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Associations between early shared music activities in the home and later child outcomes: Findings from the Longitudinal Study of Australian Children☆

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ABSTRACT

The benefits of early shared book reading between parents and children have long been established, yet the same cannot be said for early shared music activities in the home. This study investigated the parent–child home music activities in a sample of 3031 Australian children participating in *Growing Up in Australia: The Longitudinal Study of Australian Children* (LSAC) study. Frequency of shared home music activities was reported by parents when children were 2–3 years and a range of social, emotional, and cognitive outcomes were measured by parent and teacher report and direct testing two years later when children were 4–5 years old. A series of regression analyses (controlling for a set of important socio-demographic variables) found frequency of shared home music activities to have a small significant partial association with measures of children's vocabulary, numeracy, attentional and emotional regulation, and prosocial skills. We then included both book reading and shared home music activities in the same models and found that frequency of shared home music activities maintained small partial associations with measures of prosocial skills, attentional regulation, and numeracy. Our findings suggest there may be a role for parent-child home music activities in supporting children's development.

Introduction

Early shared book reading between parents and children holds many developmental benefits. Higher frequency of parent-child book reading has been strongly and consistently associated with language and literacy achievement across early childhood (Silinskas et al., 2012). Less is known about its influence on social-emotional outcomes. In contrast, there is very little research that examines whether shared home music activities are also of benefit to children's development. Research on the efficacy of family music therapy interventions for children with special needs or from particular risk backgrounds suggests that guided parent-child music activities hold social development benefits for children (Nicholson, Berthelsen, Abad, Williams, & Bradley, 2008; Oldfield, 2006; Williams, Berthelsen, Nicholson, Walker, & Abad, 2012). Participation in formal early music education classes has been linked with better self-regulation skills (Winsler, Ducenne, & Koury, 2011), enhanced cognitive processing (Flohr, Miller, & deBeus, 2000), and enhanced phonemic awareness (Gromko & Poorman, 1998) in young children. However, little is known about the extent to which *informal* early shared home music activities have positive longitudinal developmental benefits for *all* children. In this study, we examine the extent to which frequency of shared home book reading and shared home music activities at 2–3 years are associated with a range of cognitive and social-emotional outcomes at 4–5 years. Further, we estimate the extent to which shared home music activities are associated with these outcomes when both shared home book reading and music activities are included in the same models. We do this by using two single-item measures

☆ This paper uses unit record data from *Growing Up in Australia: The Longitudinal Study of Australian Children* (LSAC). The LSAC study is conducted in partnership between the Department of Social Services (DSS), the Australian Institute of Family Studies (AIFS) and the Australian Bureau of Statistics (ABS). The findings and views reported in this paper are those of the authors and should not be attributed to the DSS, AIFS, or the ABS. This study was supported by ARC Discovery Project DP130102488 *Being and becoming musical: Toward a cultural ecological model of early musical development* (Barrett & Welch 2013–2015).

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of shared home book reading and shared home music activities and include measures of seven developmental outcomes in an exploratory approach to this under-researched area. The investigation of the role of these two distinct early home learning activities across a range of developmental domains will contribute to greater understanding of those early parent-child activities that best support children's development.

The importance of early home learning environments

A substantial body of literature has established the relations between the general quality of the home learning environment and positive academic (Melhuish, Phan et al., 2008; Skwarchuk, Sowinski, & LeFevre, 2014) and social outcomes for children (Foster, Lambert, Abbott-Shim, McCarty, & Franze, 2005). The home learning environment comprises shared parent-child activities aimed formally or informally to expose children to concepts of numeracy and literacy (e.g., we play games that involve counting; we identify words on signs; Kleemans, Peeters, Segers, & Verhoeven, 2012; Skwarchuk et al., 2014), or the availability of materials that encourage specific skills (e.g., I buy my child maths workbooks; Froyen, Skibbe, Bowles, Blow, & Gerde, 2013). Measures of the home learning environment vary in their content and specificity but, typically, involve asking parents to report on the frequency particular activities occur, or in-home observations.

The general quality of the home learning environment in the early years has been linked to a wide range of positive developmental outcomes for children including enhanced communication, language, and literacy skills (Hartas, 2011; Hindman & Morrison, 2012), numeracy skills (Anders et al., 2012), school readiness (Chazan-Cohen et al., 2009), social and emotional skills including self-regulation (Chazan-Cohen et al., 2009; Foster et al., 2005; Hartas, 2011), and fewer behavior problems (Hindman & Morrison, 2012). It appears that the mechanism through which home learning environments stimulate positive developmental trajectories for children relates primarily to domain-specific skills presented within home learning activities. For example, books and book reading expose children to words they may not hear in daily conversation, thus expanding their vocabulary (Sénéchal, 2006). Counting games and songs expose children to early numeracy concepts (Skwarchuk et al., 2014).

The ways in which home learning activities support domain-general skills such as self-regulation, behavior, and prosocial skills has been far less researched. It is conceivable that particular shared parent-child home learning activities that require joint attention, active cooperation, turn-taking, and immediate feedback between parent and child, would support children's self-regulatory and social development. Such contentions are evidenced in recent research that links parent-reported frequency of formal home learning activities, such as teaching letter names and doing math workbooks, with enhanced parent-reported cooperation and compliance in preschool children (Hindman & Morrison, 2012). The current study builds on such work by investigating the relations between the informal home learning activities of shared book reading and shared home music activities, and a number of domain-general developmental skills.

Shared book reading

The most frequently studied aspect of the home learning environment is home literacy practices, including number of books in the home, reading behaviors of parents, and frequency of shared book reading. The benefits of shared book reading, particularly in relation to domain-specific skills such as children's literacy competency, are well established (Sparks & Reese, 2013). Shared book reading is correlated positively with the development of vocabulary, comprehension, and narrative skills (Farrant & Zubrick, 2013; Sénéchal, Pagan, Lever, & Ouellette, 2008). These skills are integral to reading development across the early school years (Hood, Conlon, & Andrews, 2008; Sénéchal, 2006). Shared book reading has also been linked to children's math achievement (Baker, 2013; Farver, Xu, Eppe, & Lonigan, 2006; Melhuish, Phan et al., 2008; Melhuish, Sylva et al., 2008).

The links between shared book reading and domain-general areas of development such as social, emotional, and self-regulatory skills, have been less researched, with most of the existing studies cross-sectional, rather than longitudinal, in nature. Frequency of mother–child literacy-related activities in the home (including shared book reading) has been cross-sectionally linked with teacher-rated positive approaches to learning, social skills, and self-regulatory functioning in children aged 4–6 years (Baker, Cameron, Rimm-Kaufman, & Grissmer, 2012; Farver et al., 2006; Foster et al., 2005). Further, home literacy involvement has been found to mediate the relation between socio-economic status and social skills (Foster et al., 2005), and behavior problems and academic achievement (Haak, Downer, & Reeve, 2012), highlighting the protective role that shared home learning experiences may play for children from particular risk backgrounds.

