Randomized controlled trial of a book-sharing intervention in a deprived South African community: effects on carer–infant interactions, and their relation to infant cognitive and socioemotional outcome

Lynne Murray,[1,2,3] Leonardo De Pascalis,[1] Mark Tomlinson,[2] Zahir Vally,[1] Harold Dadomo,[4] Brenda MacLachlan,[1] Charlotte Woodward,[5] and Peter J. Cooper[1,2,3]

[1]Department of Psychology, University of Reading, Reading, UK; [2]Department of Psychology, Stellenbosch University, Stellenbosch; [3]Department of Psychology, University of Cape Town, Cape Town, South Africa; [4]Department of Neuroscience, University of Parma, Parma, Italy; [5]Department of Psychology, University of Bath, Bath, UK

Background: Consistent with evidence from high-income countries (HICs), we previously showed that, in an informal peri-urban settlement in a low-middle income country, training parents in book sharing with their infants benefitted infant language and attention (Vally, Murray, Tomlinson, & Cooper, 2015). Here, we investigated whether these benefits were explained by improvements in carer–infant interactions in both book-sharing and non-book-sharing contexts. We also explored whether infant socioemotional development benefitted from book sharing. **Methods:** We conducted a randomized controlled trial in Khayelitsha, South Africa. Carers of 14–16-month-old infants were randomized to 8 weeks' training in book sharing (*n* = 49) or a wait-list control group (*n* = 42). In addition to the cognitive measures reported previously, independent assessments were made at base line and follow-up of carer–infant interactions during book sharing and toy play. Assessments were also made, at follow-up only, of infant prosocial behaviour in a 'help task', and of infant imitation of doll characters' nonsocial actions and an interpersonal interaction. Eighty-two carer–infant pairs (90%) were assessed at follow-up. (Trial registration ISRCTN39953901). **Results:** Carers who received the training showed significant improvements in book-sharing interactions (sensitivity, elaborations, reciprocity), and, to a smaller extent, in toy-play interactions (sensitivity). Infants in the intervention group showed a significantly higher rate of prosocial behaviour, and tended to show more frequent imitation of the interpersonal interaction. Improvements in carer behaviour during book sharing, but not during toy play, mediated intervention effects on all infant cognitive outcomes, and tended to mediate intervention effects on infant interpersonal imitation. **Conclusions:** Training in book sharing, a simple, inexpensive intervention that has been shown to benefit infant cognitive development in a low-middle income country, also shows promise for improving infant socioemotional outcomes in this context. Benefits are mediated by improvements in carer–infant interactions, particularly in book-sharing contexts. **Keywords:** Parent–child interactions; prosocial behaviour; attention; language; parent training.

Introduction

In high--income countries (HICs), there is a well-established association between parental dialogic book sharing with infants and small children, and child positive cognitive outcomes (e.g. language development, attention, literacy and school readiness) (Mol, Bus, de Jong, & Smeets, 2008). These associations are likely to reflect, at least in part, the causal effects of book sharing, since they obtain independently of key background variables, such as parental social class and education, and since interventions to train parents in book sharing have resulted in improvements in child functioning (e.g. Arnold, Lonigan, Whitehurst, & Epstein, 1994; Sénéchal, 1997; Whitehurst et al., 1988). Far less is known about the effects of book sharing in low- and middle-income countries (LMICs), although two studies produced consistent findings (Opel, Ameer, & Aboud, 2009; Valdez-Menchaca & Whitehurst,

1992), as did our own pilot study and a full randomized controlled trial in South Africa (Cooper et al., 2014; Vally et al., 2015): thus, we found that a book-sharing intervention for carers of 14–16 month-old infants living in an impoverished peri-urban settlement was effective in promoting children's language development (comprehension and expression) and their sustained attention. The primary aim of the current paper was to determine the effects of this intervention on carer–child interactions, and to establish whether any improvements in these interactions accounted for the gains in child language and attention brought about by the intervention. We assessed interactions during book sharing, that is, the same context in which the intervention group carers had received training; and we also assessed interactions in a non-book sharing, general play, context, enabling us to see whether any benefits to carer–infant interactions during book sharing generalized beyond this specific situation.

Although book-sharing interventions have principally been directed at improving children's language

and cognitive performance, there is evidence from observational studies that parental behaviour during picture book sharing is associated with child social and emotional understanding [e.g. on Theory of Mind tasks (Ruffman, Slade, & Crowe, 2002; Taumoepeau & Ruffman, 2008; Adrian, Clemente, Villanueva, & Rieffe, 2005)], as well as prosocial behaviour (e.g. Brownell, Svetlova, Anderson, Nichols, & Drummond, 2013). Accordingly, a secondary, more exploratory, aim of our study was to determine whether our intervention also benefitted socioemotional understanding. To this end, we employed a 'Help task', modelled on that of Buttleman, Carpenter, and Tomasello (2009), in which infant understanding of another person's predicament, and their help in solving it, was assessed. In addition, since the actions that infants will imitate are an index of their ability to perceive and understand others' actions, changing consistent with their developing social cognitions before they can express such capacities in words (Gergely, Bekkering, & Kiraly, 2002; Meltzoff, 1995), we assessed imitation of different behaviours modelled by doll characters. Because we were specifically interested in whether our intervention would improve children's social understanding, we used dolls' enactment of a social interaction, but we also included as a comparison condition two noninterpersonal, functional behaviours, similarly modelled by doll characters.

