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Associations between Maternal Behaviors at 1 Year and Child Language at 2 Years in a Cohort of Women Experiencing Adversity

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Title Page

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Associations between maternal behaviours at 1 year and child language at 2 years in a cohort of women experiencing adversity

Variations in parenting have been suggested as contributing to a higher prevalence of language difficulties in children experiencing economic, environmental and social adversity. Within these cohorts, the contribution of responsive and intrusive parenting to child language has been investigated; *specific* responsive and intrusive behaviours encapsulated within these parenting styles have yet to be fully examined. Additionally, the role of the mother-child dynamic in moderating mother-child associations has also not been explored. This study aimed to augment current research by identifying specific responsive and intrusive maternal behaviours associated with child language in a cohort experiencing adversity, as well as exploring the role of the fluency and connectedness of mother-child conversation in moderating associations ($n=249$). Specific behaviours and the fluency and connectedness of the mother-child interaction were coded from free-play videos at child age 12 months. Child language measures were derived from transcripts of free-play at 24 months. Linear regression models were used to examine maternal-child associations. The moderating role of fluency and connectedness was then explored. Maternal imitations were positively associated with the child's total words; successful redirectives were negatively associated with the child's mean length of turn. Both associations were moderated by the fluency and connectedness of the interaction.

There are several widely acknowledged biological and genetic risk factors for poorer language in preschool children such as gender and family history of speech and language difficulties (Reilly et al., 2009). Yet these factors explain little of the prevailing variability in early language trajectories (Snowling, Duff, Nash, & Hulme, 2015). Since language acquisition occurs in the context of everyday adult-child interactions (Bruner, 1975; Vygotsky, 1962), the influence of these factors may be less important for young children than

their communicative environment (Bishop, Price, Dale, & Plomin, 2003; Scarr & Weinberg, 1978). As poor early language is negatively associated with various academic and social outcomes (Snowling et al., 2015; Zubrick, Taylor, & Christensen, 2015), continued exploration of modifiable, environmental factors related to language development is important (Reilly et al., 2009).

Maternal responsiveness and child language

It is unsurprising that maternal responsiveness facilitates early language development (Bornstein, Tamis-LeMonda, & Haynes, 1999; Eshel, Daelmans, Cabral de Mello, & Martines, 2006; Tamis-LeMonda, Bornstein, & Baumwell, 2001) as language learning occurs within adult-child exchanges. Responsiveness is defined as the provision of expeditious, semantically contingent and appropriate responses to what a child has said or done (Tamis-LeMonda et al., 2001; Tamis-LeMonda, Kuchirko, & Song, 2014). Specific maternal responsive behaviours positively related to child language include responsive questions (Cristofaro & Tamis-LeMonda, 2011; Levickis, Reilly, Girolametto, Ukoumunne, & Wake, 2014; Tamis-LeMonda et al., 2001), responsive labels (Della Corte, Benedict, & Klein, 1983), imitations and expansions (Levickis et al., 2014; Masur, Flynn, & Eichorst, 2005; Tamis-LeMonda et al., 2001).

The contingencies found in responsive parenting may be beneficial to child language learning in several ways, for example, provision of predictable parental responses allowing the infant to understand the value of their own behaviour (Baumwell, Tamis-LeMonda, & Bornstein, 1997). These contingencies also help scaffold language acquisition by working within the 'zone of proximal development' (Vygotsky, 1962) to maintain the child attention, facilitate tasks and elucidate salient interaction features (Laakso, Poikkeus, Katajamäki, & Lyytinen, 1999). Another important aspect of responsive contingencies is that they require the mother to follow the child's lead thus promoting shared attention. Shared attention theoretically simplifies the task for the child as it does not require them to use additional resources to switch attention to understand the word-object referent (Shimpi & Huttenlocher, 2007). The capacity to learn new words is therefore optimised in periods of joint attention advancing the transition from pre-symbolic (i.e. concrete gestures) to symbolic communication (i.e. using a word to represent meaning) (Bruner, 1975; Murray & Hornbaker, 1997). During infancy,

responsive maternal behaviours may consequently be particularly instrumental in promoting and scaffolding early word use (Tamis-LeMonda et al., 2001).

Maternal intrusiveness and child language

Whereas responsive parenting behaviours are associated with positive language outcomes, early language development appears hampered by intrusive communicative environments (Clincy & Mills-Koonce, 2013; Keown, Woodward, & Field, 2001; Pungello, Iruka, Dotterer, Mills-Koonce, & Reznick, 2009; Snow, 1995; Yoder & Kaiser, 1989). Definitions of maternal intrusiveness are often based on the work of Ainsworth, Blehar, Waters, and Wall (1978) in relation to mother-child attachment. Intrusive behaviours are those which are not contingent on child actions and aim to commandeer the activity (Ipsa et al., 2004).

Redirecting or prohibiting the child from their chosen task are examples of intrusive behaviours in the literature. In most cohorts of children, these types of behaviour have been found to be negatively associated with language outcomes (Hart & Risley, 1995; Masur et al., 2005; Taylor, Donovan, Miles, & Leavitt, 2009).

There are several explanations for the inverse association between intrusive parenting and child language. One explanation is that these types of behaviour discourage collaborative language learning, questioning and participation (Keown et al., 2001; Taylor et al., 2009). These behaviours may also encourage children to communicate in a non-verbal manner, limiting conversational partners and therefore language modelling (Yoder & Kaiser, 1989). Additionally, intrusive language often only provides information about the immediate context, for example, "*Don't chew that*" or "*Look over here!*" therefore may not stimulate broader lexical hierarchies and representations in the child's mind (Diaz, Neal, & Vachio, 1991). The opportunities for development of word relationships may consequently be impeded by frequent exposure to prohibitions and redirectives (Song, Spier, & Tamis-LeMonda, 2014). Repeated redirection may also mean that these infants do not benefit from sustained periods of joint attention on a shared topic. The child may expend resources shifting attention to understand adult word-object referents, reducing capacity for word learning (Shimpi & Huttenlocher, 2007; Tomasello & Todd, 1983).

Adversity and parenting

Children living in households experiencing adversity have parents who are frequently *less* responsive and *more* intrusive (Dyer, Owen, & Caughey, 2014; Fuller, Bein, Kim, & Rabe-Hesketh, 2015; Hart & Risley, 1995). Teenage mothers, for example, are often less verbally responsive and more intrusive than older mothers (Keown et al., 2001; Rafferty, Griffin, & Lodise, 2011). Adversity, as used in the current study, refers to typical socioeconomic status measures but also includes other risk factors related to child language, for example, teen parenthood (Keown et al., 2001; Rafferty et al., 2011), ethnic minority status (Fuller et al., 2015) and parental mental health difficulties (Pan, Rowe, Singer, & Snow, 2005).