In one of the few longitudinal studies, Baker (2013) found in an Early Childhood Longitudinal Study – Birth cohort (ECLS-B) of 5190 families, that more frequent home literacy practices at 24 months were associated with higher sustained attention and fewer negative behaviors in direct assessments of parent-child interactions when children were 4-years-old. A further longitudinal study has also linked the relatively poorer quality of the home learning environment with poorer self-regulation and behavior problems as measured by symptoms of Attentional Deficit Hyperactivity Disorder (ADHD) in German children from kindergarten to Grade 2 ($N = 924$; Schmiedeler, Niklas, & Schneider, 2013). Taken together, existing cross-sectional and a limited number of longitudinal studies suggest that frequency of shared book reading is associated with more positive language and cognitive skills in children and more positive social-emotional skills. To the best of the authors' knowledge, no prior study has tested for these longitudinal associations in a large Australian cohort. The current study, in part, addresses this gap and is also unique in including a range of both cognitive and social-emotional outcomes in a longitudinal design spanning two to five years.

Music as a home learning activity

While research has identified the positive developmental benefits of early shared book reading, very little is known about the benefits that may accrue from early shared music activities in the home. Parent-child music activities in the early years include joint and supported singing (including action songs, counting songs, nursery rhymes, and children's songs), generating original songs to accompany routine activities, dancing, playing basic instruments, and listening to music on CD, DVD, and MTV (Barrett, 2009, 2011, 2012). In these contexts shared music activities may function as 'signs' or 'cultural tools' (Vygotsky, 1986/1934) as parents use the conventions of songs and nursery rhymes to build their child's understandings of cultural conventions.

A number of measures of the early home learning environment used in large cohort studies include items related to such music practices (Baker, 2013; Hartas, 2011), and home numeracy and literacy scales often include musical activities such as "we sing counting songs" and "we make up rhymes in songs" (Skwarchuk et al., 2014). Such measurement items not only recognize the supportive role of music in developing numeracy and literacy skills, they also recognize that music provides an important context in which parents and children engage in home learning.

A small body of evidence for the positive developmental benefits of early music engagement with children from 4 years of age supports the notion that early music practices might support children's development across a range of domains. The strongest evidence arises from a small number of well-designed experimental studies with random assignment to music and comparison groups. The outcomes examined in these studies include vocabulary, executive functioning, IQ, math achievement, and social skills.

Moreno and colleagues provided 64 children aged 4–6 years with intensive computerized training on either musical concepts (such as rhythm, pitch, melody) or visual art concepts (including shape, color, and dimension). Children received two daily sessions of one hour each for five days per week over four weeks. Only children in the music-training group showed significant improvements in vocabulary and improved performance on an executive function task (Moreno et al., 2011). Socio-demographic variables were not included in the models, but the control and experimental groups were equivalent on levels of maternal education.

Schellenberg (2004) randomly assigned 132 6-year-old children to one of four groups. Two intervention groups received either standard keyboard lessons or voice lessons for one year. The two control groups received either drama lessons or no lessons. The music intervention groups were found to experience larger increases in tested IQ over the year than those children in the control groups. The extent to which children's varying socio-economic circumstances influenced the differing results of the control and experimental groups was not clearly investigated (Schellenberg, 2004).

A small Australian experimental study of 4–5-year-old children found that children who participated in a weekly early childhood music program performed better on a test of early math achievement than the non-music control group (Goeghegan & Mitchelmore, 1996). In a further correlational analysis within this study, the home music environment also contributed to better performance on the math test, with children who listened more frequently to adults singing and their own music collection at home performing better (Goeghegan & Mitchelmore, 1996). In this study, quasi-control of socio-economic variables was achieved by selecting only research participants with a pre-specified level of parental income and engagement in their child's education.

Lobo and Winsler (2006) used a rigorous experimental design to examine the effects of an eight-week creative dance program (including movement to music) for 40 low income kindergarten children aged 39–62 months. Children in both the experimental and control groups met for 35 minute sessions twice per week in groups of 10 children. The intervention condition was a dance program designed to address elements of body, movement, space, time, force, and form. Music and instrumental play were used throughout the program. The control group played with the experimenter and each other with various curriculum activities and toys during their sessions that did not involve music or dance. Results on parent- and teacher-reported scales measuring social skills and internalizing and externalizing behavior demonstrated greater pre- to post-test improvements in each of the three measures for the experimental group compared to the control group.

Kirschner and Tomasello (2010) recruited 48 pairs of German 4-year-olds and engaged them in a joint play sequence that incorporated musical features in the music condition (song, rhythm, pitch), and contained only spoken elements in the non-music condition. Following this session, the pairs were set a series of tasks designed to assess children's levels of spontaneous helping behavior and cooperative problem-solving. Children who had experienced the music condition displayed more of these prosocial behaviors than children in the non-musical condition.

Additional, though weaker evidence for the potential benefits of early music participation for children is provided by studies with non-random group assignment. Daily music training in kindergarten (compared to weekly training) has been linked with enhanced phonological awareness which supports early language and literacy skills (Moritz, Yampolsky, Papadelis, Thomson, & Wolf, 2013), though this study did not control for socio-demographic variables. In the early primary years, instrumental music lessons have been associated with improved vocabulary and verbal sequencing skills in those receiving piano lessons, compared to those who did not (Piro & Ortiz, 2009).

Active engagement with music, including singing and piano instruction, has been associated with children's visual-spatial intelligence in the preschool years (Bilhartz, Bruhn, & Olson, 1999; Rauscher & Hinton, 2011; Rauscher & Zupan, 2000). This effect has been shown to persist for two years following the cessation of instruction (Rauscher & Hinton, 2011), with most consistent effects shown for those who receive instrumental instruction for two years or more (Hetland, 2000).

Evidence that music is related to children's self-regulation skills was documented by Winsler et al. (2011) who compared a group of 3–4-year-old children receiving weekly Kindermusik music and movement classes with a socio-demographically equivalent group who had not experienced any structured early childhood music classes. Children currently enrolled in Kindermusik showed better self-regulation than those not enrolled, as measured by a battery of tasks that required children to wait, slow down, and initiate or suppress a response. Further, the Kindermusik children were more likely to use a range of positive self-regulatory strategies, including private speech during an attention task and singing/humming during a waiting task (Winsler et al., 2011).