In sum, we addressed the following specific questions: first, whether training in book sharing improved the quality of parent–infant interactions in a book-sharing task; second, whether benefits to book-sharing interactions extended to a wider, non-book-sharing, context; third, whether any improvements in parent–infant interactions, in either context, mediated the benefits of the intervention to infant language and attention; and finally, whether book-sharing training also benefitted child socioemotional development, and if so, whether similar mediating effects of parent–infant interaction improvements obtained.

Methods

The study methods, including full recruitment details and randomization procedures, are described in detail in Vally et al. (2015). The sample comprised families identified in a defined area of Khayelitsha, an impoverished peri-urban settlement on the outskirts of Cape Town, South Africa, with a child aged 14–16 months, whose carer was available and competent to take part. Of 112 identified, 91 families were recruited, and were randomized either to the index book-sharing training group ($N = 49$), or to a wait-list control group ($N = 42$) (see Figure 1. CONSORT). Carers, mostly infants' mothers (81%), gave signed informed consent. The trial was conducted in accordance with the declaration of Helsinki. Ethical approval was received from the University of Reading Research Ethics Committee (2012/007/PC) and the Stellenbosch University Research Ethics Committee (S12/04/088). The trial was registered (ISRCTN39953901). Carer–infant interactions and child language and attention were assessed in both groups at base line. The intervention was conducted with index group participants over the following 8 weeks.

Within 1 week of the index group completing the intervention, participants in both intervention and control groups were assessed again on the same measures. Measures of infant socioemotional development were also administered. All assessments and coding were conducted by trained researchers who were blind to group.

Sample

The two groups were demographically similar. For index and wait-list control groups, characteristics were, respectively, as follows: for infants, age in months [M (SD)] 15.45 (0.71) and 15.29 (0.77); male gender 67% and 62%; for carers, age in years 33.35 (10.21) and 31.76 (8.49); >12 years of education 4% and 5%; single status 53% and 60%; family income < R2000[1] per month 55% and 68%; shack housing 41% and 36%.

Intervention

The training programme is described in Vally et al. (2015), and further details are available from PJC and LM. In brief, index group carers were trained in dialogic book sharing (BS) during 90-minute sessions conducted once a week for 8 weeks in a research base in Khayelitsha. Sessions were manualized and delivered in isiXhosa by two trained women from the local community who received weekly supervision. Intervention sessions were carried out in small groups (four-to-five carers); each started with a 45-minute group-delivered didactic presentation, including video-presentations and modelling, that illustrated the principles of sensitive book sharing. These included following the child's lead and encouraging their active participation, facilitating their handling of the book, elaborating on the picture content (including drawing attention to the actions and feelings of book characters), and making links between its content and the child's experience. This was followed by group discussion around a specific book, copies of which were provided to carers to take home, with encouragement to use it with the infant over the following week. The books were sturdy board books with clear, coloured picture drawings, and with minimal text. They included a series by Helen Oxenbury [such as 'All Fall Down' (2009a)] and depicted babies of different ethnic groups, of similar age to those participating in our study, engaging in everyday activities (playing in mud, being washed, interacting with each other and with adults). After the group session, each carer received 10–15 min individual guidance while sharing the week's book with their infant. The last two sessions were focussed on giving individual guidance.

Assessments

Assessments were administered at the research base by a trained local researcher, and for some tasks, with the help of a local assistant.

Cognitive outcomes

Full details of measures are given in Vally et al. (2015).

Child language. Carers were interviewed with the MacArthur-Bates Communication Development Inventory (CDI; Fenson et al., 2000), and asked which of 89 items (translated into isiXhosa) the child could understand, and both understand and say. This provided continuous measures of child comprehension and production.

A culturally adapted version of the Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981) was administered, in which the child was asked to identify from
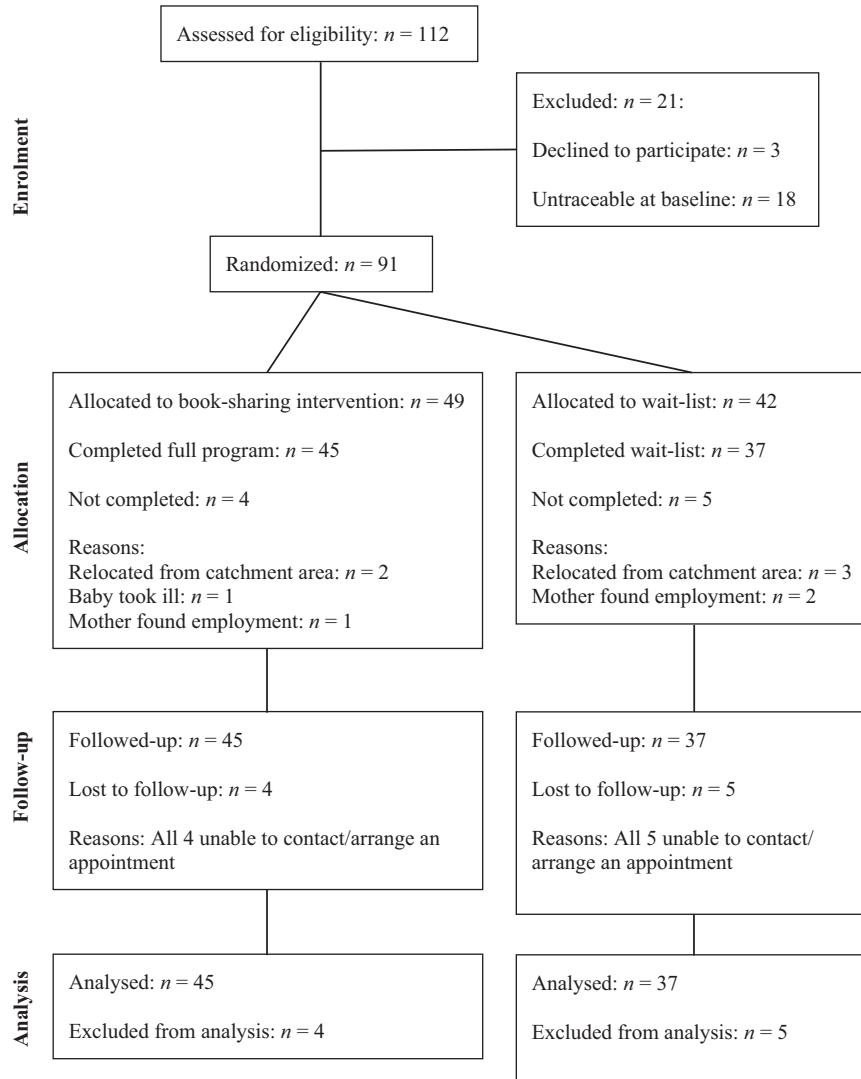
Figure 1 CONSORT diagram showing flow of participants through trial