Importantly, risk factors which impact child development are not mutually exclusive and may in fact cumulatively impact a parent's ability to cope (Conger, Conger, & Elder, 1997; Ghate & Hazel, 2002). This compounding may result in less spontaneous and more goal-directed parent-child interactions, necessitating a more directive style (Hoff-Ginsborg, 1991). This may be why less responsive and more intrusive parenting correlates with increasing sociodemographic risk factors (Clincy & Mills-Koonce, 2013; McLoyd, 1990).

It may not only be the pressure of living in adversity which fosters intrusive parenting. Parents with lower levels of education and family income may also have less knowledge of child development and different verbal skills (Rowe, 2008), factors which have been associated with greater use of utterances intended to direct child behaviour (Adams & Ramey, 1980; Hoff-Ginsborg, 1991; Rowe, 2008). Additionally, lower socioeconomic status parents can be less able to adapt their verbal responsiveness in line with their child's development when compared to middle class parents (Lawrence & Shipley, 1996). These types of parenting differences have been posited as contributing to the higher prevalence of language difficulties in children experiencing adversity (Conger et al., 1997). Where population studies suggest around six to ten per cent of young children have persistent speech, language and communication needs (Law, Boyle, Harris, Harkness, & Nye, 2000) the rate increases to around one third within cohorts experiencing adversity (Law, Rush, Schoon, & Parsons, 2011; Ryan, Gibbon, & O'Shea, 2015).

Cultural variations in parenting

Although child-focused parenting styles are upheld as optimal for language acquisition (Lieven, 1994), beliefs about children and child-rearing vary with cultural background (Vigil

& Hwa-Froelich, 2004) meaning that directive parenting is typical in many cultures (Simmons & Johnston, 2007). Furthermore, this directiveness may not adversely impact child outcomes (Tardif, Shatz, & Naigles, 1997). In fact, for African American children experiencing adversity directive parenting has been *positively* associated with child language (Shimpi, Fedewa, & Hans, 2012). One recent study explored mother-child interactions and emerging school readiness for both African American and Latin American children (Dyer et al., 2014). Latin American mothers were more likely to be child-orientated and directive and less likely to be harsh-intrusive or withdrawn when compared to African American mothers. These same styles of parenting did not translate to comparable child outcomes however; African-American children had higher language and school readiness scores when mothers were child-orientated and directive. Latin American children only benefitted from child-oriented mothering. These findings reveal the complex, multi-faceted nature of parenting and child language. As much of this research focuses on American cohorts, exploring the interplay between parenting and child language in a diverse cohort of Australian families experiencing adversity will add to the current body of literature.

Adversity, parenting and child language

There are a growing number of studies investigating the influence of parenting on early language for infants experiencing adversity (Brockmeyer Cates et al., 2012; Shimpi et al., 2012; Vallotton, Mastergeorge, Foster, Decker, & Ayoub, 2017). To date, however, many of these studies have only measured universal parenting styles within these cohorts, for instance, positive parenting (Rafferty et al., 2011), negative parenting (Pungello et al., 2009; Rafferty et al., 2011), sensitive parenting (Pungello et al., 2009; Vallotton et al., 2017) and intrusive parenting (Dyer et al., 2014; Keown et al., 2001). These universal measures are inclusive of numerous, subjective behaviours making it difficult to discern which specific aspects of the interaction are facilitating language acquisition (Hirsh-Pasek et al., 2015). Studies which have explored specific parenting behaviours (Della Corte et al., 1983; Levickis et al., 2014; Masur et al., 2005; Paavola, Kunnari, Moilanen, & Lehtihalmes, 2005; Tamis-LeMonda et al., 2001) have not yet used these behaviours with cohorts experiencing adversity where variations in parenting may play a larger role in language outcomes (Baydar & Akcinar, 2015).

Reciprocity between the mother and child

Another important aspect of early language acquisition is that it occurs within shared social interactions (Bruner, 1975; Vygotsky, 1962). Maternal language scaffolding *and* child language learning take place within co-constructed exchanges (Hirsh-Pasek et al., 2015) yet previous studies with cohorts experiencing adversity often do not explore the nuances of mother-child interaction (Vallotton et al., 2017). In early infancy, the onus is on the mother to establish joint engagement by regulating the child's attention (Tronick, Als, & Brazelton, 1977). The mother can then assist the child to take conversational turns (Bloom, Russell, & Wassenberg, 1987; Snow, 1977). A recent study with low-income families ($n=60$, average age 25.2 months) explored the contribution of sensitive parenting and maternal words per minute to child language (Hirsh-Pasek et al., 2015). This study also accounted for the dyadic nature of language by measuring how communication partners scaffolded and maintained their dialogue using verbal and non-verbal turns (termed fluency and connectedness). The authors found fluency and connectedness at 24 months to be the strongest predictor of later language.

Previous studies without a focus on adversity have also found shared, reciprocal interactions to be positively related to child language (Akhtar, Dunham, & Dunham, 1991; Tomasello & Todd, 1983; Zimmerman et al., 2009). The scaffolding provided by mutual turn-taking (or fluency and connectedness) supports the child to develop a 'speak-listen' conversational structure (Black & Logan, 1995; Nelson, 2008), with the child potentially more receptive to the introduction of novel words in their role as a listener. It may also help shape syllabic, speech-like sounds by providing the infant with frequent linguistic responses which can be imitated (Bloom et al., 1987). Maternal behaviours *and* the reciprocity within the mother-child dyad may therefore be fundamental for early language acquisition (Adamson, Bakeman, Decker, & Brook Nelson, 2014).

The present study will add to the current literature by measuring both specific responsive and intrusive maternal behaviours in relation to child language and exploring the role of the fluency and connectedness of mother-child conversation in moderating associations. The findings will make an important contribution to understanding more about barriers and facilitators to child language acquisition in a large, understudied population.

Study aims:

1. To explore the associations between specific maternal responsive and intrusive behaviours at 12 months and child language skills at 24 months in a cohort of women experiencing adversity;
2. To understand the extent to which significant associations are moderated by the fluency and connectedness of the mother-child interaction.

Method

Study design and participants

This prospective, longitudinal study is nested within the *right@home* trial. *Right@home* is a randomised controlled trial exploring the effectiveness of sustained, nurse home visiting (SNHV) provided to women experiencing adversity from pregnancy to child age two years. *Right@home* is an ongoing trial scheduled to conclude in December 2019. As the current study comprises data from the control arm only, it does not report on *right@home* outcomes.

Pregnant women experiencing adversity were recruited to *right@home* between April 2013 and September 2014 ($n=722$). Recruitment took place across 11 maternity hospitals in Victoria and Tasmania, Australia. According to the Australian Standard Geographical Classification Remoteness Area categories, the majority of women recruited lived in major cities (48.0%) or inner regional (40.6%) areas. Women with limited spoken English were excluded. Indicators of adversity were two or more of the following: current smoking, young pregnancy (<23 years), no support during pregnancy, poor/fair/good health (versus very good/excellent general health), anxious mood, not finishing high school, not having a household income, a long-term illness, not living with another adult and/or never having a job. These indicators were chosen following a pilot screening and data linkage where a statistician examined various algorithms to identify which criteria would best capture women experiencing adversity. Following an initial baseline assessment at home, participants were randomised to intervention and control arms.