Similar research that has compared children engaged and not engaged in parent–child music classes and arts-enriched preschool curricula, provides additional evidence for the role that early music activities might have in supporting children's development. Participation in weekly parent-infant active music classes has been associated with enhanced communicative gestures, and distress regulation in 12-month-old children compared to those who participated in passive music experiences (Gerry, Unrau, & Trainor, 2012). Arts-enriched preschool environments that include music have been found to improve school readiness, receptive vocabulary (Brown, Benedett, & Armistead, 2010), literacy (Phillips, Gorton, Pinciotti, & Sachdev, 2010), cognitive reasoning (Portowitz, Lichtenstein, Egorova, & Brand, 2009), and emotional regulation skills in low-income children (Brown & Sax, 2013) when compared to non-arts enriched programs.

Finally, a very small number of correlational and cohort studies, and intervention efficacy studies report findings that suggest music participation holds developmental benefits for children, though the designs of these studies do not allow for causal inferences to be made. In a very large American correlational cohort study ($N = 12{,}157$), a higher degree of music engagement within the first grade school curriculum was associated with higher achievement on both reading and math tests even when prior achievement levels were accounted for (Southgate & Roscigno, 2009). This study did not include family socio-economic variables in the models.

Only one longitudinal study has examined the frequency of early shared home music activities and longitudinal associations with developmental outcomes. In a very large British cohort study ($N = 15{,}600$), Hartas (2011) found no relation between parent-reported frequency of singing songs and rhymes or playing music at 3 years, and teacher-rated performance on literacy and social-emotional development at 5 years in a range of parent groups defined by income (below or above the poverty line) and maternal education level. A modest association for shared book reading was found, but the strongest relations were between family income and maternal education and children's outcomes. As parents tended to engage in home learning activities equally across income and education groups, the author concluded that socio-economic status has

the most substantial impact on later outcomes for children independent of home learning activities. This study was limited by the use of only a three-point response scale as a measure of frequency of music activities (every day, several times a week, once or twice a week), and a univariate approach to analyses (ANOVA), rather than multivariate modeling.

Parent–child music therapy efficacy studies indicate that joint active music participation is associated with improved parent–child interactions and enhanced impulse control or self-regulation skills (Pasiali, 2012), and social and communication skills for children (Mackenzie & Hamlett, 2005; Nicholson et al., 2008; Nicholson, Berthelsen, Williams, & Abad, 2010; Walworth, 2009; Williams et al., 2012). These correlational studies have largely been with small numbers of participants and with specialized populations deemed to require additional parenting and child development support. Nevertheless, the described processes of mutually responsive behavior between parent or adult therapist and child that occurs during musical interactions (Malloch et al., 2012; Pasiali, 2012; Shoemark, 2006), suggest that parent–child music activities in the home might afford developmental benefits for all children.

The mechanisms through which early shared music activities might influence later developmental outcomes is an under-researched area. First, as with formal music instruction, informal shared music participation might enhance general neural processing skills in children, particularly those related to phonological and spatial awareness. Second, music activities might provide a motivating context, functioning as a cultural tool (Vygotsky, 1986/1934), in which domain-specific information is shared between adults and children, for example, *The Alphabet Song, Five Little Ducks* (number sense, subtraction), and *Heads, Shoulders, Knees, and Toes* (body part awareness, spatial awareness). Third, active music making often requires sensory-motor involvement from children (action songs, dancing, and instrumental play). This sensory-motor involvement is likely to support brain-body neural connections, a common characteristic of activities known to improve important executive functioning skills in children (Diamond & Lee, 2011). Early childhood music and movement interventions have also been particularly effective in improving important domain-general social, behavioral, and motor skills in young children (Lobo & Winsler, 2006; Zachopoulou, Tsapakidou, & Derri, 2004). Finally, shared home music activities might provide a structure within which parents and children engage in mutually responsive interactions requiring joint attention, active cooperation, turn-taking, and immediate feedback, thus supporting children's self-regulatory and social development (Pasiali, 2012).

The current study

This study seeks to identify those benefits that might accrue from early shared book reading and music activities in the home, and addresses three specific aims. First, it examines the association between frequency of shared book reading when children are 2–3-years-old and measures of children's vocabulary, numeracy, school readiness, self-regulation, prosocial skills, and behavioral problems at 4–5-years-old. Second, it examines the association between frequency of home music activities when children are 2–3-years-old and the same group of outcome variables. Finally, models that examine the extent to which the frequency of early home music activities is associated with later outcomes when home reading is included in the same model are tested. This study addresses some of the limitations found in prior research by: (a) using multivariate regression modeling and including a set of important socio-demographic variables as controls in all models and (b) using a large population sample of Australian children.

Method

This study uses data from *Growing Up In Australia: The Longitudinal Study of Australian Children (LSAC)* which is sponsored by the Australian Government through the Department of Social Services. Data collection for this study began in 2004 with two cohorts of children participating. The focus for this research was the Infant cohort which comprised 5107 children aged from birth to 12 months of age, with data collected biennially since 2004 (Edwards, 2012). At each two-yearly data collection wave, parents and teachers complete questionnaires, computer-assisted interviews are undertaken with parents and children, and direct assessments with children are also completed. The current study uses data collected from the infant cohort when children were 2–3-years-old and again when children were 4–5-years-old.

The sampling unit for LSAC is the study child, with children selected through use of the Medicare Australia (health insurance) database. A two-stage clustered design was employed. First, 311 postcodes were randomly selected. In the second stage, children were randomly selected from these postcodes. Stratification was used to ensure that the numbers of children selected were roughly proportionate to the total numbers of children within each state/territory, and within the capital city statistical districts and the rest of each state (Soloff, Lawrence, & Johnstone, 2005). The cohorts have been found to be broadly representative of the Australian population (Gray & Smart, 2009).

Participants

The sample used in the current study was selected from the 5107 members of the infant cohort in relation to a number of requirements. To be included, participants needed to have completed the home music activity item in the parent interview when children were 2–3-years-old and also to have provided parent-report data on the outcome variables when children were 4–5-years-old. Data were collected from the parent who considered themselves to know the child best. In the vast majority of cases, this was the biological or adoptive mother. In order to minimize the confounding factors in this study, only biologically related or adoptive mother informants who remained the same informant across the two waves of data collection were selected for inclusion ($n = 99$ excluded due to being non-biological or male relative, $n = 6$ excluded due to changing informant across waves of data). It is recommended that further research testing similar models with father-reported data should be undertaken at a later date.

A total of 3031 participants met these criteria and were selected for inclusion. The selected sample was tested on key demographic characteristics and was found to differ significantly from those excluded (Table 1). The mothers and children selected for this study were less likely to be Indigenous and have a main language other than English. Selected families were also from a higher socio-economic group. The children selected for the study were slightly younger at the 4–5-year-old data collection time. These differences between the selected sample and those not included are typical of the patterns of losses experienced in longitudinal studies, and mean that the participants in this study are no longer fully representative of the LSAC study and the Australian population.

