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# Background

The most cost-effective way to tackle the root causes of many social and educational problems is to intervene early in children's lives, before the problems have had a chance to entrench. Key to this strategy is improving children's language development in the early years. Children who enter school with good language skills have better chances in school, better chances of entering higher education, and better economic success in adulthood.

Reading is very effective at boosting children's language. Children who read regularly with their parents or carers tend to learn language faster, enter school with a larger vocabulary and become more successful readers in school. Because of this, local authorities often commission services to promote family-based shared book reading (e.g. Bookstart).

However, recent studies suggest that shared book reading interventions work less effectively for children from disadvantaged backgrounds than originally thought, particularly when their parents have lower levels of education. This means that there is a danger that the benefits of shared reading will be restricted to children from more affluent homes.

To solve this problem, we need to develop a better understanding of how reading interventions work, and of how parents use them. We need to identify what parents do and say when reading aloud with their children and why this makes reading so effective at boosting children's language. We need to find out whether differences in how parents read mean that parents from disadvantaged backgrounds use these language boosting behaviours less frequently. We need to determine how to design interventions that increase the use of these behaviours in all parents, especially those with lower levels of education. Then, once we have identified how reading interventions work, we need to determine how to help parents use them successfully in their daily lives.

The aim of this project, across 3 work packages and 7 studies, is to determine how shared reading promotes child language development, and use this knowledge to make it an effective language boosting tool for children from all social and economic backgrounds.

This study (*Work Package 2, Study 6*) will target the effect of inference-generating language on inferential understanding. We taught parents of 4-year-olds to promote inference-making during reading by providing inferential information (e.g. “Look! She’s wearing a swimsuit and sunglasses so she must be going to the beach”) and eliciting it from the child (e.g. “Look! She’s wearing a swimsuit and sunglasses. Where’s she going?”). We hypothesised that the intervention would improve children’s inferential understanding.

# Study Design

This study (*Work package 2, Study 6*) is an educational intervention developed to promote caregiver-child inference based dialogue during shared booking reading and to establish whether an increase in this type of talk will have a causal relationship with the child’s later inferencing ability. The study was pre-registered at <https://clinicaltrials.gov/ct2/home> (NCT02854462, Appendix A). Ethical approval was granted by the Ethics Sub-committee in the Psychology department at the University of Sheffield.

## Participants

100 four-year olds were recruited from South Yorkshire and North Derbyshire. 83 participants had previously taken part in a randomised controlled trial investigating the role of caregiver contingent talk on early language development (McGillion, Pine, Herbert, & Matthews, 2017). 2017). 89 participants gave permission of their data to be uploaded to the UK Data Archive (Appendix B).

Inclusion criteria: All children were firstborn, full term (i.e. born no more than 3 weeks prematurely) and with birth weight over 2.5 kg and were monolingual English speakers; Exclusion criteria: Neither caregivers nor infants had any significant known physical, mental or learning disability.

Participants were given a small cuddly toy and the materials required to complete the intervention at baseline visits and a second cuddly toy and a £40 gift voucher at post-test.

## Materials

*Intervention videos*

A short video was used to deliver the *Inferencing Training* Intervention*.* The script explained what inferencing was and why it might be important for language and reading comprehension and by extension success in school (Appendix C). Stills and video clips illustrated how caregivers and their children engaged in inference-eliciting dialogues while book reading. A second video (matched in length and format to the training condition) introduced caregivers to the *Mathematical Control* Intervention. This video explained how using maths workbooks to practise basic mathematical concepts might help children prepare for starting school (Appendix D). All caregivers appearing in these videos gave permission for their recordings to be used in this way.