Three-hundred and fifty-nine women were randomised to the control arm, with 311 of those women completing face-to-face assessments when their child turned 12 months of age

(86.6%) (mean maternal age at baseline = 28.44 years, SD 6.18 years; mean child age at 12-month assessment = 12.12 months, SD 1.0 month). Control participants with videos from that assessment were included in this study ($n=249$, 80.1%). The control arm was chosen to eliminate any intervention effects. Those women were then followed up when their child was 24 months (mean child age at 24-month assessment = 24.23 months, SD 1.0 month). Another face-to-face assessment was conducted where the same videoing procedure was repeated. Retention at follow-up was 76.3% ($n=190$). Of note, 16 videos at 12 months and 13 videos at 24 months were excluded from the analysis for several reasons including missing or corrupted videos and poor sound quality. Six of the 24-month videos were also excluded on the basis that they were predominately in a home language and so could not be transcribed (see *Figure 1* for participant flow diagram). Reasons for not collecting videos included child sleeping, no custody of child, maternal/child illness, limited time, did not consent and phone/postal survey conducted.

Ethics

Ethical approval has been gained from The Royal Children's Hospital (RCH) (RCH HREC Number: 32296A) for the *right@home* study. Site specific approvals were also gained from the individual locations involved in the study. Ethical approval has also been gained from The University of Melbourne, Human Research Ethics Committee for this study (Ethics Application ID: 1545222.1).

Procedures

Right@home researchers conducted the 12- and 24- month face-to-face assessment in the home. As part of these assessments, mother and child were video recorded on an iPad during eight minutes of free-play. Women were provided with an identical set of age-appropriate toys which allowed for different types of play, including a toy playground with figurines and plastic construction blocks. The toys were the same at both 12- and 24-month assessments. Women were encouraged to play with their children as they usually would at home. The data for this current study comes from analysis of 300 seconds (s) of footage from the middle of each video (12 months: $M=297s$, range 208-301s; 24 months: $M=299s$, range 253-300s). Of note, five minutes of footage has been used to measure maternal responsiveness and sensitivity in other research studies (Alston & James-Roberts, 2005; Lloyd & Masur, 2014)

Measures

Maternal behaviours (predictor variables)

From a comprehensive literature search, responsive and intrusive behaviours associated with child language were selected as predictor variables. Detailed descriptions of each maternal behaviour can be found in Table 2. From the 12-month videos, imitations (Bornstein et al., 1992; Hampson & Nelson, 1993; Levickis et al., 2014; Tamis-LeMonda et al., 2001), labels (Bornstein et al., 1992; Della Corte et al., 1983), 'wh' questions (Hampson & Nelson, 1993; Levickis et al., 2014; Tamis-LeMonda et al., 2001) and yes or no questions (Hampson & Nelson, 1993; Paavola et al., 2005) were coded as responsive behaviours. Behaviours were only counted as responsive if the mother acted within five seconds of the child's preceding action (Baumwell et al., 1997; Bornstein et al., 1992). An example of a responsive question would be a child picking up a toy car and the mother asking "What's that?" (responsive 'wh' question) or "Is that a car?" (yes or no question). Questions were divided into open-ended (wh) and closed questions (yes or no); the latter question type involves less child participation, choice-making and problem-solving therefore the language learning benefit may be lessened (Rowe, Coker, & Pan, 2004; Taylor et al., 2009).

Prohibitions (Della Corte et al., 1983; Hart & Risley, 1995; Taylor et al., 2009), successful redirectives and unsuccessful redirectives (Akhtar et al., 1991; Hampson & Nelson, 1993; Masur et al., 2005; Pine, 1992; Taylor et al., 2009) were coded as intrusive behaviours. Intrusive behaviours could occur at any time during the videos. A delineation was made between redirectives which successfully shifted the child's attention, versus those that did not. Theoretically, if the mother successfully redirects the child's attention, the child may have learnt language from the exchange (Shimpi & Huttenlocher, 2007). An example of a mother successfully redirecting her child would be her calling the child's name and the child turning to look. If the child continued with their activity without acknowledging their mother, an unsuccessful redirective would be coded. Behaviours were coded using Observer® XT software (Noldus, 2008) by the first author. All maternal behaviours were mutually exclusive, but not exhaustive.

Infant communication behaviours (outcome measures)

Five minutes from the middle of each 24-month video was transcribed using the Systematic

Analysis of Language Transcripts (SALT) software. All videos were transcribed by the first author, an experienced speech-language pathologist. Coding conventions including word definitions, utterance boundaries and clausal chaining were consistent with SALT software (Miller, Andriacchi, & Nockerts, 2011). In order to obtain accurate vocabulary measures, word transcriptions were the same for both speakers irrespective of articulatory production, for example, if the child used cluster reduction in their speech (for example, saying “sing” for “swing”) the word would be transcribed correctly (“swing”). Utterance boundaries were based on pausing and intonation (Loban, 1976). Language measures were calculated by SALT software. Due to the age of the children, only information from the SALT standard report was calculated including total number of utterances, mean length of utterance (MLU), total number of words, number of unique words (different root morphemes) and mean turn length (words). The child’s mean length of turn was included as it provided a measure of the balance of communication between partners. Of note, observational assessment is a useful method to gather representative information about an infant’s holistic communication skills (Tamis-LeMonda & Bornstein, 1994). Observational measures have also been found to correlate with maternal report of child expressive language (Pan, Rowe, Spier, & Tamis-LeMonda, 2004).

Moderator variable: Fluency and connectedness

To test the hypothesis that the quality of maternal-child turn-taking would moderate any significant associations between maternal and child behaviours, the fluency and connectedness rating scale from Hirsh-Pasek et al. (2015) was used. The rating scale was assigned using the technical report procedure from the Communication Foundation Rating Items (Adamson, Bakeman, Deckner, & Brooke Nelson, 2012). To measure the fluency and connectedness of the interaction, the same five minutes of footage was re-watched. A score of one was assigned if no verbal or non-verbal exchange occurred between the infant and mother for the entire video. A ceiling score of seven was assigned if the interaction was balanced, sustained and moved smoothly between turns (Hirsh-Pasek et al., 2015). See Table 3 for anchor behaviours for the fluency and connectedness rating scale.