pictures of four objects the one named by the researcher. Pictures were presented on a series of four cards mounted on a screen in front of the child, (each presented four times, providing 16 trials). Since children were often too inhibited to indicate the named object within the requisite 10 s, their looking time (video-recorded by a camera embedded in the screen at the child's eye level) to the correct item for more than 50% time was used as an alternative measure of comprehension (Houston-Price, Mather, & Sakkalou, 2007).

Child attention. The Early Childhood Vigilance Task (ECVT; Goldman, Shapiro, & Nelson, 2004) was administered. Child duration of gaze to a screen during a 7-minute computerized presentation of images that appeared and disappeared was recorded to measure sustained attention.

Socioemotional outcomes

The two tasks were videotaped for subsequent scoring.

Prosocial behaviour. The Help Task (modelled on Buttleman et al., 2009).

A female researcher enthusiastically displayed a pen to the infant, making comments about how much they liked it, that it was their favourite pen, and how useful it was. After 20 s,

the researcher placed the pen to one side, nearby, where the infant could see it, and turned away to search for something in their bag. While they were busy searching, a second researcher appeared on the scene, and removed the pen, in full view of the infant, to an open box positioned to the infant's left, without the first researcher appearing to notice, and then withdrew. The first researcher then turned back to where the pen had been, feigned puzzlement, and enacted a sequence of three, increasingly explicit, searches for their pen, stating their need for it, and pausing between each search. If the infant helped at any point, by either showing the researcher the pen, or by giving it to them, the researcher thanked them and terminated the task. If the infant did not help, the researcher said, 'Oh actually, don't worry, I think I can find it myself', and retrieved the pen. The Help Task was coded only if the child was judged to have seen the pen being moved to the open box (Intervention $N = 31$, Control $N = 30$). A binary code was used to distinguish whether the child either showed no helpful behaviour, or else helped to some degree (i.e. looking around for the pen, looking and pointing at it in the box, retrieving it and giving it to the researcher).

Imitation tasks. For social interaction imitation, the infant sat at a table on the carer's lap. The carer was requested not to participate in the experiment or interact with the infant.

A researcher, sitting opposite the infant, presented the infant with two dolls for 10 s to obtain baseline behaviour. Then the researcher, using identical dolls, enacted one doll approaching, greeting, and kissing the other for 10 s, using clear movements and vocal cues to enact the sequence. The infant's subsequent behaviour was observed for 10 s to identify any imitation.

For nonsocial, functional behaviour imitation, the researcher passed the infant a doll and a toy hairbrush. The infant was given 10 s to obtain baseline behaviour. The researcher then took an identical doll and hairbrush, and in full view of the infant, enacted brushing the doll's hair, using clear downwards strokes, for 10 s, and then stopped. The infant's behaviour was then observed for 10 s to identify any imitation of the adult's actions. The same basic procedure, but involving a slightly more complex action, was repeated with a doll with a spoon and bowl, this time with the researcher modelling feeding the doll.

The imitation tasks were coded only if the child did not show the target behaviour during the baseline period, and if the carer neither encouraged the child nor enacted the target behaviour. Data that could be coded were available as follows: Social interaction task – Intervention $N = 35$, Control $N = 33$; Hairbrush task – Intervention $N = 33$, Control $N = 28$; Feeding task – Intervention $N = 35$, Control $N = 28$. Since it was not possible for the infants to enact the social task doll actions on themselves, to provide comparable scoring across tasks, we set the criterion for a pass as performing the modelled action on the dolls, rather than themselves.

Carer–infant interactions

Carers and infants were settled into an observation room, where the carer was invited to sit comfortably together with the infant. Carer–infant interactions were then videotaped during two-5-minute periods- book sharing and toy play. The first was always book sharing, since this was the principal focus of the study. Carers were given a picture book that was not used during training ('Tickle, Tickle' by Oxenbury (2009b)), and were asked to share it with their infant. Following this interaction, the book was removed and carers were given a shape-sorter toy and were asked to use it to play with their infant.

Measures

We used the coding scheme we employed in our pilot study (Cooper et al., 2014). The same dimensions were scored for the two sets of interactions, except 'pointing and naming' and 'elaborations' (see below), which were specific to book sharing. Videotapes were scored by trained researchers who were blind to intervention status. To avoid contamination, different raters coded the two different interactions for each dyad.

All dimensions were event counts, apart from two that were rated low to high, on 1–5 scales (i.e. carer sensitivity and child attention).

Carer variables

Sensitivity. Awareness of the infant's direction of interest and their behavioural cues, and appropriate and timely responsiveness to them.

