathematics and their formal mathematics knowledge vary considerably when they begin school, partly because of a diversity of experiences and opportunities to explore mathematical contexts and ideas prior to school. There is a wide variation in how well young children will be positioned to benefit from mathematics teaching when they begin school. Many children living in socially disadvantaged communities will be vulnerable. This raises concern about how families, educators, and communities can best promote mathematics learning in early childhood so that all children benefit; and about how to support those who are less favourably positioned than others when beginning school.

The Smith Family (2013), an Australian children's charity, commissioned *Let's Count,* an initiative aimed at promoting positive mathematical experiences for young children (3-5 years) in ways that position them to learn mathematics successfully when they start school. This paper reports some initial findings from the *Let's Count* longitudinal evaluation which has been conducted by the authors. It examines whether participation in *Let's Count* is associated with increases in children's performance on mathematics tasks, and explores the implications of the findings for the children's transition to school. The key research questions investigated were:

1. For which mathematics tasks was participation in *Let's Count* associated with increased performance?
2. What was the nature of the mathematics underpinning the tasks for which there was a difference?

Disadvantaged Communities and Mathematics Learning

When communities are designated by governments as *disadvantaged*, there can be expectations that, on average, children will not perform as well academically as children from more *advantaged* communities (Caro, 2009). This expectation extends to pre-school children (Carmichael, McDonald, & McFarland-Piazza, 2013; Rimm-Kaufman, Pianta, Cox, & Bradley, 2003). Carmichael et al. (2013) concluded that "the socio-economic status of the community in which the family resides was the strongest home microsystem

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predictor of numeracy performance, explaining 10.5% of the variance in the home-community microsystem model". (p. 16)

In contrast, there is also evidence that many young children begin school as capable mathematicians who already surpass many of the first year expectations of mandated mathematics curricula or textbooks (Bobis, 2002; Clarke, Clarke, & Cheeseman, 2006; Ginsburg & Seo, 2000; Gould, 2012; Hunting et al., 2012). For example, Gould (2012) concludes from his study of the results of the mandated Best Start assessment in New South Wales (NSW Department of Education and Communities, 2013) that the expectation in the Australian Curriculum – Mathematics (ACARA, 2013) that students can make connections between the number names, numerals and quantities up to 10 by the end of the first year at school "would be a low expectation for at least half of the students in NSW public schools" (p. 109). Even in *disadvantaged* communities (Ginsburg & Seo, 2000) and rural and regional communities (Hunting et al., 2012), many children show that they are powerful mathematicians before they start school. The examination of children's knowledge presented in this paper will consider whether this is also true for children who participated in *Let's Count*.

Let's Count

Let's Count is an early childhood mathematics initiative commissioned by The Smith Family (an Australian children's charity) to promote positive mathematical experiences for young children (3-5 years). The focus of *Let's Count* is building partnerships between early childhood educators and families who live in disadvantaged communities so that opportunities are cultivated for children to engage with the mathematics encountered as part of their everyday lives, talk about it, document it, and explore it in ways that are fun and relevant to them. Such an approach is designed to enable children to learn powerful mathematical ideas in ways that develop positive dispositions to learning and mathematical knowledge and skills. *Let's Count* was piloted in 2011 in five socio-economically disadvantaged communities spread across Australia. In 2013-2014, The Smith Family delivered a revised *Let's Count* program in additional *disadvantaged* sites in 2013 and 2014 (Gervasoni & Perry, 2013).

Let's Count involves two professional learning modules for early childhood educators: (1) Noticing and exploring everyday opportunities for mathematics; and (2) Celebrating mathematics. Between modules, the educators meet with families to discuss ways that they can encourage children to notice, explore and discuss the mathematics that they encounter in everyday situations, including through games, stories and songs.

One method for evaluating the effectiveness of *Let's Count* was to measure participating children's mathematical growth across their preschool year and contrast this with a comparison group of children whose families had not participated in *Let's Count*. This comparison group was from the same economically disadvantaged communities and provided baseline data in 2012 prior to the introduction of *Let's Count* in 2013-2014.