Interrater reliability

For both measures coded at 12 months of age (maternal behaviours and fluency and connectedness) interrater reliability was conducted on 10% of the sample ($n=50$). Videos

were randomly selected and coded by a second coder (fifth author). For maternal behaviours, intraclass correlation coefficients (ICC) were deemed suitable to assess interrater reliability (McGraw & Wong, 1996). As reported by Cicchetti (1994), reliability was excellent for maternal behaviours with the following coefficients: imitations (.95), labels (.97), responsive questions (.94), yes or no questions (.92), prohibitions (1.0), successful redirectives (.92) and unsuccessful redirectives (.96). For fluency and connectedness, the weighted kappa statistic was used to measure interrater agreement; agreement was met when both raters achieved the same score or one score apart. According to Landis and Koch (1977) substantial agreement was met between raters ($k=0.80$).

Reliability of the 24-month randomly selected transcripts was estimated by using a second trained research assistant checking 10% of the original transcripts ($n=19$). The research assistant edited each transcript and language measures were calculated for both the original and edited transcripts. Intraclass correlation coefficients (ICC) were then calculated for reliability of each language measure. Reliability was again excellent for all measures: total utterances (.99), MLU (.99), total words (.98), unique words (.94) and mean length of turn (.99). For all videos, disagreements were discussed with the final decision being made by the first author.

Statistical analysis

To address the first research aim, a correlation matrix of the predictor and outcome variables was initially generated. Intelligibility at 24 months is expected to be minimum 50% (Lanza & Flahive, 2008) so transcripts less than 50% intelligible were excluded from analysis. As assumptions of linearity were met, linear regression models were then fitted. Only significant maternal and infant associations were explored in the regression models. First, maternal behaviours were included individually in unadjusted linear regression models as predictors of child language at 24 months. Analyses were then extended to adjust for all potential confounders including child age at assessment, gender, family history of language and literacy difficulties, birth order and main language. Although not finishing high school was one inclusion criteria for the *right@home* study, maternal education (from the baseline data) was also included as a confounder due to its distinct role in factors related to language development, for example, responsiveness and provision of learning opportunities (Fewell & Deutscher, 2004).

The second analysis then tested the adjusted regression models using fluency and connectedness as a moderator. Simple slopes were computed to gauge the amount of change in each significant infant outcome with one unit change in the predictor variable, whilst keeping the moderator (fluency and connectedness) constant at different values between one (low quality interaction) and seven (high quality interaction).

Results

All statistical analyses were carried out using Stata 14.0 software (StataCorp, 2015). Baseline characteristics of the women and infants enrolled in the study are presented in Table 1. There were no significant differences between the group of participants at 12 months and at 24 months on key demographic variables, including main language ($t(242)=0.21$, $p=.833$), disadvantage decile ($\chi^2(9)=5.44$, $p=.794$), country of birth ($\chi^2(20)=16.55$, $p=.682$) and maternal education ($\chi^2(7)=3.81$, $p=.801$). Correlations between indicators of adversity and maternal behaviours are presented in Table 4. Imitations were positively correlated with anxious mood and negatively correlated with current smoking and not finishing high school. Responsive questions were positively correlated with health issues. Yes/no questions were positively correlated with current smoking and negatively correlated with never having a job. Prohibitions were positively correlated with young mothers, health issues, no support and never having a job. Unsuccessful redirectives were positively correlated with no support and no household income and negatively correlated with young mothers. Labelling and successful redirectives were unrelated to any adversity indicator.

Descriptive statistics

All results are presented in rate of behaviours per minute to account for minor variations in video length. Regarding specific responsive behaviours; 85% of mothers used labelling ($M=1.21$, $SD 1.10$, range 0-6), 78% of mothers used responsive questions ($M=.65$, $SD .64$, range 0-3.2), 70% of mothers used yes or no questions ($M=.48$, $SD .57$, range 0-3.2) and 60% of mothers used imitations ($M=.40$, $SD .46$, range 0-2.2). Regarding specific intrusive behaviours, 82% of mothers used successful redirectives ($M=.55$, $SD .47$, range 0-2.2), 62% of mothers used unsuccessful redirectives ($M=.58$, $SD .92$ range 0-5.6) and 43% of mothers used prohibitions ($M=.34$, $SD .71$, range 0-6.2). There was a wide range of scores on all child language measures. As some children did not talk for the entire duration of the video the

minimum value for the range across all measures was zero, with the following means, standard deviations and ranges for each measure: mean number of utterances ($M=45$, SD 20.84, range 0-106), MLU ($M=1.26$, SD .38, range 0-3.52), total words ($M=42$, SD 26.34, range 0-136), unique words ($M=19$, SD 10.54, range 0-51) and mean length of turn (words) ($M=1.95$, SD .99, range 0-9). Regarding intelligibility, average child intelligibility was 73.41% (SD 17.75, range 0-100). Due to the young age of the children, the maximum fluency and connectedness rating obtained was five, with a minimum rating of one ($M=2.82$, SD .96).

Maternal-child associations

To examine associations between specific maternal behaviours at 12 months and child language skills at age 24 months, a correlation matrix of all maternal and child behaviours was initially derived (Table 5). Ten correlations were found to be statistically significant, varying in magnitude from small (.1) to moderate effect sizes (.3) (Cohen, 1988). Imitations and responsive questions were found to be positively correlated with total number of words (.16 and .15 respectively) and unique words (.14 and .18 respectively). Successful redirectives were negatively correlated with mean length of turn (-.23). Unsuccessful redirectives were negatively correlated with all child language measures with small effects sizes for all five correlations. These ten significant associations were then explored in linear regression models; Table 6 presents fully adjusted associations. In the fully adjusted models imitations significantly predicted total words (coefficient 9.64, 95% CI [.88, 18.39], $p=.031$). Successful redirectives significantly predicted mean length of turn (coefficient -.40, 95% CI [-.79, -.00], $p=.049$). All other associations explored between maternal behaviours and child language were non-significant in the fully adjusted models.

Moderation by fluency and connectedness

The associations between imitations and total words and successful redirectives and mean length of turn were explored using fluency and connectedness as a moderator. For imitations and total words, when fluency and connectedness was held at zero, there was no main effect of imitations on total words ($F(9,136) = 4.48$, $p = .233$). When imitations were held at zero, there was no main effect of fluency and connectedness on total words ($F(9,136) = 4.48$, $p = .483$). There was also no significant interaction between imitations and fluency and connectedness ($F(9,136) = 4.48$, $p = .079$). For successful redirectives and mean length of turn, when fluency and connectedness was held at zero, there was no main effect of

successful redirectives on mean length of turn ($F(9,136) = 2.34, p = .167$). When successful redirectives were held at zero, there was no main effect of fluency and connectedness on mean length of turn ($F(9,136) = 2.34, p = .656$). There was also no significant interaction between imitations and fluency and connectedness ($F(9,136) = 2.34, p = .555$).