Facilitation. The provision of assistance to the infant in order to achieve their goal (e.g. helping to turn a page if the infant has difficulty, or steadying the shape sorter if it wobbled).

Pointing and naming. In relation to parts of the picture being looked at.

Elaboration. Comments or actions in relation to the picture that expand on the focus of interest, rather than simply pointing to and naming it (e.g. marking out the number of items on the page, animating characters' actions), or that link the picture content to the child's own experience (e.g. pointing to the baby in the picture having his tummy washed and miming washing the infant's own tummy).

Child variables

Attention. The extent to which the child focused on the picture book/shape sorter.

Vocalizations. Non-crying sounds including actual words, part words or communicative babbling/expressive sounds.

Carer–child variable

Reciprocity. The extent of co-ordination, mutual gaze and turn taking between carer and infant.

Coding and reliability

The videotapes of infant behaviour during the socioemotional assessments, and of mother–infant interactions were scored by different trained coders to prevent bias. All coders were blind to group status. In addition, to assess reliability, independent trained coders scored a randomly selected 20% of the videos. Intraclass correlation coefficients for carer–child interaction variables ranged between 0.76 and 0.98. Cohen's Kappa for the Help Task binary help code was 0.89, and for the Imitation tasks it ranged between 0.81 and 1.00.

Data analysis

Apart from socioemotional outcomes, which were measured only at follow-up, analyses included variables measured at baseline and follow-up, with the effect of the former on the latter controlled (Van Breukelen, 2006). Poisson or Negative Binomial models were used for count variables. For non-normally distributed scale variables, a Bias-Corrected and accelerated (Bca) bootstrap procedure was adopted, with 5,000 replications.

We ran multivariate multiple regression models for carer and child interaction variable sets to determine the effect of the intervention. Where significant, we ran separate models on each variable. False Discovery Rate (FDR) adjustment was used to correct *p*-values for multiple testing. For carer–child reciprocity, we ran a single, unadjusted, test. Book-sharing and toy-task interactions were analysed separately. To test the role of carer–child interaction variables in mediating the effect of intervention on child cognitive outcomes, we followed the method described by MacKinnon et al. (2001). We ran a multiple mediator model for all four cognitive outcomes, including as potential mediators the carer–child interaction variables significantly affected by the intervention. The model paths included, for each mediator, and for each outcome, the relationship between baseline and follow-up, as well as the relationships between the mediators at baseline and outcomes at follow-up (MacKinnon et al., 2001). To take into account associations between variables, we also estimated co-variances between the intervention variable, mediators

and outcomes at base line, between follow-up mediators, and between follow-up outcomes (MacKinnon et al., 2001). (See Tables in the Supplementary Materials for bivariate correlations). We assessed indirect effects through BCa bootstrapped (with 5,000 replications) 95% confidence intervals (Hayes, 2009). To illustrate the size of the indirect effects, the ratio between the standardized indirect effect and the standardized total effect was reported (MacKinnon et al., 2001).

We used Chi-Square tests to assess the effect of intervention on the help and imitation tasks. Given the reduced sample sizes for these tasks, we ran mediation analyses on the single mediators. When assessing indirect effects, to decrease the risk of Type I error due to multiple testing, we used the Sobel test (MacKinnon et al., 2001). A p-value ≤.05 was considered statistically significant.

IBM Amos (Arbuckle, 2014) was used to run the mediation model on child cognitive outcomes, the Mplus software (Muthén & Muthén, 2012) for the multivariate multiple regression models and the mediation models on categorical outcomes (i.e. child socioemotional outcomes), and the R statistical package (R Core Team, 2015) for all remaining analyses.

Results
Carer–child interactions

Table 1 shows means and standard deviations for carer–child interaction variables (both book sharing, and toy play).

Book sharing

Carer variables. The multivariate multiple regression model used to investigate the effect of the intervention on the book-sharing carer variables Sensitivity, Facilitations, Pointing and Naming, and Elaborations, showed a significant effect (Wald's $X^2(4) = 17.360$, $p = .002$). Specifically, compared to the control group, intervention group carers showed greater sensitivity during the follow-up assessment ($F(1, 79) = 12.254$, $p ≤ .001$; FDR-corrected $p = .003$). This effect of training on sensitivity was of medium magnitude ($d = .777$, 95% Confidence Interval: 0.319–1.235). A medium sized effect of training was also found for elaborations ($d = .656$, 95% CI: 0.203–1.109), with carers in the intervention group showing a higher rate at follow-up than controls ($X^2(1) = 8.504$, $p = .004$; FDR-corrected $p = .007$). No effect of training was found on either facilitation, or pointing and naming.

Child variables. No effect of training was found for either child Attention or Vocalizations during the book-sharing interaction.

Carer–child variable. Scores for Reciprocity during book sharing deviated from a normal distribution, so a bootstrapped multiple regression model was used. A significant effect of training was found ($d = .450$, 95% CI: 0.003–0.898), with higher Reciprocity scores

in the intervention group compared to the controls ($b = .409$, 95% BCa CI: 0.028–0.804, $p = .041$).

Toy play

Carer variables. The multivariate multiple regression model used to investigate the effect of the intervention on carer Sensitivity and Facilitations during toy play showed a significant effect (Wald's $X^2(2) = 9.807$, $p = .007$). Specifically, the intervention group showed higher sensitivity scores compared to controls ($F(1, 79) = 8.258$, $p = .005$; FDR-corrected $p = .010$). This effect was of medium size ($d = .640$, 95% CI: 0.187–1.093). No effect of intervention was found for facilitations during toy play.

Child variables. No effect of training was found for either child Attention or child Vocalizations.