*Intervention Support Materials*

Participants in the inferencing training condition were given 10 books (R.R.P £43.90). Inference-making questions were pasted alongside the text of these books to elicit inferencing during book reading. Each question label included a picture of a tiger. The tiger was introduced on the front cover of every book. Caregivers explained that the tiger might need some help to understand the story and that they could do this by answering the questions beside his picture throughout the book. Caregivers were encouraged to provide supportive feedback for correct responses. Model answers and feedback were included for cases where the child refused to respond or responded incorrectly (see Appendix E for book titles, inferencing questions and model responses). Participants in the control condition were given a commercially-available maths workbook called “At Home with Counting” (Ackland, 2012). Families in both conditions were given an intervention diary to record each time they read a particular book (training condition, Appendix F) or completed a page in the maths workbook (control condition, Appendix G). In addition, families in the intervention condition received a leaflet summarising the main points in the intervention (Appendix H).

*Measures of inference making*

Age-appropriate vignettes and questions were used to measure child inference-making ability at baseline and post-test. Inferencing story/vignettes for pre-schoolers taken from the LARRC - Language and Reading Research Consortium (Currie & Cain, 2015; Language and Reading Research Consortium, 2015) were administered at baseline (*Birthday*) and at post-test (*A New Pet, A Family Day Out Part 1*). Author-designed vignettes followed the LARRC template (baseline n = 1; post-test n = 1; see Appendix I). Each vignette was administered orally followed by between 4 and 8 questions to assess inferencing ability. Bespoke vignettes, which were administered first at both time points, included pictorial supports to identify characters in the story.

## Procedure

Families were sent a letter and information sheet (Appendix J) inviting them to take part in a study investigating factors that impact on school readiness. Caregivers who were interested in taking part then contacted the research team to make an appointment. Prior to this appointment, participants completed a Family Questionnaire to measure demographic information (Appendix K) and a Home Life Questionnaire (Appendix L) to collect information about family routines and activities.

*Randomisation*

Participants were randomised to either the inferencing training or mathematical control condition according to the Consolidated Standards of Reporting Trials (CONSORT) 2010 guidelines (Schulz, Altman, & Moher, 2010). Randomisation was conducted by a statistician, Dr Tim Heaton, at the University of Sheffield’s School of Maths and Statistics. Randomisation was stratified by household education (degree or no degree) and the condition participants had been allocated in the previous intervention study (McGillion et al., 2017). For each participant number, condition allocations were placed in a sealed envelope, identified only by participant number, by a research assistant not involved in any other aspect of the project. Participants (n = 17) who had not taken part in the previous study were allocated a condition envelope from a previous participant (who chose not to take part in this study), matched for SES (degree level education or not). Another researcher who collected a subset of the baseline measures and administered the intervention became aware of condition allocation as follows. During the baseline visit, once the final measure had been collected, the research assistant opened the envelope with the appropriate participant number to find out which condition the participant had been randomised to and then administered the relevant intervention.

*Baseline Data Collection*

Participants completed two baseline visits. On the first visit, at the university, participants completed several measures of mathematical ability as part of another study on mathematical development (Yanez Diaz Barriga, in prep). Visit two took place in the participant’s home. Consent forms, Family and Home Life questionnaires were collected.Caregivers and their child then spent approximately 10 minutes participating in a warm up *Book Reading Session*. After two cameras had been set up (Sony HDR-PJ810E and Sony HDR-PJ220E), the researcher gave each participant the same book (Butterworth, 2011) and left the room for the duration of the recording. Two vignettes were then administered to measure baseline *inferencing ability* (primary outcome, Appendix I). Finally, child *language and communication* was measured (secondary outcome) using the NFER Baseline Reception Assessment Language and Communication scale (NFERL; National Foundation for Educational Research, 2015) and the Language Content index of the Clinical Evaluation of Language Fundamentals Preschool 2 UK (CELF; Wiig, Second, & Semel, 2006). The NFERL assessed phonics, picture sequencing, story prediction, word reading, simple sentence reading and name writing. The Language Content index of the CELF is a measure of vocabulary, concept development, comprehension of simple and complex sentences, and comprehension of associations and relationships among words.

*The Intervention*

After all baseline measures were collected, the researcher opened the envelope containing the participant’s condition allocation and administered the appropriate intervention.

*Inference Training Condition*

The researcher explained that the study was investigating whether asking questions during shared book reading could help language comprehension before children start school. Participants were shown the intervention materials, watched the intervention video and were asked to read each book (with inferencing questions included) at least twice over the course of the following month.