Measures

Two items commonly used in large longitudinal studies were selected to measure the frequency with which parents engaged in home learning activities involving music and reading. Similar items have been used in the National Household Education Survey (NHES; U.S. Department of Education. National Centre for Education Statistics, 1996) and the Head Start Family and Child Experiences

Table 1
Sample demographics of selected and excluded participants.

Individual characteristics	Sample		Significance	
	Included (n = 3031)	Excluded (n = 2076)		
Child characteristics	**n (%)**		**$\chi 2$**	***p***
Female	1489 (49)	1008 (46)	161	.36
Indigenous	89 (3)	141 (7)	42.59	.00
Home language other than English	240 (8)	312 (15)	64.62	.00
	M (SD)		***F***	***p***
Age in months (at 2-3 years)	33.877 (2.91)	34.01 (2.95)	2.10	.15
Age in months (at 4-5 years)	57.539 (2.78)	57.78 (3.05)	6.63	.01
Parent / family characteristics	**n (%)**		**χ^2**	***p***
Indigenous	52 (2)	112 (5)	53.67	.00
Non-English speaking background	284 (9)	353 (17)	70.85	.00
Maternal history of depression				
	M (SD)		***F***	***p***
Socio economic position (Wave 2)	.12 (.97)	-.179 (1.02)	113.12	.00

Survey (FACES; Miller, Farkas, Lowe Vandell, Duncan, 2014). Single-item measures are considered appropriate where the construct under investigation is concrete and can be measured discretely without the need for multiple items tapping different aspects of the same construct (Bergkvist & Rossiter, 2007; Bowling, 2005). Recent studies investigating the early home learning environment have used similar single-item measures (Farrant & Zubrick, 2013; Hartas, 2011).

Home music activities. Mothers were asked "in the past week, on how many days have you, or an adult in your family, played music, sung songs, danced, or done other musical activities with the child?" Responses were coded 1 – *not in the past week*, 2 – *1 or 2 days*, 3 – *3–5 days*, or 4 – *6–7 days*.

Home reading. Mothers were asked "in the past week, how often have you, or an adult in your family, read to the child?" The response scale was the same as for home music activities.

Vocabulary. Vocabulary was measured by direct testing (conducted by LSAC data collectors in the field) using an adapted version (Rothman, 2003) of the *Peabody Picture Vocabulary Test – Third Edition* (PPVT-III; Dunn & Dunn, 1997). Items consist of a stimulus word given orally by the examiner, and four numbered picture plates, each with a simple black and white illustration. These are displayed to the child in a multiple choice format. The child's task is to indicate which picture best represents the meaning of the stimulus word by pointing, or saying the picture number. A core set of 20 items were administered to all children. If children made 15–20 errors, an additional basal set of 10 items was administered, and for children who made 0–6 errors an additional ceiling set of 10 items was administered. Full psychometric details of this measure are found elsewhere (Rothman, 2003). Briefly, a one-parameter (Rasch) item response model was fitted to the data, including all correct and incorrect responses (person separation reliability .78[1]). The Pearson product-moment correlation between the full PPVT-III and the Adapted PPVT-III was .93 for all children (Rothman, 2003). The Adapted PPVT scores in this study represent a continuous range of ability.

Numeracy. Numeracy was measured by teacher report on a numeric competency scale that consisted of five items drawn from the Canadian National Longitudinal Survey of Children and Youth (Statistics Canada, n.d.), to which teachers responded *yes* or *no*. Items were: able to sort and classify; able to count objects; able to count to 20; able to recognize numbers; and, able to do simple addition. Responses of *yes* were summed to create a numeracy score ranging from zero to five (α = .80).

School readiness was measured by direct testing using the *Who Am I* (de Lemos & Doig, 2000). Children were asked to complete a series of 11 tasks in a booklet, which were scored for accuracy. Tasks included writing their name, copying various shapes, copying a sentence, writing any numbers, letters and words, and writing a sentence. The score range for each item is 0 (fails to respond) to 4 (mastery of an item based upon the set criteria). Rasch modeling was used to create the overall *Who Am I* Score in the LSAC dataset which has shown high internal consistency (person separation reliability .89). This score is considered to represent children's abilities across a range of pre-academic skills known to contribute to transition to formal classroom settings (Edwards, Baxter, Smart, Sanson, & Hayes, 2009).

Self-regulation was measured using the *Short Temperament Scale for Children* (STSC) developed for the Australian Temperament Project (Prior, Sanson, & Oberklaid, 1989). Previous studies have found these items to be useful in measuring self-regulation across time (Gialamas et al., 2014; Sawyer et al., 2014; Williams, Walker, Nicholson, & Berthelsen, 2013). The STSC has a total of 12 items and three subscales. On the STST items, parents rate their children's behaviors on a 6-point scale: 1 *(almost never)* to 6 (*almost always*). The overall scale has strong psychometric properties. As a measure of *attentional regulation*, four items from the *persistence* subscale of the STSC were used. This scale measures the degree of persistence a child displays in completing tasks or activities. Example items are "when this child starts a project such as a puzzle he/she works on it until it is completed even if it takes a long time" and "this child likes to complete one task or activity before going on to the next" (α = .79).

The measure of *emotional regulation* was the *reactivity* subscale of the STSC which has four items. It assesses the degree of negative reactivity a child exhibits. Example items are "when this child is angry about something, it is difficult to sidetrack him/her" and "when shopping together if I do not buy what this child wants he/she cries and yells." The scores on this scale were reverse coded and summed for these analyses in order that higher scores reflected lower emotional reactivity and thus higher emotional regulation (α = .69).

Prosocial skills were measured with the prosocial behavior subscale from the *Strengths and Difficulties Questionnaire* (SDQ; Goodman, 2001). Mothers completed the subscale during the interview. The SDQ is a 25-item inventory with five subscales: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. Informants rate how true/typical the behavioral statements reflect the child's behavior across the last six months. The items are rated on a 3-point scale (1 – *not true*; 2 – *somewhat true*; and 3 – *certainly true*). The SDQ has received extensive psychometric evaluation across national

[1] In Rasch modeling the person separation reliability statistic indicates how efficiently a set of items is able to separate those persons measured.

contexts and exhibits strong reliability and validity (Goodman, 2001; Hawes & Dadds, 2004). Example items for the prosocial subscale include: "is considerate of others feelings"; "is helpful if someone is hurt"; and, "often volunteers to help". Items scores were summed with higher scores reflecting greater prosociality ($\alpha = .69$).