Carer–child Variable. No effect of the intervention was found on Reciprocity during the toy-play interaction.

Mediation analysis: child cognitive outcomes

As previously shown (Vally et al., 2015), the book-sharing training improved child cognitive outcomes (see Table 2).

Having found a significant effect of intervention on carer sensitivity and elaborations, and carer–child reciprocity during book sharing, and on carer sensitivity during toy play, we explored the role of these variables as possible mediators of the effect of training on the four child cognitive outcomes.

The model (Figure 2) fitted the data well ($X^2(40) = 53.309$, $p = .078$; CFI = 0.959; RMSEA = .064, 90% CI: 0.000–0.106, $p = .292$; SRMR = 0.067), with good proportions of explained variance for the four outcomes (R^2:CDI-U: 0.366; CDI-U/S: 0.370; PPVT-R: 0.227; ECVT: 0.453).

Table 3 shows the mediator effects on the child cognitive outcomes, and the mediated effects. Neither improvements in carer sensitivity during toy play, nor in elaborations during book-sharing mediated the effect of intervention on any child cognitive outcome. Carer sensitivity during book sharing, by contrast, significantly predicted PPVT-R performance ($p = .017$), mediating 58.82% of the effect of intervention. Further, improvement in carer–child reciprocity during book sharing significantly predicted CDI-U scores ($p = .027$), CDI-U/S scores ($p = .004$), and ECVT scores ($p = .013$), mediating 8.97%, 15.79%, and 11.75%, respectively, of the effect of the intervention on these child outcomes. We conducted a secondary analysis to examine whether the impact of reciprocity was accounted for by change in infant attention to the book, but we found no reduction of its impact for any of the analyses reported above.

Table 1 Carer–child pre- and post-intervention interaction variables in book sharing and toy play: means (and standard deviations)

	Book sharing				Toy Play			
	Pre		Post		Pre		Post	
	Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control
Carer								
Sensitivity (1–5)	2.59 (0.83)	2.59 (0.62)	3.28 (1.02)	2.51 (0.96)	2.37 (0.83)	2.55 (0.73)	3.08 (0.79)	2.72 (0.91)
Facilitations (N)	0.98 (1.22)	1.38 (1.53)	5.73 (2.75)	6.26 (2.31)	3.58 (2.52)	4.16 (2.98)	4.27 (2.93)	4.86 (3.56)
Elaborations (N)	0.16 (0.47)	0.34 (0.94)	4.79 (4.51)	2.22 (4.22)				
Pointing and Naming (N)	8.49 (6.13)	7.76 (5.60)	20.19 (10.26)	17.39 (12.85)				
Interaction								
Reciprocity (1–5)	1.61 (0.66)	1.81 (0.69)	2.17 (1.02)	1.85 (0.89)	2.44 (0.98)	2.49 (0.86)	3.09 (0.97)	2.78 (0.87)
Infant Outcomes								
Attention (1–5)	2.63 (0.94)	2.96 (1.01)	3.41 (0.99)	3.62 (0.83)	3.06 (0.98)	3.01 (1.29)	3.56 (0.94)	3.22 (0.77)
Vocalizations (N)	4.78 (5.20)	4.84 (5.11)	27.12 (22.40)	24.49 (21.03)	2.53 (3.34)	5.65 (7.02)	5.20 (8.83)	5.08 (7.07)

Socioemotional outcomes

Percentages for success in the socioemotional tasks, for the two groups, are shown in Table 2.

Prosocial behaviour. An effect of intervention (d = .620, 95% CI: 0.013–1.227) was found on the Help Task, with 48.39% of children in the intervention group showing helpful behaviour, compared to 23.33% of controls ($X^2(1)$ = 4.150, p = .042).

Imitation tasks. No effect of intervention was found for the nonsocial, functional tasks. However, for the social interaction imitation task, 34.29% of children in the intervention group imitated the stimulus behaviour, compared to 15.15% in the control group ($X^2(1)$ = 3.317, p = .069), an effect of moderate size (d = .591, 95% CI: −0.059–1.242).

Mediation analysis. No carer–child interaction variable emerged as a mediator of the effect of training on prosocial behaviour in the Help Task. With regard to social imitation, improvement in carer sensitivity during book sharing was a marginally significant predictor of child performance (b = .661, 95% CI: −0.006–1.328, p = .052), accounting for 58.63% of the intervention effect (b = .669, 95% CI: −0.065–1.403, Sobel test: z = 1.787, SE = 0.374, p = .074).

Discussion

In our earlier paper (Vally et al., 2015), we showed that training carers of 14–16 month-old infants in book sharing over eight, weekly, sessions, brought about substantial gains in infant language and sustained attention. The results reported in the current paper showed that our training programme also brought about improvements in the quality of carer–infant book-sharing interactions, increasing carers' sensitivity to their infant's interests and cues, their elaborations on the book content, and the level of mutual, reciprocal engagement between carers and infants. Further, we found that the improvements in carer interactions, and particularly the increase in reciprocity, mediated the benefit of the intervention to infant language and attention.

Two further, and novel, aspects of our study were to examine whether carer–infant interactions also improved in a non-book-sharing context, and whether infant socioemotional outcomes also showed a benefit of the intervention. With regard to the former, we did find some benefit of the book-sharing training in terms of carer sensitivity to the infant during toy play, although the improvement was not as marked as during book sharing itself; and improvement in play sensitivity was unrelated to the benefits to child cognitive functioning. With regard to socioemotional outcomes, the intervention was associated with higher rates of prosocial behaviour in a task that required the infant to perceive an adult's need for help; and improvement in social understanding was also suggested by the tendency to imitate an affectionate social encounter between two dolls, an effect that was related to gains in maternal sensitivity during book sharing.