*Mathematical Control Condition*

The researcher explained that the study was investigating whether completing daily maths activities could help children get ready for school. Participants watched a video explaining what the intervention involved, were shown the maths workbook and asked to try and complete one or two pages a day over the course of the following month.

Participants in both conditions were given an information leaflet, to recap the main intervention message and an intervention diary to record how often they completed the relevant intervention activities.

*Post-test Data Collection*

Approximately one month later, participants visited the university for post-test data collection. An adapted version of the Home Life questionnaire, including questions about the experience of taking part in the study, was posted to participants in advance of this visit. Caregivers were asked to complete this questionnaire and to bring it and their completed intervention diary to the university in a sealed envelope. The researcher who conducted this visit was blind to condition except on occasions where the caregiver revealed condition allocation through the course of the testing session (*n*=20). 10% of inferencing vignette responses, our primary outcome, randomly selected were double coded by a researcher blind to condition allocation at baseline (*n* = 10) and post-test (*n* = 10). Correlations between scorers indicated high levels of agreement at baseline (*r* = .97). There was 100% agreement between coders at post-test.

The researcher read 3 short vignettes (see Materials, two LARRC, one author-designed, Appendix I). After each story, the researcher asked a series of questions designed to measure the child’s *inference making ability*. The Communication Language and Literacy and Mathematical Literacy components of the NFER Baseline Reception Assessment were administered to measure *child language* (secondary outcome) and mathematical ability.

*Debrief*

In accordance with ethical guidelines laid down by the University of Sheffield Department of Psychology Ethics Sub-committee, all participants were fully debriefed by email after all participants had completed the final outcome visit.

# Documentation

The documentation has been organised into the following sections

 Questionnaires & Support Materials (contains questionnaires, intervention scripts and diaries)

 Data (contains the list of variables)

Data is stored in this file: WP2\_STUDY6\_DATA. XLS (N=89). This file contains the following data:

1. Demographic information including gender, age, socio-economic status (parental education, household income and neighbourhood deprivation). Due to the homogeneity of the sample as described above (Section 2.1 Participants) information at the level of individuals has not been included for variables indexing gestation, birth weight/order, or home language (collected using the Family/Demographic Questionnaire). Furthermore, any data that could be used to identify individual participants (either in isolation or in tandem with other variables) has been redacted.
2. Intervention information including condition allocation and dosage
3. Outcome variables including inferencing and child language scores at baseline and post-test

Variables have been extracted from questionnaires and derived e.g., responses to inferencing vignettes and performance on standardised tests of language development. Missing data is indexed with the code ‘999M’

# Notes on Individual Variables:

1. Study Site & Study Number

This project was broken down into 3 work packages and 7 studies. All data for this study (Work package 2, Study 6) was collected in and around Sheffield, South Yorkshire by a team based at the Department of Psychology at the University of Sheffield

1. Participant Number

100 participants took part in this study, of which 89 agreed for their data to be uploaded to the UKData Archive. A subset of these participants (n=79) had taken part in a previous study (McGillion et al., 2017). These participants, as part of a longitudinal cohort, retained their original participant numbers (from 1-148). Additional participants were numbered from 149, reflecting this, participant numbers run from 1 – 168.

1. Gender (v1\_gender)

This variable records the child’s gender. 1 indicates female; 2 indicates male.

1. Number of Siblings (v2\_siblings)

All participants were first born, this variable collected using the Family Questionnaire records any younger siblings on a scale of 0 to 4 (0 = no siblings, 4 = 4 or more siblings).

1. Indices of Multiple Deprivation (v3\_IMDD)

This is a derived variable. The English Indices of Multiple Deprivation (IMD 2015) ranks every lower layer super output area (LSOA, n=32,844) or neighbourhood according to its level of deprivation relative to that of other areas in England. This statistic, produced by the ONS, is derived from Income; Employment; Health and Disability; Education, Skills and Training; Crime; Barriers to Housing and Services; and Living Environment statistics. IMD deciles are calculated by ranking LSOAs from the most deprived (1) to least deprived (32844) and dividing them into 10 equal groups. The Ministry of Housing, Communities and Local Government provide an interface to find IMD data for any English Postcode. We used this tool (<http://imd-by-postcode.opendatacommunities.org/>) to find the IMD decile for each participant postcode (collected using the Family Questionnaire).