Behavioral problems were measured using the Totals Problems Score of the SDQ (Goodman, 2001). Scores from the four problem behavior subscales of peer problems, hyperactivity, emotional problems, and conduct problems are summed to provide the Total Problems Score ranging from 0 to 40 with higher scores representing a higher degree of problems ($\alpha = .78$).

Control variables included in the analyses were child gender (0 = boy, 1 = girl), child age in months (at the 4–5 years data collection point), Indigenous status (0 = no, 1 = yes), non-English speaking home environment (0 = no, 1 = yes), family socio-economic position at 4–5 years, and, history of maternal depression over the last 12 months collected when children were 4–5-years-old (0 = no, 1 = yes). Socio-economic position is a derived variable within LSAC that combines parental occupational prestige, parental education level, and household income. It has an approximate mean of zero and standard deviation of one (Blakemore, Gibbings, & Strazdins, 2009). To establish a history of depression, mothers were asked whether in the last 12 months they had had two weeks or more of feeling depressed, 'blue' or nothing could cheer them up. Each of the control variables were selected on the basis of prior research showing relations between these and child developmental outcomes (Cooper, Crosnoe, Suizzo, & Pituch, 2010; Goodman et al., 2011; Hartas, 2011; Matthews, Ponitz, & Morrison, 2009).

Analysis and missing data

All analyses were undertaken in the *Statistical Package for Social Sciences* program Version 21 (SPSS; IBM Corp., 2012). Descriptive statistics and zero-order correlations among study variables were first examined. The relevance of each of the control variables to the outcomes variables was then examined using correlational analysis for pairs of continuous variables and ANOVAs to determine the extent to which membership of the cultural groups or having a maternal history of depression was related to each outcome. Based on the results of these, a series of linear regression models were run in two stages. The first stage tested the relation between frequency of shared book reading and home music activities at 2–3 years and the outcomes measured two years later respectively, while controlling for socio-demographic characteristics. In the instance of each home activity, seven different models were run, one for each outcome variable. Based on these analyses, a second stage of regression analyses were run to examine the effect of early home music activities on later outcomes, over and above the influence of early book reading.

Because of the sample selection procedure described earlier in this section, the level of missing data was minimal. Most mother-reported variables had complete data with cases with instances of missing data representing at most 3% of cases. For the continuous variables, maximum likelihood EM imputation was conducted prior to analytic modeling to ensure that a complete dataset was available for analysis, (as recommended by Shin, Davison, & Long, 2009). Missing cases on the dichotomous history of depression item were imputed with the most common response of 'no history of depression'.

A greater extent of missing data was present for the outcome variable of numeracy, as this was the only teacher-reported variable ($n = 655$, 22% missing). Cases with complete teacher data represented a non-random sample of the full sample for this study as they were of a higher socio-economic position, $F(1, 3029) = 31.26$, $p = .00$, were slightly older, $F(1, 3029) = 6.88$, $p = .000$, and were less likely to be Indigenous, $\chi^2 (1, N = 3031) = 32.38$, $p = .00$, or have a non-English home language, $\chi^2 (1, N = 3031) = 10.830$, $p = .00$. This reduced, non-representative sample of $n = 2376$ was used for the analyses below that are concerned with the numeracy outcome. The analyses were also run with a fully imputed dataset with no difference in results thus only the non-imputed results for the numeracy outcome are reported here.

Results

Descriptive analyses

The largest group of families were using music activities with their children 6–7 days per week (42%, $n = 1265$). Only 4% ($n = 109$) reported not using music at all in the last week. Of the others, 23% ($n = 672$) used it one or two days a week and 32% ($n = 975$) used it 3–5 days. The frequency of book reading to children was higher overall with 67% ($n = 1958$) engaging in it 6–7 days a week, 20% ($n = 616$) 3–5 days a week, 10% ($n = 309$) 1 or 2 days a week, and 5% not at all ($n = 148$). The correlation between frequency of music activities and book reading was significant, but low, $r(3029) = .21$, $p = .00$, suggesting that these are separate activities that may not typically co-occur to the same frequency in families. To further explore this, a cross tabulation analyses was conducted and showed that very few mothers (.01%, $n = 24$) reported that they used *neither* music nor book reading, while 30% ($n = 924$) reported that they used *both* on 6–7 days a week. There were small groups (1.5%, $n = 45$ each) that used either book reading on a daily basis and music activities never, or music activities on a daily basis and book reading never.

Descriptive statistics for all of the study variables along with bivariate correlations are shown in Table 2. All bivariate correlations were significant, in the expected direction and small to moderate in size. Frequency of book reading at 2–3 years was significantly and positively correlated with vocabulary, numeracy, school readiness, attentional and emotional regulation, and negatively correlated with behavior problems two years later. Frequency of music activities at 2–3 years was significantly and positively correlated with vocabulary, numeracy, attentional and emotional regulation, and prosocial skills at 4–5 years, but was not correlated with school readiness or behavior problems.

A series of ANOVAs was run to test the extent to which membership in the Indigenous group, home language other than English group, or the group of children with a mother with a history of depression, was related to scores across the seven outcomes of interest. Indigenous status was significantly associated with poorer vocabulary, $F(1, 3029) = 17.60$, $p = .00$, poorer teacher-rated numeracy, $F(1, 3029) = 6.70$, $p = .01$, lower school readiness scores $F(1, 3029) = 13.67$, $p = .00$, and more behavior problems $F(1, 3029) = 10.01$, $p = .00$. A non-English speaking home environment was significantly associated with lower vocabulary scores, $F(1, 3029) = 127.49$, $p = .00$, higher school readiness scores, $F(1, 3029) = 14.51$, $p = .00$, and more behavior problems, $F(1, 3029) = 12.76$, $p = .000$. Membership of these cultural groups was not associated with attentional or emotional regulation or prosocial skills. In the interest of model parsimony, Indigenous and non-English speaking home are maintained as control variables in the models below only where bivariate associations with the relevant outcome were established.

A history of maternal depression was significantly associated with poorer attentional, $F(1, 3029) = 21.30$, $p = .00$, and emotional regulation, $F(1, 3029) = 64.25$, $p = .00$, fewer prosocial skills $F(1, 3029) = 6.046$, $p = .01$, and more behavior problems, $F(1, 3029) = 83.91$, $p = .00$. There were marginal associations between history of maternal depression and poorer vocabulary, $F(1, 3029) = 3.73$, $p = .05$, and history of depression and poorer school

Table 2
Descriptive statistics and correlations.