Our findings are notable in several respects. First, unlike almost all previous studies of book-sharing interventions, we showed benefits in a low and middle income country. Second, while almost all previous interventions have been conducted with children in their preschool or early school years, our study was conducted with infants at the point where their language is starting to become established.

Table 2 Child cognitive and socioemotional performance pre- and postintervention

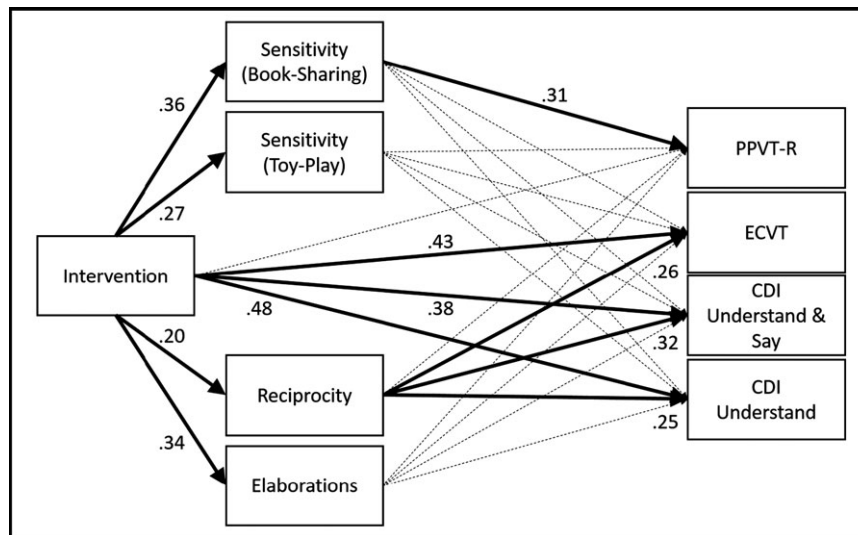|	Pre		Post	
	Intervention	Control	Intervention	Control
CDI understand (*N* words) *M* (*SD*)	32.87 (9.30)	30.57 (9.55)	55.82 (8.76)	44.46 (9.88)
CDI understand and say (*N* words) *M* (*SD*)	3.13 (3.52)	1.84 (1.71)	26.04 (18.72)	9.62 (14.07)
PPVT-R (*N* words) *M* (*SD*)	1.31 (1.20)	1.57 (1.34)	3.19 (1.67)	2.62 (1.85)
Attention ECVT (*N* seconds) *M* (*SD*)	26.93 (17.77)	29.31 (14.37)	45.78 (18.47)	30.12 (14.60)
Help Task (% helping)			48.39%	23.33%
Hairbrush Task (% imitating)			57.58%	42.86%
Feeding Task (% imitating)			45.71%	28.57%
Social Imitation Task (% imitating)			34.28%	15.15%

Figure 2 Multiple Mediator and Multiple Outcome Model, with Standardized Weights for Significant Effects (shown in bold). Paths from baseline to follow-up measures, and covariances were estimated but, for clarity, are not shown

This is important, since early language already shows significant effects of socioeconomic deprivation (Fernald, Marchman, & Weisleder, 2013), and, together with attention, is among the strongest predictors of later cognitive functioning and school achievements (Bornstein, 2014). Third, while it is well-established that parental behaviour during book sharing is associated with child cognitive performance, and that training parents in book sharing improves this child outcome, to our knowledge, no previous study has demonstrated that changes in carer–infant engagement brought about by the intervention mediate its effects on child outcome. Having said this, it is notable that there are significant direct effects of the intervention on some child cognitive outcomes, which remain to be explained. Explanatory factors might include aspects of the mother–child relationship not covered in our observations of book-sharing interactions, such as the overall volume of maternal speech to the child at home, or other, less specific, factors, such as improvements in maternal mood and sense of parenting efficacy, all of which would be profitable to assess in future research. Finally, we found indications of a positive benefit of the book-sharing training to child social understanding and prosocial behaviour.

A key question is why book sharing, rather than general play interactions, should be particularly good at promoting child cognitive and socioemotional development (Cooper et al., 2014). With regard to cognition, it is striking that the illustrations in good books for young children distil the essential characteristics of referents, typically repeating them throughout the book, along with variation in their precise presentation. Such material provides the ideal conditions for concept formation, and when combined with parents' tendency to offer verbal labels for the referents depicted [something done more during book sharing than in any other context (Ninio & Bruner, 1978)], constitutes what has been regarded as a 'language acquisition device' (Ninio, 1983). With regard to socioemotional functioning, picture books can similarly provide unique opportunities to promote its development. In this case, it is the fact that picture books afford the possibility to pause, reflect on and discuss the behaviour, feelings, relationships and differing intentions and perspectives of the book characters in a way that might be far more difficult to achieve amid the hurly-burly of

Table 3 Mediator effects of carer–child interaction measures on child cognitive outcomes, mediated effects, and standard errors of estimates in the multiple mediator and multiple outcome model