Despite the fact that these findings were non-significant, it was still hypothesised that interaction quality would theoretically moderate maternal-child associations so simple slopes were computed (Kirkwood & Sterne, 2005) (Table 7). Simple slopes for imitations and total words were only significant when fluency and connectedness was held at the two highest levels (Figure 2). Simple slopes for successful redirectives and mean length of turn were only significant when fluency and connectedness was held at two (coefficient $-.64$, 95% CI $[-.97, -.08]$, $p=.020$) or three (coefficient $-.42$, 95% CI $[-.78, -.05]$, $p=.027$) (Figure 3). A positive linear association was found between imitations and the fluency and connectedness of the interaction whereby the predicted amount of change in total words increased as the fluency and connectedness increased. A similar pattern was found for the association between successful redirectives and the fluency and connectedness of the interaction. The predicted negative change in amount of child mean length of turn decreased as the fluency and connectedness increased.

Discussion

This prospective, longitudinal study explored associations between responsive and intrusive maternal behaviours at 12 months and child language at 24 months in a cohort of women experiencing adversity. It is widely-acknowledged that responsiveness is positively associated with child language, and intrusiveness often negatively related. This study aimed to extend current research by identifying specific maternal behaviours associated with responsiveness and intrusiveness in a large, underrepresented cohort. It also aimed to explore if the fluency and connectedness of the mother-child interaction would moderate significant associations. In this study, maternal imitations were positively associated with child total words at 24 months. Maternal successful redirectives were negatively associated with child mean length of turn at 24 months. Furthermore, these associations were moderated within fluency and connected mother-child interactions. The positive association between imitations and total words was augmented in fluent and connected dyads; the negative association

between successful redirectives and the child's mean length of the turn was ameliorated in fluent and connected dyads.

Associations between maternal behaviours, mother-child interaction and child language

Previous studies have documented a positive association between maternal imitations and expressive language (Levickis et al., 2014; Masur et al., 2005; Tamis-LeMonda et al., 2001). These studies speculate on how the mother-child interaction influences maternal behaviour, as “maternal responsiveness reflects the temporal sequence of child-act and mother-respond” (Tamis-LeMonda et al., 2001, p. 763). However, it is not just the sequence of behaviours which is important (‘child-act, mother-respond’), it is how those behaviours progress and flow together to build shared, sustained conversation. In this study, the synchronicity (Leclère et al., 2014), or fluency and connectedness, of the interaction moderated the association between maternal imitations and vocabulary; maternal imitations were only significantly associated with total words when fluency and connectedness was held at the two highest levels.

As children approach their second year they are developing their joint attention skills i.e. ability to match attention with their communicative partner and a third external focus (Moore & Dunham, 1995). Joint attention is particularly important in this early stage of word learning as it establishes an essential foundation for early object-word mapping (Baldwin, 1995; Tomasello, 1999). It may be that imitations are more effective for word learning when a mother uses them within a co-constructed, joint communication framework (Hirsh-Pasek et al., 2015; Nelson, 2008; Tamis-LeMonda et al., 2014). Without such scaffolding, the child may not attend to, and learn, words as effectively (Hirsh-Pasek et al., 2015). Previous research has shown fluency and connectedness to be important for vocabulary learning at 24 months of age (Hirsh-Pasek et al., 2015), this is the first study to demonstrate its value earlier in infancy.

Responsive questions (Levickis et al., 2014; Tamis-LeMonda et al., 2001), yes or no questions (Paavola et al., 2005) and labels (Tamis-LeMonda et al., 2001) have also been positively related to early language. In the current study, there was a trend for children to have more vocabulary when their mothers used responsive ‘wh’ questions but associations fell short of significance (total words $p=.076$, unique words $p=.067$). Between 12-18 months,

the age of children in this sample, they are only starting to understand simple 'wh' questions (Lanza & Flahive, 2008), consequently a benefit may only be manifest later in childhood. However, yes or no questions and labels were largely unrelated to language outcomes. Explanations for both findings may be similar as yes or no questions in infancy often play a descriptive (for example, "Is that a cat?") rather than a questioning role (Paavola et al., 2005). Basic labels and yes or no questions may help pre-linguistic children develop their first words (Paavola et al., 2005), but their benefit may reduce as the child enters their second year. Support for this explanation can be gained from Tamis-LeMonda et al. (2001) who found simple descriptives to be associated with language milestones at nine but not 13 months of age.

Whilst most literature has found directives to be negatively associated with child language (Masur et al., 2005; Paavola et al., 2005; Pungello et al., 2009; Taylor et al., 2009), some studies have found them to be unrelated in early infancy (Baumwell et al., 1997). Successful redirectives have also been positively associated with child vocabulary (Shimpi & Huttenlocher, 2007). In the current study, both types of redirectives were unrelated to child vocabulary and MLU; successful redirectives were *negatively* associated with the child's mean length of turn. It has been suggested that lower frequencies of maternal intrusive behaviours may be the reason behind non-significant associations between intrusive behaviours and child language outcomes, effectively under powering analyses to detect differences (Baumwell et al., 1997). This explanation may be valid for prohibitions, which were used less frequently than all other maternal behaviours. A more plausible explanation may be that certain behaviours are relatively more important at different periods of child development (Baumwell et al., 1997). In early infancy directiveness may not necessarily be detrimental to the development of early word-object relations (Akhtar et al., 1991; Matatyaho & Gogate, 2008). However, continual redirection throughout the second year may dissuade child initiation and participation (Keown et al., 2001; Taylor et al., 2009; Yoder & Kaiser, 1989), resulting in children who take shorter conversational turns.

It is notable that the negative association between successful redirectives and child mean length of turn was moderated within fluent and connected mother-child dyads. At the two highest levels of fluency and connectedness, successful redirectives were not significantly associated with the child's mean length of turn. It could be that the scaffold of a 'speak-listen' structure (Black & Logan, 1995; Nelson, 2008) supports children to take their turn,

even with a more directive partner. For those children who have no framework to know when or how to take turns, the impact of a directive partner may be more disruptive to conversational balance. The fact that there was no significant association between successful redirectives when fluency and connectedness was held at the lowest level is also noteworthy. As no conversation was established within these dyads there was potentially nominal use of successful redirectives.

The influence of cultural background

The confounding influence of ethnicity could be another factor in insignificant mother-child associations. Almost a fifth ($n=45$, 18.1%) of mothers were born overseas, nine of whom were from England or New Zealand. The remaining women were of Asian or African descent (14.5%), with women from India comprising the largest group ($n=12$, 4.8%). Within the literature, it has been found that minority culture caregivers often direct their child's attention more than their North American or European counterparts (Vigil & Hwa-Froelich, 2004). Although less research has been conducted with Australian families specifically, Australian national identity, language and culture is considered comparable to North American and British societies (Washbrook, Waldfogel, Bradbury, Corak, & Ghangro, 2012). Indian mothers, for example, lean towards more adult-led, directive models of child language facilitation when compared to Euro-Canadian mothers (Simmons & Johnston, 2007). Chinese immigrant caregivers have also been found to direct their infants attention more than mothers of British origin (Vigil, 2002). Additionally, Turkish immigrant mothers have been observed to be more intrusive than native Dutch mothers (Yaman, Mesman, van Ijzendoorn, Bakermans-Kranenburg, & Linting, 2010). It is plausible that minority culture mothers in the current study were also biased towards this style of parenting and this parenting style was not detrimental to their child's language acquisition (Tardif et al., 1997). Although no conclusions can be drawn from this subgroup of mothers, reflection on child language learning in the context of ethnicity and parental beliefs about adult-child interaction is important to consider in both clinical and research settings (Vigil & Hwa-Froelich, 2004).