	1	2	3	4	5	6	7	8	9	10
1. Home music activities										
2. Home reading	.21*									
3. Socioeconomic position	.06*	.30*								
4. Vocabulary	.06*	.25*	.28*							
5. Numeracy	.07*	.14*	.23*	.28*						
6. School readiness	.03	.11*	.20*	.37*	.42*					
7. Attentional regulation	.09*	.09*	.12*	.14*	.16*	.26*				
8. Emotional regulation	.06*	.12*	.13*	.12*	.11*	.25*	.25*			
9. Prosocial skills	.11*	.07*	.07*	.14*	.15*	.19*	.28*	.33*		
10. Behavior problems	−.03	−.13*	−.23*	−.21*	−.17*	−.21*	−.41*	−.49*	−.39*	
Range	0–3	0–3	−3.51–2.94	34.19–84.78	0–5	29.94–96.88	1–6	1–6	0–10	0–34
Mean	2.12	2.45	.04	65.41	3.60	65.44	3.88	4.42	8.17	8.17
SD	.88	.86	.97	5.91	1.18	8.55	.90	.86	4.66	4.66

* Correlation is significant ($p < .05$).

readiness scores, $F(1, 3029) = 3.91$, $p = .05$. A history of maternal depression was not significantly related to teacher-rated numeracy and was not included in the regression model for that outcome, but was included as a covariate in all other regression models.

Early home reading and later outcomes

A series of linear regression models was conducted to determine the extent to which the frequency of early home reading when children were 2–3 years old was associated with a range of outcomes two years later (4–5 years old) over and above the influence of the control variables (child gender, child age, Indigenous, non-English home environment, socio-economic position, and history of maternal depression). As shown in Table 3, higher frequency of home reading was significantly partially associated with later vocabulary, school readiness, numeracy, attention and emotional regulation, and prosocial skills. Higher frequency of book reading was also associated with fewer reported behavior problems two years later.

The control variables were related to outcomes in expected ways with girls and those from more socio-economically advantaged households performing better on all outcomes and having less behavioral problems. Slightly older children also had higher vocabulary, numeracy, school readiness, attentional regulation, and prosocial skills scores. Indigenous children were more likely to have poorer school readiness scores. A history of maternal depression was associated with poorer attentional and emotional regulation, poorer social skills, and more behavior problems.

Early home music activities and later outcomes

A series of linear regression models was conducted to determine the extent to which the frequency of early home music activities when children were 2–3 years old was associated with the same range of outcomes two years later (4–5 years old) over and above the influence of the control variables. As shown in Table 3, higher frequency of home music activities was partially associated with children's vocabulary, numeracy, attentional and emotional regulation, and prosocial skills. Results should be interpreted in light of the fact that in large sample sizes such as these, statistically significant effects are more easily found than they are in small samples and it is important to note that all estimates were very small. Home music activities were not associated with children's school readiness and behavior problems. The control variables were related to outcomes in similar ways as in the prior model.

The contribution of early home music activities over and above book reading

Based on the findings presented above, a series of five linear regression models was conducted for those outcomes where frequency of early home music was found to have an association over and above the control variables (vocabulary, numeracy, attentional and emotional regulation, and prosocial skills). These models examined the extent to which music activities contributed additional variance to the outcome measures over and above the effects of shared book reading (and the control variables). As shown in Table 4, frequency of home reading was significantly partially associated with children's vocabulary, numeracy, and attentional and emotional regulation, but was not related to prosocial skills in this model. Frequency of home music activities was related to prosocial skills with this slope coefficient one of the strongest across the models ($\beta = .10$). Frequency of home music activities also remained partially associated with measures of numeracy and attentional regulation, in these models in which book reading was included along with the control variables. Again, it is important to consider the small effect sizes of these estimates ($\beta < .08$) when interpreting the results. Comparison of the slope estimates shows that music activities contributed slightly less variance than book reading in

Table 3
Regression models predicting outcomes at 4–5 years from home reading at 2–3 years.

Outcome	Vocabulary	Numeracy	School readiness	Attentional regulation	Emotional regulation	Prosocial skills	Behavior problems
Variable	*B*						
Girl	.08*	.10*	.31*	.12*	.05*	.16*	−.09*
Child age	.22*	.09*	.35*	.05*	.04	.05*	−.03
Indigenous	−.03	−.03	−.03*	–	–	–	.02
Non-English	−.17*	–	.08*	–	–	–	.05*
SEP	.22*	.21*	.18*	.09*	.09*	.05*	−.20*
Depression	−.01	–	−.03	−.08*	−.13*	−.04*	.14*
Home reading	.17*	.08*	.07*	.06*	.08*	.05**	−.05*
R^2	.19	.12	.07	.03	.04	.04	.09

* Significant at $p < .05$.

Table 4
Regression models predicting outcomes at 4–5 years from home music activities at 2–3 years.

Outcome	Vocabulary	Numeracy	School readiness	Attentional regulation	Emotional regulation	Prosocial skills	Behavior problems
Variable	*B*						
Girl	.08*	.10*	.31*	.03*	.05*	.15*	−.09*
Child age	.22*	.22*	.35*	.05*	.04*	.05*	−.06
Indigenous	−.04*	−.03	−.04*	–	–	–	.02
Non-English	−.20*	–	.07*	–	–	–	.06*
SEP	.26*	.23*	.19*	.10*	.11*	.06*	−.21*
Depression	−.02	–	−.03	−.08*	−.14*	−.04*	.15*
Home music	.05*	.07*	.03	.08*	.05*	.10*	−.01
R^2	.17	.12	.27	.04	.04	.04	.09

* Significant at $p < .05$.

relation to numeracy, but more variance than book reading in relation to attentional regulation. Music activities were no longer associated with vocabulary when book reading was included in the model (Table 5).

Discussion

The important relation between early childhood shared book reading and children's language and cognitive development is well established. Less is known about the role of shared book reading in supporting social–emotional development. Theoretically, shared home music activities might also yield developmental benefits for children, given the related efficacy evidence regarding music education and music therapy for particular populations (Moreno et al., 2011; Schellenberg, 2004; Winsler et al., 2011; Williams et al., 2012). This study investigated the longitudinal associations between early shared book reading and shared music activities in the home and a range of cognitive and social-emotional developmental competencies for young children.

Findings from this study indicate that frequency of shared book reading at 2–3 years was positively associated with children's vocabulary, numeracy, school readiness, attentional and emotional regulation, and prosocial skills, and was associated with fewer reported behavioral problems at 4–5 years. Frequency of shared music activities was also positively associated with children's vocabulary, numeracy, attentional and emotional regulation, and prosocial skills. When frequency of shared book reading was controlled for, music activities continued to be partially associated with children's numeracy, attentional regulation, and prosocial skills. The study findings make an important early and exploratory contribution to the understudied field of music as a home learning activity.