Outcome	Mediator	Mediator effect on Outcome (SE)	Mediated effect (95% BCa CI)
CDI-U	Sensitivity (BS)	0.094 (1.192)	–
	Elaborations (BS)	0.022 (0.245)	–
	Reciprocity (BS)	2.804 (1.269)*	1.070 (0.029–3.532)
	Sensitivity (SS)	0.646 (1.369)	–
CDI-U/S	Sensitivity (BS)	−0.266 (2.017)	–
	Elaborations (BS)	−0.622 (0.415)	–
	Reciprocity (BS)	6.129 (2.147)**	2.338 (0.141–6.854)
	Sensitivity (SS)	1.252 (2.315)	–
PPVT-R	Sensitivity (BS)	0.506 (0.212)*	0.387 (0.069–0.972)
	Elaborations (BS)	−0.008 (0.044)	–
	Reciprocity (BS)	0.125 (0.225)	–
	Sensitivity (SS)	−0.261 (0.243)	–
ECVT	Sensitivity (BS)	0.222 (1.870)	–
	Elaborations (BS)	−0.350 (0.384)	–
	Reciprocity (BS)	4.919 (1.991)*	1.877 (0.093–5.661)
	Sensitivity (SS)	−1.395 (2.147)	–

BS: Book Sharing; TP: Toy Play.
p-value: *<.05; **<.01.

swift-moving real-life events (Dyer, Shatz, & Wellman, 2000; Murray, 2014; Sabbagh & Callanan, 1998). Indeed, naturalistic studies show that parents use more mental state talk during book sharing than during other kinds of interaction (Adrian et al., 2005), that is, talk of the kind that predicts child performance on tasks of social understanding (De Rosnay & Hughes, 2006; Dunn, Brown, & Beardsall, 1991; Ensor & Hughes, 2008; Ruffman et al., 2002).

Unfortunately, it was beyond the scope of our study to conduct a comprehensive analysis of carers' speech to the infants. It would be valuable in future work to determine whether the same dimensions of speech that are found in naturalistic studies to be associated with better child outcome both change with intervention and mediate improved child performance. Such evidence would constitute a more rigorous test of causal relationships than can be achieved in correlational studies. Nevertheless, albeit limited, our findings to date regarding carers' speech, namely their 'pointing and naming' and 'elaborating', suggest that, although such practices may well be important for child cognitive progress, they may not be sufficient. Thus, we found 'pointing and naming', to be similarly present in the control and intervention groups (possibly reflecting such a ubiquitous tendency on the part of carers that training in its application is unnecessary), and it was not, therefore, by virtue of this particular behaviour that infant vocabulary benefitted from the training programme. Similarly, while elaborations *did* increase with intervention, they did not mediate the effects on any outcome. By contrast, as noted above, carers' ability to sensitively follow infant interests and cues, and, in particular, to engage them actively in reciprocal exchanges around the book, were the key predictors of child outcome.

This suggests that it is not simply a question of teaching carers particular techniques, but of helping them to use these techniques sensitively, in engagements in which the child's participation is encouraged and supported.

A limitation of our study was that the number of infants for whom data that could be coded were available on the socioemotional outcomes was limited. Indeed, on the social imitation task, differences only approached statistical significance, indicating that larger scale investigation is warranted.

Finally, it would be valuable to establish whether our training could also be effective when delivered to larger groups of carers, and in a smaller number of sessions, that is, whether greater efficiency could be achieved. It would also be valuable to investigate the usefulness of developing the training materials and curriculum, for example, to include a more explicit focus on the promotion of child socioemotional capacities.

Conclusion

Book sharing is effective in improving child cognition and socioemotional development, and improvements in carer–child interactions in the book-sharing context help explain these benefits to child outcome. Further, it is inexpensive and can be delivered by local community workers in conditions of considerable adversity. Given the prediction from early child cognitive functioning to later literacy and school achievements, this result suggests that book-sharing programmes should be widely implemented in LMICs where educational outcomes are often poor and are important in the intergenerational transmission of poverty. The potential of book-sharing training to improve child socioemotional outcomes in conditions where interventions are urgently needed

to address the development of aggression and violent behaviour is of special interest. This needs further investigation.

Supporting information

Additional Supporting Information may be found in the online version of this article:

Table S1. Correlations among the study variables, measured during the baseline assessment (*p < .050; **p < .010; ***p < .001).

Table S2. Correlations among the study variables, measured during the follow-up assessment (*p < .050; **p < .010; ***p < .001).

Appendix S1. CONSORT checklist.

Correspondence

Lynne Murray, Department of Psychology, University of Reading, Whiteknights, Reading RG6 6AL, UK; Email: lynne.murray@reading.ac.uk

---

Key points

- Training parents in HICs in book sharing with their child is associated with better child language and cognitive outcome.
- The current study showed these same benefits can obtain in a LMIC (South Africa) and may also extend to child socioemotional functioning.
- Training improves carer–infant interactions during book sharing, and these improvements are important in bringing about the benefits to child development.
- Providing training in book sharing is feasible and inexpensive in a low income context, and its implementation in these conditions could have a profound impact on child development.

Note

1. i.e. less than the national minimum living wage for farm labourers, which at that time was R2274 per month (£129).

References

Adrian, J., Clemente, R., Villanueva, L., & Rieffe, C. (2005). Parent-child picture book reading, mothers' mental state language and children's theory of mind. *Journal of Child Language, 32*, 673–686.

Arbuckle, J.L. (2014). *Amos 23.0 user's guide*. Chicago: IBM SPSS.

Arnold, D.H., Lonigan, C.J., Whitehurst, G.J., & Epstein, J.N. (1994). Accelerating language development through picture book reading: Replication and extension to a videotape training format. *Journal of Educational Psychology, 86*, 235–243.

Bornstein, M.H. (2014). Human infancy...and the rest of the lifespan. *Annual Review of Psychology, 65*, 121–158.

Brownell, C., Svetlova, M., Anderson, R., Nichols, S., & Drummond, J. (2013). Socialization of early prosocial behaviour: Parents' talk about emotions is associated with sharing and helping in toddlers. *Infancy, 18*, 91–119.