Findings in relation to adversity

In the current study, maternal imitations and high quality mother-child interactions were important in promoting early linguistic advances. Imitations of child language are less likely to be present in adult directed talk to children who have language difficulties than those

children who do not (Nelson, Camarata, Welsh, Butkovsky, & Camarata, 1993). This is noteworthy when considering this cohort because poorer language associated with adversity has been observed in infants as young as 18 months (Weisleder & Fernald, 2013); potentially these mothers have fewer opportunities to imitate their children throughout infancy since they “cannot imitate vocalizations that do not occur” (Tamis-LeMonda et al., 2001, p. 763). Additionally, mothers experiencing adversity often have a smaller amount of knowledge of child development (Rowe, 2008) and consequently might be less likely to acknowledge and respond to vocalisations unless regarded as ‘real words’. Support for this supposition may be found in the negative correlation between imitations and not finishing high school. Both mothers and infants, therefore, could unconsciously perpetuate an environment less conducive to language learning with fewer infant vocalisations, plus lower levels of maternal input, sustaining poorer interactions between mothers and infants (Alston & James-Roberts, 2005).

Lower levels of child vocalisation might also engender intrusive maternal behaviours. Studies of children with communication difficulties have also discovered that parents may employ unhelpful strategies in an attempt to facilitate child language. For example, one study found that caretakers of children with language difficulties were more likely to use strategies linked with communication breakdown, for example, interruptions, incoherent responses and topic reintroductions (van Balkom, Verhoeven, & van Weerdenburg, 2010). The negative association between successful redirectives and the child’s length of turn in the current study could indicate that mothers are using unfavourable compensatory strategies (like redirection) in an attempt to facilitate interaction. Mother’s experiencing adversity may be doubly disadvantaged when it comes to supporting their child’s language acquisition; they may not only have fewer linguistic cues to scaffold interactions (Snow, 1995) but might be less able to beneficially adapt their own behaviour in response to their child’s lower language level (Lawrence & Shipley, 1996).

This twofold disadvantage could play a role in why social, economic and environmental adversity predicts more language variation in older toddlers as compared to children in early infancy (Pan et al., 2005; Reilly et al., 2010). Minimal disparities in early development potentially translate in to larger differences due to unsupportive maternal and child behaviours hindering ongoing language development (Walberg & Tsai, 1983). One large

study (n=5,900) found comparable language outcomes for children of teenage mothers compared to controls at child age nine months (Mollborn & Dennis, 2012). At 54 months, however, those same children were significantly poorer on every outcome measure, including receptive vocabulary, phonological processing and early literacy. Weaker early linguistic skills, in the context of adversity, should therefore prompt clinicians and early years professionals to investigate further (Bishop & Norbury, 2009).

Study limitations

Regarding study limitations, there are several of which should be acknowledged. Although observational measures may be more objective than parent report (Hawes & Dadds, 2006), five minutes of free-play may not have entirely reflected the capacity of the mother or child (Flynn & Masur, 2007). Additionally, the process of videoing could have influenced the interaction between the communication partners, changing their typical dynamic. A further limitation is that only maternal behaviours were measured, not amount or quality of maternal linguistic input, which have both been related to child language acquisition (Hart & Risley, 1995; Hoff & Naigles, 2002). Finally, child language measures were only collected *within* mother-child interactions at 12 and 24 months. As interactions are socially shaped, collecting and controlling for discrete child language skills, independent of mother-child interactions, would have strengthened the analysis.

Conclusion

It appears that maternal behaviours *and* mother-child conversations are important for language acquisition. A reciprocal, sustained mother-child interaction in which a mother imitates and shapes both non-linguistic and linguistic infant vocalisations may be protective against the impact of adversity on early vocabulary. In contrast, children who are continually redirected by their mother in early childhood may be at greater risk of language difficulties, especially if mother-child conversations are difficult to establish and maintain. Including measures of mother-child turn-taking and maternal verbal responsiveness within current language assessments may help elucidate further risk and protective factors related to later language skills for children experiencing adversity. Furthermore, language interventions for children identified with language difficulties which focus on establishing a 'speak-listen' early conversational structure by matching adult-child conversational turns (Manolson, 1992; Pepper & Weitzman, 2004), *as well as* encouraging language facilitation strategies, may

optimise child language outcomes.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writings of the paper.

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Table 1: Baseline characteristics of mothers and infants in the study

	Participants (n=249)
Mean maternal age at baseline: years; months (SD)	28.4 (6.2)
Mean infant age at 12 month assessment: months (SD)	12.1 (1.0)
Maternal mental health¹	(m, SD)
DASS Anxiety total ²	3.4 (3.2)
DASS Depression total ³	2.7 (2.8)
DASS Stress total ⁴	5.4 (3.9)
Maternal characteristics	n (%)
Teen parenthood	18 (7.2)
Highest level of education	
Did not complete high school	56 (22.5)
Completed high school	14 (5.6)
Vocational training/diploma	131 (52.6)
Completed bachelor degree or higher	26 (10.4)
Currently employed	95 (38.2)
Marital status	
Single / Not living with partner	61 (24.5)
Married / Living with partner, not married	183 (73.5)
Separated / Divorced	5 (2.0)
Language other than English	25 (10.0)
Born overseas (total)	45 (18.1)

Participants (n=249)	
Born overseas (top eight)	
India	12 (4.8)
New Zealand	5 (2.0)
England	4 (1.6)
Sri Lanka	3 (1.2)
Sudan	3 (1.2)
Afghanistan	2 (0.8)
Bhutan	2 (0.8)
Pakistan	2 (0.8)
Infant characteristics	
First born	78 (31.3)
Female/male	110/139 (44.2/55.4)
Twin	5 (2.0)
Family / household	
SEIFA Index of Social Disadvantage Quintile ⁵	
1	88 (35.3)
2	19 (7.6)
3	100 (40.2)
4	23 (9.2)
5	9 (3.6)
Household main source of income	

	Participants (n=249)
Full time employment	125 (50.2)
Part time employment	26 (10.4)
Benefit / Pension	95 (38.2)
Other (Casual, self-employed)	3 (1.2)
Current housing problems	45 (18.1)
Currently being threatened with eviction	4 (1.6)

¹ Measured using the Depression Anxiety Stress Scales (DASS) (Lovibond & Lovibond, 1995)

² Anxiety range: normal 0-3, mild 4-5, moderate 6-7, severe 8-9, extremely severe 10+

³ Depression range: normal 0-4, mild 5-6, moderate 7-10, severe 11-13, extremely severe 14+

⁴ Stress range: normal 0-7, mild 8-9, moderate 10-12, severe 13-16, extremely severe 17+

⁵ Lowest scoring 20% of areas receive a decile number of 1; highest scoring 20% receive a decile number of 5.