1. Maternal and Paternal Education (v4\_maternal\_ed, v5\_paternal\_ed)

The highest level of education for both parents was collected using the Family Questionnaire during baseline data collection on a 7-point scale (1 = no formal education, 7 = postgraduate level education).

1. Household Income (v6\_income)

Household Income was collected using the Family Questionnaire during baseline data collection on a 4-point scale (1 =<£14,000, 4 = >£42,000).

1. Participant Age at Baseline (v7\_bl\_age\_days, v8\_bl\_age\_months)

Participant age in days (v7\_bl\_age\_days) and months (v8\_bl\_age\_months) was calculated by subtracting their date of birth from the date of the baseline visit where they were visited at home.

1. Language & Communication Ability (v9\_bl\_CELF\_LCI, v10\_bl\_CELF\_BC, v11\_bl\_CELF\_EV, v12\_bl\_CELF\_CFD, v13\_bl\_NFERL, v19\_pt\_NFERL)

Child *language and communication* was measured at baseline using the Language Content index of the CELF (Second UK Edition; v9\_bl\_CELF\_LCI) and the NFER Baseline Reception Assessment Language and communication scale. The Language Content index of the CELF is a composite of three subscales that measure expressive vocabulary (v11\_bl\_CELF\_EV), basic concept development (v10\_bl\_CELF\_BC), comprehension of simple and complex sentences and comprehension of associations and relationships among words (v12\_bl\_CELF\_CFD). The NFER Language & Communication scale assesses phonics, picture sequencing, story prediction, word reading, simple sentence reading and name writing (v13\_bl\_NFERL). At post-test, the NFER Language & Communication scale was repeated (v19\_pt\_NFERL).

A raw frequency score was calculated for these standardised tests according to assessment guidelines. Infrequent cases of missing data due to experimenter error or caregiver interference were replaced with the sample mean for the item in question.

1. Condition (v15\_condition)

Following baseline data collection, participants were randomised to either the inferencing condition (1) or maths condition (0) according to CONSORT guidelines.

1. Dosage (v16\_dose)

Participants in both conditions received a diary to record every time they completed intervention activities. The number of times a caregiver reported completing intervention activities was summed to produce a dosage score (v16\_dose). It is worth noting that once the maths book had been completed it was not possible to return to it again whereas the storybooks for the inferencing intervention could be shared multiple times, resulting in higher dosage scores for participants in the inferencing intervention than the maths intervention.

1. Participant Age at Post-test (v17\_pt\_age\_days, v18\_pt\_age\_months)

Participant age in days (v17\_pt\_age\_days) and months (v18\_pt\_age\_months) was calculated by subtracting their date of birth from the date of the post-test visit.

1. Mathematical Ability (v20\_pt\_NFERM)

Child *mathematical ability* was measured at post-test using the NFER Baseline Reception Mathematics scale (National Foundation for Educational Research, 2015; v20\_pt\_NFERM). This scale assesses counting, identification/sequencing of numerals, finding more or less, addition and subtraction and shape and pattern recognition. A raw score was calculated for these tests according to assessment guidelines. Rare cases of missing data due to experimenter error or caregiver interference were replaced with the sample mean for the item in question.

1. Inferencing Ability (v14\_bl\_vig, v21\_pt\_vig)

*Inferencing Ability* was indexed by child performance on inferencing questions following vignettes that were administered at baseline and post-test.Children were awarded (1/2) for a correct answer and 0 for incorrect responses. Scores were summed to produce an inferencing score at baseline (scored out of 32) and post-test (scored out of 40) separately. All coding was undertaken by a researcher blind to condition allocation. Incidences of missing data/experimenter error were replaced with the sample mean for that particular item.

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