Method

The *Mathematics Assessment Interview (MAI)* (Gervasoni et al., 2011) is used extensively throughout Australia to measure the mathematical knowledge of children when they begin school and throughout schooling and was used in the *Let's Count* longitudinal evaluation. The *MAI* is a task-based assessment interview, formerly known as the *Early Numeracy Interview* (Clarke et al., 2002), the development of which has been widely reported (e.g., Bobis et al., 2005). The tasks in the MAI are designed to correspond to a research-based learning trajectory in nine mathematics domains: Counting, Place Value, Addition and Subtraction Strategies, Multiplication and Division Strategies, Time, Length and Mass Measurement, Properties of Shape, and Space Visualisation (Clarke et al., 2002).

The interview includes a Foundation Section for school beginners, or any students who have difficulty counting a collection of 20 objects. This Foundation Section was the starting point for assessing the pre-school children in the *Lets Count* longitudinal evaluation. Children were assessed in the domains of Counting, Place Value, Addition and Subtraction Strategies, Multiplication and Division Strategies, Time and Length Measurement, Properties of Shape, and Space Visualisation. Interview stress on the children is reduced through scripted instructions that the interviewer only continues with the next task in any domain (e.g., Place Value) for as long as the child is successful. The interview was conducted by specifically trained interviewers, and independently coded to obtain the data examined in this paper.

Participants

The participants in the *Let's Count* longitudinal evaluation included three groups of children and their parents/caregivers and pre-school educators. The children are the key focus of this paper. Three groups of children including a Comparison Group of 125 children who were assessed in December 2012 and eligible to start school in 2013, and the 2013 and 2014 *Let's Count* groups. The comparison group children attended 10 low SES Early Childhood centres in regional Victoria (5) and New South Wales (5).

The 2013 *Let's Count* Group comprised 142 children eligible to start school in 2014, whose educators and families were going to participate in *Let's Count* during 2013. These children were assessed using the *MAI* in March and November 2013. Of the 142 children assessed in March, 117 were assessed in November. These children came from the same 10 Early Childhood centres as the 2012 Comparison Group.

The 2014 *Let's Count* Group comprised 195 children eligible to start school in 2015, whose educators and families were going to participate in *Let's Count* during 2014. They were assessed in March and December 2014 using the *MAI*. Of the 195 children assessed in March, 172 were assessed in December. These children came from 17 low SES Early Childhood centres in regional Victoria (6), regional NSW (8), and metropolitan Perth, Western Australia (3).

Assessment of Young Children's Mathematics Knowledge Using the MAI

The children were assessed by a team of interviewers who were all familiar with the assessment instruments and with working with young children. All children's responses to the *MAI* tasks were recorded on a detailed record sheet completed by the interviewers. The record sheets were then analysed by independent coders, with all responses entered into an SPSS database. The responses for each task were coded as correct or incorrect, and where appropriate, children's strategies for solving the tasks were also coded. These data were further analysed to calculate the percentage of children in each cohort who were successful with each task and the percentage of students using particular strategies to solve the tasks. The performance of the *Let's Count* children were compared within groups and with the Comparison Group to determine whether any differences between the performances of groups was statistically significant. This paper focuses on the results of these comparisons for the whole number tasks.

Results

The analyses presented in this paper focuses on whether participation in *Let's Count* was associated with improved performance in the Whole Number and Foundation Detour aspects of the Mathematics Assessment Interview. Table 1 shows the results for tasks involving small sets for the children in the 2012 Comparison Group and for the 2013 and 2014 *Let's Count* Groups. Of importance for the analysis was identifying any tasks for which there was a significant difference in performance associated with participation in *Let's Count*.