Shared music activities are rarely addressed separately in the research as an important component of the home learning environment, but rather are typically grouped together with other home learning practices (Baker, 2013; Hartas, 2011). The findings presented here suggest that while there is some co-occurrence of shared book reading and music activities in Australian homes, there is also a degree of independence, with only 30% of participants reporting that both activities occurred on a daily basis with 2–3-year-olds. When modeled separately, both book reading and music activities were associated with more positive developmental outcomes for children. However, the final combined models suggest a unique role for shared music activities over and above shared book reading, with additional contributions to the variance in numeracy and attentional regulation. Importantly, shared music activities were relatively strongly associated with children's later prosocial skills, with shared book reading no longer significant in the combined model.

To the authors' knowledge, only one other large sample cohort study has examined the longitudinal relations between home music activities and outcomes for young children. The findings of the current study contrast with those of Hartas (2011) who found frequency of home music activities at 3 years to be unrelated to teacher-rated performance on literacy and social-emotional development two years later. Differences in study design, measurement sensitivity, and selection of outcome measures (Hartas used teacher-report, here primarily parent-report is used) may account for these differing results. With only this and one other preceding study, and given the limitations and small effect sizes yielded in the current study, it is clearly too early to come to a consensus on findings. However, the current study makes a valuable contribution to this emergent field of inquiry.

The shared and unique contributions that both book reading and shared music activities likely make to children's development may be interpreted through elucidation of the shared and unique elements of each activity. Both involve parents and children in close proximity engaging in joint action, shared attention, and both expose children to rich language and vocabulary. Both activities also hold the potential for parents to share domain-specific information with children such as number facts, letters of the alphabet, and other concepts. Unique to music activities, participation in dancing, action songs, and playing instruments, involves children in structured fine and gross motor activities that are less likely to

Table 5
Regression models predicting outcomes at 4–5 years from home reading and home music activities at 2–3 years.

Outcome	Vocab	Numeracy	Attentional regulation	Emotional regulation	Prosocial skills
Variable	*B*				
Girl	.08*	.10*	.11*	.05*	.15*
Child age	.22*	.22*	.05*	.04*	.05*
Indigenous	−.03	−.03	–	–	–
Non-English	−.17*	–	–	–	–
SEP	.22*	.21*	.09*	.09*	.05*
Depression	−.01	–	−.08*	−.13*	−.04*
Home reading	.15*	.07*	.04*	.07*	.03
Home music	.02	.05*	.07*	.03	.10*
R^2	.19	.12	.04	.05	.04

* Significant at $p < .05$.

occur during book reading. Further, many action songs provide cues that practice regulation of impulse and action. This sensori-motor element to music participation may be key to children's domain-general developmental capacities, given that interventions known to be efficacious in improving children's executive functioning share an element of physical exercise and brain-body connectivity (Diamond & Lee, 2011). Further, for pre-verbal children the gestures and cues that are integral to action songs can operate as signs or cultural tools (Vygotsky, 1986/1934) by which they can create and communicate meaning with self and others. Due to this potential for motor involvement, shared music activities also do not require children to sit still for long periods of time, as is developmentally appropriate for children of 2–3 years-of-age, and thus they might be more engaging to very young children.

Of all the developmental outcomes examined, music activities were most strongly and independently (of shared book reading) associated with children's prosocial skills. No other large-sample longitudinal study has investigated these associations in early childhood for the general population. The findings align with those that document relations between parent–child music therapy and improved social skills in early childhood for specialized populations (Nicholson et al., 2010; Williams et al., 2012), and those that link group music-making with improved empathy and prosociality in early (Kirschner & Tomasello, 2010), and middle childhood (Rabinowitch, Cross, & Burnard, 2012). Early parent–child music activities such as singing (including action songs), dancing, and playing instruments might provide an important opportunity for children to practice imitation, shared intentionality, social interaction, cooperation, and mutual responsivity with a trusted caregiver (Pasiali, 2012; Rabinowitch et al., 2012). Practice of these skills is likely to contribute strongly to children's later prosocial orientation. In comparison to book reading, shared music-making may provide more face-to-face interaction between adults and children, as the constraint of a printed resource on which joint attention is required is not present. Particularly at the young age of 2–3 years, when most children are not yet reading, children might find more opportunities for turn-taking and mutual engagement in music activities than they do in book reading. Parents might also find it easier to provide opportunities for children to be active and equal participants within music with children of this age. Each of these opportunities, along with practice of the skills discussed above, may support the development of children's theory of mind and empathy, thus contributing to later prosociality.

Frequency of shared music activities was partially associated with a measure of children's later attentional regulation when book reading was also included in the model. This finding supports those of other, smaller studies that have linked adult-child music activities with improved self-regulation in infancy (Malloch et al., 2012) and early childhood (Pasiali, 2012). Exposure to music training in early childhood has also been linked with improved self-regulatory strategies and performance on executive function tasks (Moreno et al., 2011; Winsler et al., 2011). The structure of music in regular phrases might provide additional support for children's sustained attention as sign posts for the beginning, middle, and ends of activities are made clear through the time-sequencing elements of music. Disengaging part-way through a particular song or musical activity may be less attractive than disengaging part-way through a book when the end point of the attention-requiring activity is less clear to the child.

In the final model, frequency of shared music activities also maintained significant, though small partial associations with a measure of children's later numeracy. This finding reflects that of an earlier cross-sectional study with 4–5-year-old children, which linked the home music environment and early childhood music program participation with enhanced math performance (Goeghegan & Mitchelmore, 1996). It may be that the content of parent–child music activities conveys domain-specific information related to early numeracy (counting songs etc.). The time-sequenced structural nature of music means that it may provide very young children with their first experience of patterning thus exposing children to a vital early math concept (Geist, Geist, & Kuznik, 2012). It is also likely that repeated exposure to music activities over time supports children's spatial reasoning skills (Rauscher & Hinton, 2011), important in early math competency. Parents who report a high frequency of music activities at 2–3-years may also have been exposing their child to music as a home learning activity at high levels from birth. Similarly to the way in which long term music instruction (two years or more) is associated with the most consistent non-musical benefits in later childhood (Hetland, 2000), this persistent exposure in very early childhood might have cumulative benefit in terms of children's neural development at a time when brain plasticity is high. Future studies should examine patterns of home music activity use from birth, right across early childhood.

Shared music activities showed associations with later vocabulary and emotional regulation, but did not contribute unique variance once home reading was controlled for. Music activities were not associated with the school readiness measure or with later behavioral problems. The skills tapped by the school readiness measure used in this study favor children who have had high exposure to pencil and paper activities and the printed word and so the association between book reading (but not music) and school readiness found here is not surprising. None-the-less, given that attentional regulation is particularly important for children's adjustment to formal learning environments (Razza, Martin, & Brooks-Gunn, 2012), music activities can be viewed as associated with more domain-general aspects of school readiness.