N = 227–249 for current study (some missing participant data on one or more variables).

Table 2: Detailed description of maternal behaviours (predictor variables)

Maternal behaviour	Definition	Example		Previous studies exploring associations between parental behaviours and child language
		Infant	Adult	
RESPONSIVE				
Imitation	Mother repeats infant vocalisations and words. Imitations of words coded if developmentally and contextually appropriate (Tamis-LeMonda et al., 2001). Can be imitation of real word or non-word vocalisation. In instances where a mother's response both imitates the child <i>and</i> labels the item, imitations take precedence.	"Ca!" whilst holding a cat	"Cat!"	Bornstein et al., 1992; Hampson & Nelson, 1993; Levickis et al., 2014; Masur et al., 2005; Tamis-LeMonda et al., 2001
Responsive 'Wh'	Mother asks a "wh" question (e.g., " <i>what,</i> " " <i>when,</i> " " <i>who</i> "), which is immediate and dependent on the infant's preceding act (Tamis-LeMonda et al., 2001).	Infant reaches in to a bag	" <i>What's in there?</i> "	Hampson & Nelson, 1993; Levickis et al., 2014; Paavola et al., 2005; Tamis-LeMonda et al., 2001

Question	Yes/No	Mother asks a question requiring a binary (yes or no) answer which is immediate and dependent on the infant's preceding act.	Infant pushes a toy figure down the slide	<i>"Is the boy going down the slide?"</i>	
Label		Mother labels an object or action, which is the focus of the infant, with the label in the final position of the carrier phrase (Levickis et al., 2014).	Infant picks up a toy horse	<i>"It's a horse!"</i>	Bornstein et al., 1992; Della Corte et al., 1983; Levickis et al., 2014
Maternal behaviour		Definition	Example		Previous studies exploring associations between parental behaviours and child language
			Infant	Adult	
INTRUSIVE					
Prohibition		Imperatives used explicitly to try and prevent the infant's current behaviour or vocalisation (Della Corte et al., 1983). Excluded commands related to infant or sibling safety.	Infant mouths a toy	<i>"Don't eat it!"</i>	Della Corte et al., 1983; Hart & Risley, 1995; Taylor et al., 2009
		Mother uses a command to successfully	Infant playing	<i>"Look at the</i>	Akhtar et al., 1991;

Redirective ²	Successful	move the infant's visual or physical attention from their current activity to one of the mother's choosing.	with toy playground	<i>blocks!</i> " Infant shifts attention to mother.	Hampson & Nelson, 1993; Masur et al., 2005; Pine, 1992; Shimpi & Huttenlocher, 2007; Taylor et al., 2009
	Unsuccessful	Mother uses a command which is unsuccessful at moving the infant's attention from their current activity to one of the mother's choosing.	Infant is playing with the playground	<i>"Look at the blocks"</i> . Infant does not acknowledge command.	

¹ Divided in to open-ended and closed questions as there may be variation in the learning benefit of different question types depending on encouragement of child participation, choice-making and problem-solving (Cristofaro & Tamis-LeMonda, 2011; Taylor et al., 2009). ² Directives are inconsistently associated with child language outcomes (Lloyd & Masur, 2014) and may depend on whether they are successful or unsuccessful in shifting the child's attention (Shimpi & Huttenlocher, 2007).

Table 3: Fluency and connectedness scale with anchor behaviours (modified from Adamson, Bakeman, Deckner, & Brooke Nelson, 2012; Hirsh-Pasek et al., 2015)

Item	Anchors						
	1=	2=	3=	4=	5=	6=	7=
Fluency & connectedness of conversation: characterises the flow of the conversation	No conversation established	Some fleeting verbal/non-verbal exchanges	Instances of child initiation reciprocated by the mother	Conversation lacks smoothness, appears to be largely dominated by one partner	Shared topic throughout. Both partners engaged in relatively equal turn-taking	Extension of interaction and play from both mother and child	Fluid and balanced conversation that is often sustained

Table 4: Correlation matrix of adversity risk factors and maternal behaviours (predictor variables)

Adversity risk factors	Maternal behaviours (predictor variables)													
	Imitation		Responsive question		Yes / No question		Label		Prohibition		Successful redirective		Unsuccessful redirective	
	r	p	r	p	r	p	r	p	r	p	r	p	r	p
Young mother (<23 years)	-.08	.202	-.07	.259	-.12	.056	-.03	.671	.12*	.044	-.12	.068	-.18*	.005
Not living with another adult	.04	.581	.03	.670	-.04	.539	-.01	.901	.03	.676	.06	.343	.04	.531
Lack of support	.01	.857	-.10	.114	-.01	.850	-.11	.081	.13*	.049	.11	.080	.23**	.000
Health issues	.09	.156	.17*	.007	.04	.517	.07	.240	.13*	.046	-.01	.826	-.01	.831
Current smoker	-.15*	.018	.05	.423	.15*	.017	-.00	.941	.02	.751	.05	.430	-.08	.191
Long-term illness	.00	.973	.10	.100	.03	.589	.12	.062	-.04	.527	-.02	.728	-.05	.447
Anxious mood	.16*	.014	.03	.593	.02	.697	.05	.437	-.04	.496	.02	.776	-.01	.916
Not finishing high school	-.14*	.024	-.01	.935	.02	.802	-.09	.178	.03	.607	.00	.996	-.02	.737
No household income	.04	.527	-.11	.075	-.04	.542	.02	.723	.06	.339	.04	.569	.13*	.047
Never having a job	.02	.750	-.02	.735	-.14*	.023	-.10	.111	.13*	.042	-.00	.983	.10	.107

*p<0.05, **p<0.001

Table 5: Correlation matrix of maternal behaviours (predictor variables) and infant behaviours (outcome variables)

Child language (outcome variables)	Maternal behaviours (predictor variables)													
	Imitation		Responsive question		Yes / No question		Label		Prohibition		Successful redirective		Unsuccessful redirective	
	r	p	r	p	r	p	r	p	r	p	r	p	r	p
Total utterances	.13	.075	.06	.448	-.04	.628	.01	.918	-.10	.198	-.08	.286	-.17*	.019
MLU ¹	.08	.083	.08	.285	.08	.277	.05	.501	.01	.844	-.13	.069	-.17*	.019
Total words	.16*	.028	.15*	.042	.02	.826	.03	.719	-.12	.103	-.08	.301	-.16*	.023
Unique words	.14*	.047	.18*	.014	.11	.134	.06	.415	-.04	.613	-.07	.315	-.18*	.011
Mean length of turn	.09	.232	-.11	.127	-.05	.455	-.13	.079	-.05	.456	-.23**	.001	-.18*	.012