Table 1
Percentage Success on Tasks with Small Sets

Tasks	Significance: Comparison (Dec, 2012) to (Dec, 2013) (χ^2, p)	Significance: Comparison (Dec, 2012) to (Dec, 2014) (χ^2, p)	Comp Dec 2012 (n=125)	LC Dec 2013 (n=117)	LC Dec 2014 (n=172)
Tasks with Small Sets					
Count a collection of 4 teddies	NS	NS	95	96	97
Identify one of two groups as "more"	NS	NS	90	92	87
Make a set of 5 teddies when asked	7.043, $p<0.01$	10.735, $p<0.01$	77	90	91
Conserve 5 when rearranged by child	NS	6.748, $p<0.01$	79	88	90
Make collection of 7 (when shown number 7)	11.016, $p<0.01$	23.852, $p<0.01$	63	84 (n=92)	89 (n=135)
Knows one less than 7 when 1 teddy removed	12.018, p<0.01	24.804, p<0.01	61	82 (n=85)	88 (n=131)
Knows one less than 7 without recounting	12.018, p<0.01	24.804, p<0.01	25	40 (n=85)	33 (n=131)
One to one Correspondence					
Know 5 straws needed to put 1 straw in each of 5 cups	NS	NS	88	87	95

The results in Table 1 suggest that most children, whether or not they participated in *Let's Count*, were able to accurately count small collections, identify which of two groups was *more* and demonstrate one to one correspondence. These are all important ideas associated with Level 1 in the Australian Curriculum. *Let's Count* made a positive difference to children's ability to accurately make a set of 5 and 7 items and to work out how many teddies remained when one teddy was removed from the set of 7 teddies. Thus it appears that Let's Count was associated with children's increased abilities to produce small collections (as opposed to count collections that someone else produced) and to problem solve with these collections.

The ability to recognise and produce repeating patterns has been noted as an important aspect of young children's algebraic reasoning (Papic, Mulligan, & Mitchelmore, 2011). The next set of results report on this aspect of mathematics. The results in Table 2 show that almost all children can name the colours in a pattern prior to beginning school. However, participation in *Let's Count* was positively associated with increases in children's ability to both match and continue patterns.

Table 2
Percentage Success in Pattern Tasks

Tasks	Significance: Comparison (Dec, 2012) to (Dec, 2013) (χ^2, p)	Significance: Comparison (Dec, 2012) to (Dec, 2014) (χ^2, p)	Comp Dec 2012 (n=125)	LC Dec 2013 (n=117)	LC Dec 2014 (n=172)
Pattern Tasks					
Name colours in pattern	NS	NS	98	99	96
Match pattern	5.623, p<0.05	8.824, p<0.01	72	85	86
Continue pattern	5.102, p<0.05	14.765, p<0.01	34	48	56
Explain pattern	NS	8.464, p<0.01	34	42	51

The tasks in Table 3 involve rote counting, counting collections of 20 items, and ordering numerals. The results show that participation in *Let's Count* was not associated with improvements in children's ability to count to 10 or order numerals from 1-9. Participation was associated with improvements in children accurately counting at least 20 items and in ordering numerals from 0-9. These are certainly the more cognitively challenging tasks in Table 3.

Table 3
Percentage Success with Counting and Ordering Numerals

Tasks	Significance: Comparison (Dec, 2012) to (Dec, 2013) (χ^2, p)	Significance: Comparison (Dec, 2012) to (Dec, 2014) (χ^2, p)	LC Comp Dec 2012 (n=125)	LC Dec 2013 (n=117)	LC Dec 2014 (n=172)
Counting Tasks					
Rote count to 10	NS	NS	87	93	95
Rote count to 20	NS	6.117, p<0.05	45	55	59
Count a collection of at least 20	8.079, p<0.05	13.165, p<0.01	37	55	58
Count a collection of at least 20 & when one item is removed knows total without recounting	8.079, p<0.05	13.165, p<0.01	8	16	11
Ordering Numbers Tasks					
Order numeral cards 1-9	NS	NS	48	60	54
Order numeral cards 0-9	10.354, p<0.01	5.924, p<0.05	31	52	45

The final cluster of tasks involves calculations (see Table 4). Children use small plastic teddies to model the calculation context. The first two tasks involve adding two groups of teddies. The third task requires children to place two teddies in each of 4 cars and then work out the total number or teddies. This task can be solved using multiplicative or additive reasoning, but the strategy used has not been distinguished here.