Shared book reading was the strongest predictor of vocabulary and was uniquely associated with school readiness, reflecting prior research (Baker, 2013; Farrant & Zubrick, 2013; Sparks & Reese, 2013). Fewer longitudinal studies have examined the role of shared book reading in domain-general areas of development across early childhood. The findings of the current study build on those of Baker (2013) who reported more frequent home literacy practices at two years to be associated with higher sustained attention and fewer negative behaviors when children were 4-years-old. Importantly, the current study highlights the potential for shared book reading to also be of support in children's emotional self-regulation development. Exposure to emotional language in books, and engagement with characters who experience emotional dilemmas, might support children's understanding of emotion states and associated regulation strategies. Future research should explore the mechanisms through which shared book reading contributes to children's emotional regulation abilities in more depth.

It is important to note that effect sizes were very small throughout the analyses and in a smaller sample it is unlikely that these associations would have been statistically significant. The results should be interpreted as an exploratory and correlational (rather than causal) investigation in this under-researched area. Future research should address this topic with greater specificity and depth of measurement and with more sophisticated experimental designs that allow for causal inferences to be made. The findings should also be interpreted in light of the two-year time lag between measurement points. It is likely that cross-sectional analyses or a longitudinal design with less temporal distance between measures would have yielded larger effects. It is unknown as to the extent to which home music activities remained a frequent occurrence in the study families between the two measurement points and there is likely to have been substantial variance in this across the sample. Future studies should examine the consistency with which families engage in shared music experiences across the early childhood period and the ways this consistency of participation

relates to children's development. The very small effects sizes are also likely to be related to the single-item broad measure of home music used and a number of other limitations as discussed in more detaile below.

There are a number of limitations to this study. First, a broad measure of shared music activities in the home was used which included both active (action songs, dancing) and passive (music listening) approaches to music engagement. Future research should aim to gain a more nuanced understanding of the specific types of music engagement occurring in the homes of young children and the level of active parental involvement, and relations with developmental outcomes. Use of a single non-specific item such as ours may have contributed to the very small effect sizes. With a more specific measure tapping intense face-to-face parent–child active music participation larger effect sizes might be expected. Active music making is more robustly linked with enhanced development in very young children than passive music participation (Gerry et al., 2012). In alignment with developmental theory, it can also be assumed that the nature of the child and particular biological and genetic factors interact with the home environment and shared experiences with caregivers to produce specific outcomes for children. Future research could explore the extent to which shared music experiences are associated with a range of outcomes for children with different temperamental or biological profiles. A number of our other measures also have limitations. For example, the school readiness measure taps only pen and pencil abilities and does not account for the complex multi-dimensional nature of school readiness behaviors.

Second, the models did not control for prior levels of the outcome variables. For example, it may be that children with greater early abilities in attention regulation receive more exposure to parent–child music activities because they are easy to engage, resulting in a selection effect in relation to frequency of home music. The analysis here did control for a number of important socio-demographic characteristics, but future work should include measures of baseline developmental competencies in children. This would also allow for the examination of the contribution of music activities in the *growth* of skills over time.

Third, the research is limited by the use of primarily parent-report only (with the exception of numeracy which was teacher-report, and vocabulary and school readiness which were tested). This has implications for the limitations of the measures themselves and also for interpretation of the findings. Concerns of shared method variance center primarily on issues of over-inflated regression estimates due to single-reporter bias (Conway & Lance, 2010). However, in this study, while parents' perceptions of children's abilities might influence their decisions about engaging in home learning activities (related to the previous limitation), it is unlikely to bias their reporting of actual time spent in those activities.

Fourth, the analyses did not control for the general quality of the home learning environment, the quality of parent–child relationships, or positive parenting behavior. Each of these are frequently and consistently associated with more positive child outcomes (Giallo, Treyvaud, Cooklin, & Wade, 2013; Martin, Ryan, & Brooks-Gunn, 2013). It might be that our single item measures of book reading and home music are simply reflections of these more systemic aspects of home and family quality, or that these parenting and home characteristics would provide alternate and perhaps stronger explanations of children's positive development. In a major limitation of the study, it is also possible that the parents in this sample that do more music activities with their children differ from those that don't in a number of unmeasured ways that ultimately explain the child outcomes. Finally, the extent to which the findings presented here can be generalized to the whole population is limited by the non-representative nature of the sample. Future work should examine the extent to which these relations hold in samples of various cultural backgrounds and socio-economic status.

This study presents a number of implications for parents, early interventionists, and early childhood educators. The findings suggest that parents are important early educators for their children, and that many use music in this role. Parents who are using little music in the home could be encouraged to do so by being invited to participate in group early childhood music experiences in education and community settings. This may be a particularly effective approach for engaging families from marginalized and lower socio-economic groups. The medium of music circumvents issues of poor parental literacy and low education levels in disadvantaged families, can be useful in addressing language barriers in multicultural communities, and can be implemented in homes at low or no cost. In addition to supporting child development, community held parent–child music groups for disadvantaged families have been shown to address social isolation and support the capacity of parents to connect with peers and other support services (Williams, Teggelove, & Day, 2014).

The findings also suggest that early educators should be aware of the non-musical benefits of active music participation for young children, and should be trained and supported in the use of music to support early development. As many children spend large amounts of time in early childhood education and care settings, there are strong indications that educators should be well equipped to engage in shared music experiences with children and to promote music as a home learning activity to parents. Future research should examine the extent to which music is represented in the training courses of early childhood teachers and child-care workers, and the practices and self-efficacy of teachers in using music as part of their programs.

A growing number of parents enroll their young children in specialist user-pay music classes with formal early childhood music programs described as the "new frontier of music education or intervention aimed at infants, parents and even expectant parents" (Adachi & Trehub, 2012, p. 229). Shared book reading is rarely outsourced from the home to the same extent. We concur with Adachi and Trehub (2012) who suggest a shift of focus in these very early music education settings from teaching the child music, to empowering and reinforcing parents' capacity to use music in their own parenting practices.

This study has made an important contribution to the empirical literature examining the longitudinal relations between early home learning activities and cognitive and social-emotional developmental outcomes for children. The findings support the well-established evidence for the importance of frequent shared book-reading for supporting early childhood developmental competencies known to benefit children as they enter formal schooling, with important extensions to enhanced emotional regulation and reduced behavioral problems. The study also provides distinct evidence for the associations among frequency of shared music activities and later outcomes, particularly in relation to prosocial skills, and attentional regulation and numeracy. While the encouragement of shared book reading remains a vital message for the early childhood sector, shared music should be recognized as an additional key early learning activity that might be useful in supporting vital developmental competencies in young children.

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