Buttleman, D., Carpenter, M., & Tomasello, M. (2009). Eighteen-month-old infants show false belief understanding in an active paradigm. *Cognition, 112*, 337–342.

Cooper, P.J., Vally, Z., Cooper, H., Sharples, A., Radford, T., Tomlinson, M., & Murray, L. (2014). Promoting mother-infant book-sharing and child cognitive development in an impoverished South African population: A pilot study. *Early Childhood Education Journal, 42*, 143–152.

De Rosnay, M., & Hughes, C. (2006). Conversation and theory of mind. *British Journal of Developmental Psychology, 24*, 7–37.

Dunn, J., Brown, J., & Beardsall, L. (1991). Family talk about feeling states and children's later understanding of others' emotions. *Developmental Psychology, 27*, 448–455.

Dunn, L.M., & Dunn, D.M. (1981). *Peabody picture vocabulary test, 4th edn (PPVTᴛᴍ-4)*. San Antonio, TX: Pearson Publishing.

Dyer, J., Shatz, M., & Wellman, H. (2000). Young children's story books as a source of mental state information. *Cognitive Development, 15*, 17–37.

Ensor, R., & Hughes, C. (2008). Content or connectedness? Mother-child talk and early social understanding. *Child Development, 79*, 201–216.

Fenson, L., Pethick, S., Renda, C., Cox, J.L., Dale, P.S., & Reznick, J.S. (2000). Short-form versions of the MacArthur communicative development inventories. *Applied Psycholinguistics, 21*, 95–116.

Fernald, A., Marchman, V.A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science, 16*, 234–248.

Gergely, G., Bekkering, H., & Kiraly, I. (2002). Rational imitation in preverbal infants. *Nature, 415*, 755.

Goldman, D.Z., Shapiro, E.G., & Nelson, C.A. (2004). Measurement of vigilance in 2-year-old children. *Developmental Neuropsychology, 25*, 227–250.

Hayes, A.F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs, 76*, 408–420.

Houston-Price, C., Mather, E., & Sakkalou, E. (2007). Discrepancy between parental reports of infants' receptive

vocabulary and infants' behaviour in a preferential looking task. *Journal of Child Language, 34,* 701–724.

MacKinnon, D.P., Goldberg, L., Clarke, G.N., Elliot, D.L., Cheong, J., Lapin, A., … & Krull, J.L. (2001). Mediating mechanisms in a program to reduce intentions to use anabolic steroids and improve exercise self-efficacy and dietary behavior. *Prevention Science, 2,* 15–28.

Meltzoff, A. (1995). Understanding the intentions of others: Re-enactment of intended acts by 18-month-old children. *Developmental Psychology, 31,* 838–850.

Mol, S.E., Bus, A.G., de Jong, M.T., & Smeets, D.J. (2008). Added value of dialogic parent–child book readings: A meta-analysis. *Early Education and Development, 19,* 7–26.

Murray, L. (2014). *The Psychology of Babies: How relationships support development from birth to two.* London: Constable & Robinson.

Muthén, L.K., & Muthén, B.O. (2012). *Mplus user's guide* (7th edn). Los Angeles: Muthén & Muthén.

Ninio, A. (1983). Joint book reading as a multiple vocabulary acquisition device. *Developmental Psychology, 19,* 445–451.

Ninio, A., & Bruner, J. (1978). The achievement and antecedents of labelling. *Journal of Child Language, 5,* 1–15.

Opel, A., Ameer, S.S., & Aboud, F.E. (2009). The effect of preschool dialogic reading on vocabulary among rural Bangladeshi children. *International Journal of Educational Research, 48,* 12–20.

Oxenbury, H. (2009a). *All fall down.* London: Walker Books.

Oxenbury, H. (2009b). *Tickle, tickle.* London: Walker Books.

R Core Team (2015). *R: A language and environment for statistical computing.* Vienna, Austria: R Foundation for Statistical Computing.

Ruffman, T., Slade, L., & Crowe, E. (2002). The relation between children's and mothers' mental state language

and theory of mind understanding. *Child Development, 73,* 734–751.

Sabbagh, M., & Callanan, M. (1998). Metarepresentation in action: 3-4, and 5-year-olds' developing theories of mind in parent-child conversations. *Developmental Psychology, 34,* 491–502.

Sénéchal, M. (1997). The differential effect of storybook reading on preschoolers' acquisition of expressive and receptive vocabulary. *Journal of Child Language, 24,* 123–138.

Taumoepeau, M., & Ruffman, T. (2008). Stepping stones to others' minds: Maternal talk relates to child mental state language and emotion understanding at 15, 24, and 33 months. *Child Development, 79,* 284–302.

Valdez-Menchaca, M.C., & Whitehurst, G.J. (1992). Accelerating language development through picture book reading: A systematic extension to Mexican day care. *Developmental Psychology, 28,* 1106–1114.

Vally, Z., Murray, L., Tomlinson, M., & Cooper, P.J. (2015). The impact of dialogic book-sharing training on infant language and attention: A randomized controlled trial in a deprived South African community. *Journal of Child Psychology and Psychiatry, 56,* 865–873.

Van Breukelen, G.J. (2006). ANCOVA versus change from baseline had more power in randomized studies and more bias in nonrandomized studies. *Journal of Clinical Epidemiology, 59,* 920–925.

Whitehurst, G.J., Falco, F.L., Lonigan, C.J., Fischel, J.E., DeBaryshe, B.D., Valdez-Menchaca, M.C., & Caulfield, M. (1988). Accelerating language development through picture book reading. *Developmental Psychology, 24,* 552–559.