Table 4
Percentage Success on Calculation Tasks Involving Materials (Teddies)

Tasks	Significance: Comparison (Dec, 2012) to (Dec, 2013) (χ^2, p)	Significance: Comparison (Dec, 2012) to (Dec, 2014) (χ^2, p)	Comp Dec 2012 (n=125)	LC Dec 2013 (n=117)	LC Dec 2014 (n=172)
Calculation Tasks					
Adds 5+3 with materials	NS	17.081, $p<0.01$	49	63	72
Adds 9+4 with materials	9.664, $p<0.01$	7.627, $p<0.05$	25	42	40
Calculates total for 2 teddies in 4 cars	NS	12.005, $p<0.01$	58	64	76

The results presented in Table 4 demonstrate that participation in *Let's Count* was associated with more successful performance on these calculation tasks, although this was more often significant for the 2014 group.

Discussion and Conclusion

Examination of the data demonstrates that participation in *Let's Count* was associated with statistically significant differences in young children's performance on a diverse range of mathematics tasks. What distinguished these tasks was the higher level of mathematics reasoning in which the *Let's Count* children engaged. For example, there were significant differences in the proportion of children who could produce small collections and problem solve with these collections when the *Let's Count* cohorts were compared to those children who did not access *Let's Count*. Producing a specified quantity requires more sophisticated number understanding than simply counting a collection that has been provided. This is demonstrated by the findings in Table 1 showing that almost all children in the 2012 Comparison Group and *Let's Count* groups were successful in counting a collection of four teddies, but only 77% of the Comparison Group could make a set of five teddies and 63% could make a set of seven teddies. In contrast, for the 2013 and 2014 *Let's Count* children, the percentage of correct responses was significantly higher, with over 90% of children correctly making a set of five teddies and over 80% correctly making a set of seven teddies. The *Let's Count* groups were also more successful with working out the total in a larger group of 20 items and in finding solutions for addition and multiplication tasks.

The ability to see and understand patterns has a strong correlation to early algebraic thinking (Papic et al., 2011), which in turn "promotes structural development, relational understanding and generalisation … laying the foundation for mathematical thinking (Papic et al., 2015, p. 221). This highlights that significance of our finding that children in the *Let's Count* groups were more likely than the comparison group to successfully match, continue, and explain a pattern.

There were some significant differences across the three groups of children in the counting domain, particularly in the more demanding tasks of counting to 20, recognising one less, and ordering numerals. The *Let's Count* groups were more successful in ordering numerals (0-9) from smallest to largest, while performance did not differ across the *Let's Count* cohorts and the Comparison Group when children were ordering the numerals from 1-9. This suggests that the children participating in *Let's Count* had a better understanding of zero.

All three calculation tasks provided statistically significant differences between the Comparison Group and the *Let's Count* cohorts, particularly the 2014 group. Perhaps this shows that greater realisation of the mathematics in young children's worlds provides them with opportunities to experience such calculations.

Overall, the findings highlight the extent of many children's mathematics knowledge prior to beginning school. Sometimes, this knowledge exceeds what the children will be asked to *learn* in the first year of school (Gervasoni & Perry, 2015; Gould, 2012). While these data demonstrate that children's knowledge is diverse, it is also apparent that the *Let's Count* children's everyday home and pre-school experiences provided them with a *flying start* as they made the transition to learning mathematics at school. Of interest in extending this research is investigating how successfully these children learn school mathematics and under what conditions the positive impact of *Let's Count* persists.

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