¹ Mean length of utterance (MLU), *p≤0.05, **p≤0.001

Table 6: Adjusted associations¹ between significant maternal behaviours (predictor variables) and child language (outcome variables)

Child language	Maternal behaviour (rate/min)							
	Imitation		Responsive question		Successful redirective		Unsuccessful redirective	
	Co-efficient [95% CI]	R ² %	Co-efficient [95% CI]	R ² %	Co-efficient [95% CI]	R ² %	Co-efficient [95% CI]	R ² %
Total utterances	-	-	-	-	-	-	-3.31 [-8.68, 2.06]	5
MLU ²	-	-	-	-	-	-	-.04 [-.12, .04]	22
Total words	.4.47* [.41, 8.53]	16	6.31 [-.67, 13.30]	15	-	-	-2.83 [-9.40, 3.75]	13
Unique words	1.36 [-.24, 2.96]	15	2.54 [-.18, 5.27]	16	-	-	-1.80 [-4.35, .76]	15
Mean length of turn	-	-	-	-	-.19* [-.37, .00]	7	-.14 [-.41, .13]	5

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Note: Only significant correlations between maternal and infant behaviours were explored in the regression models. Correlations between shaded associations were not significant

¹ Figures adjusted for potential confounders including age at assessment, gender, maternal education, birth order, main language, family history of language and literacy difficulties, * $p \leq .05$, all adjusted R^2

² Mean length of utterance (MLU)

- = Non-significant correlations

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Table 7: Three-way interaction between maternal behaviours, predicted child language and the fluency and connectedness of the interaction

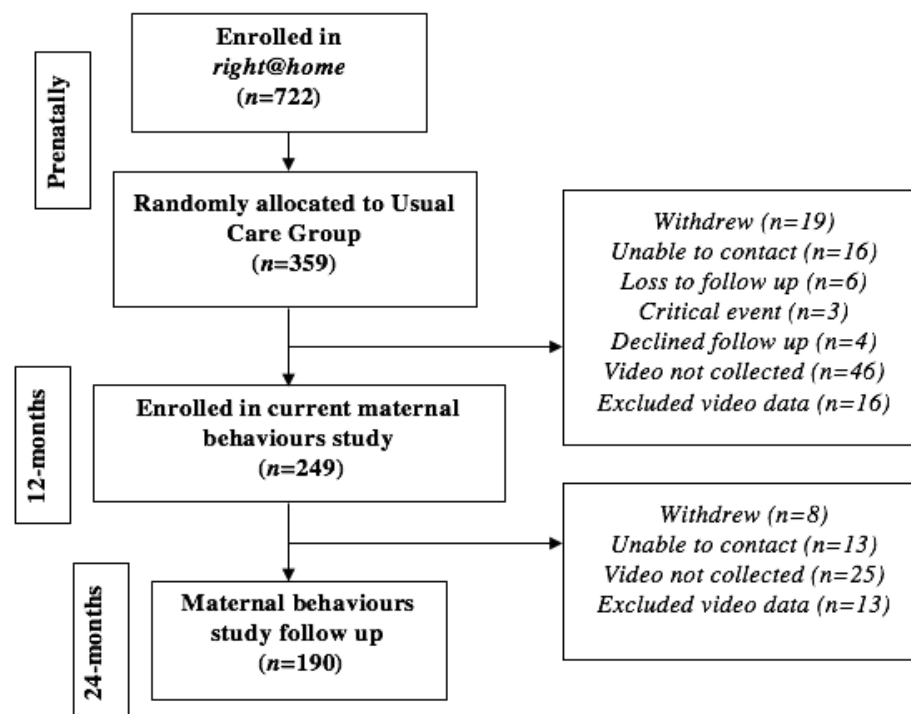
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Predictor variables held at	Imitations and total words	Successful redirectives and mean length of turn (words)
	Co-efficient [95% CI]	Co-efficient [95% CI]
Fluency and connectedness = 1	-9.05 [-28.26, 10.16]	-.64 [-1.37, .09]
Fluency and connectedness = 2	-2.14 [-14.93, 10.66]	-.53* [-.97, -.08]
Fluency and connectedness = 3	4.78 [-4.01, 13.57]	-.42* [-.78, -.05]
Fluency and connectedness = 4	11.69* [1.20, 22.18]	-.31 [-.90, .28]
Fluency and connectedness = 5	18.60* [2.42, 34.78]	-.20 [-1.11, .72]

*p= \leq .05

Figure 1: Participant flow diagram for the current maternal behaviours study

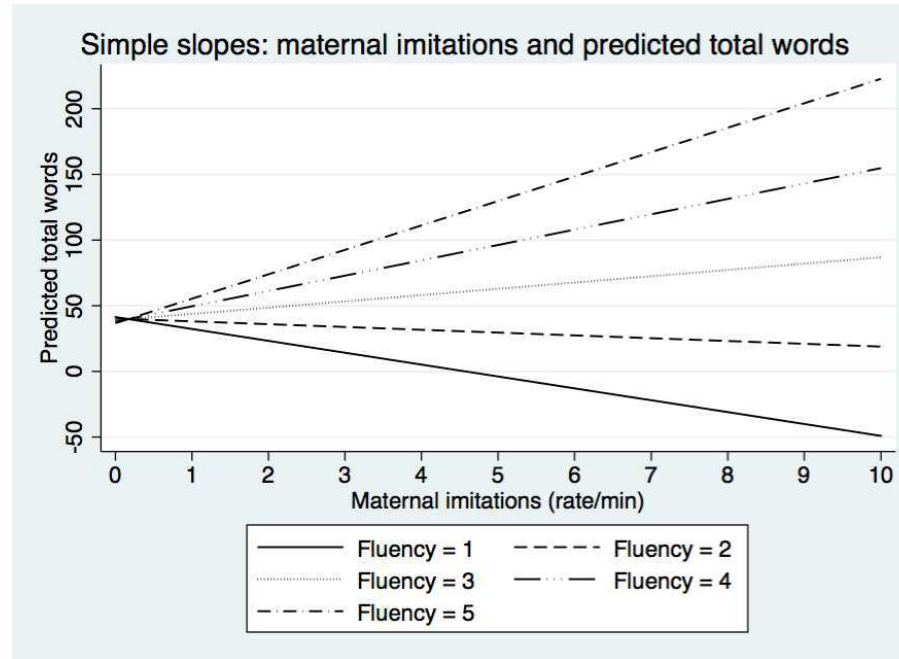
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Figure 2: Simple slopes predicting the amount of change in predicted total words with one unit change in maternal imitations whilst keeping the fluency and connectedness (fluency) constant between levels 1-5.

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Figure 3: Simple slopes predicting the amount of change in predicted mean length of child turn (words) with one unit change in maternal successful redirectives whilst keeping the fluency and connectedness (fluency) constant between levels 1-5.

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