


# An infant-led approach to complementary feeding is positively associated with language development

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## Abstract

The timing and strategy with which parents first introduce their infants to solid foods may be an important predictor of subsequent developmental outcomes. Recent years have seen a decline in the prevalence of traditional parent-led feeding of soft, puréed food and a rise in the prevalence of infant-led complementary feeding. Although there has been some research espousing the benefits of infant-led complementary feeding for improving food fussiness and self-regulation, there has been little exploration of this approach that may impact on other developmental outcomes in children. The current study explores whether aspects of the infant-led approach, specifically the child eating unaided and consuming finger foods and eating with the family, are related to child language outcomes. One hundred thirty one parents of children aged 8–24 months completed questionnaires about their approach to complementary feeding, their current feeding practices, their child's experiences with family foods and child language comprehension/production. The findings suggest that an approach to complementary feeding which promotes infant autonomy in feeding (i.e., eating finger foods rather than puréed foods) and consuming more family foods is related to more advanced child language production and comprehension. Specifically, the prevalence of eating family foods mediated the relationship between eating unaided at the onset of the complementary feeding period and later language outcomes. This study is the first to find a significant relationship between different approaches to introducing solid foods and child language outcomes and these findings highlight the potential for different complementary feeding approaches to influence behaviour beyond mealtimes.

## KEYWORDS

eating, feeding, language, mealtimes, parenting

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## 1 | INTRODUCTION

The ability to eat solid foods is a key developmental milestone. Eating is fundamental to survival, yet the way children are introduced to foods may be related to other developmental outcomes. Recent years have seen changes in the ways that children are introduced to solid foods in many countries around the world, with a decline in parent-led feeding of soft, puréed food and a rise in more independent infant-led introduction to solid foods, often referred to as 'baby-led weaning' (Rapley, 2003; Townsend & Pitchford, 2012). One of the proposed benefits of the infant-led approach is that it acts as a means for children to explore food types and textures, providing unique sensory experiences as children engage with hands-on feeding. As a result, researchers have begun to explore whether differences in the approach to the complementary feeding period may be related to later eating behaviour, weight and food fussiness (e.g., Morison et al., 2018; Taylor et al., 2017). However, the way that an infant is introduced to solid foods is not only important for eating behaviour; different methods of complementary feeding may also influence infant's oral-motor experiences, fine-motor experiences and their exposure to family mealtimes, all of which may be implicated in the development of language. In the current study, we explore whether differences in the approach to complementary feeding, and aspects of the infant-led approach to complementary feeding in particular, are related to language development during infancy.

The 'baby-led' weaning method advocates feeding children solid foods in their whole form from the onset of the complementary feeding period, with the infant eating independently within the context of family mealtimes, rather than being fed purées by a caregiver with a spoon or fork as is traditional in parent-led introduction to solid foods (Cameron et al., 2012). Brown and Lee (2010) parse baby-led weaning into three fundamental principles: (1) Solid food is offered to children in its whole form as 'finger food', rather than in puréed or mashed form; (2) children 'self-feed' by reaching for, picking up and bringing food to their mouth, rather than via spoon-feeding; and (3) children join in at family meals. The baby-led weaning approach dictates earlier introduction of foods in their whole form (from the beginning of the complementary feeding period at around 6 months), as opposed to traditional parent-led approaches, which advocate for spoon-feeding puréed food at this time, followed by a later transition to mashed, lumpy foods and self-feeding (NHS, 2020a).

In correlational studies to date, greater engagement with a baby-led approach to weaning has been associated with increased self-regulation of food intake (Rowan & Harris, 2012), greater child fruit and vegetable consumption (Fu et al., 2018) and participation in family mealtimes (Brown & Lee, 2011b). However, these studies are cross-sectional and may actually be driven by child behaviours which influence decisions about weaning, or demographic differences between families who choose to adopt different approaches to complementary feeding. Indeed, in the only randomised controlled trial to date, the BLISS trial in New Zealand has found that infants who follow a modified baby-led weaning approach to complementary feeding did not have a healthier body mass index (BMI) at follow-up at 2 years,

### Key messages

- There are strong theoretical reasons to suggest that different approaches to the complementary feeding period may relate to subsequent child language outcomes.
- A complementary feeding approach associated with the child consuming more family foods and more independent child self-feeding is positively related to child language development.
- The prevalence of the child eating family foods mediated the relationship between eating unaided at the onset of the complementary feeding period and later language outcomes.
- Different approaches to the complementary feeding period have potential to shape behaviour beyond mealtimes

although children were described as being less food-fussy by their parents (Taylor et al., 2017) and were said to have been exposed to greater texture and variety in food at 7 months (Morison et al., 2018).

In terms of other developmental milestones, there are good theoretical reasons to believe that a more infant-led approach to complementary feeding may influence the development of language. When using an infant-led approach to complementary feeding, caregivers present children with bite-sized, chewable pieces of solid food from the onset of the complementary feeding period. This means that infants naturally begin to engage in rudimentary chewing and biting behaviour at an earlier age than if they were weaned using puréed foods (Cichero, 2016). Evidence from the BLISS randomised controlled trial has shown that infants following a modified baby-led weaning approach are exposed to more textured food from an earlier age (Morison et al., 2018); this texture requires mastication that promotes the strengthening of facial muscles and craniofacial growth (Abed et al., 2007). Skills in chewing and biting have been repeatedly related to language development (Gernsbacher et al., 2008; LeBarton & Iverson, 2013), and Alcock (2006) suggests that complex oral motor movements are closely related to language skills, possibly because they are more 'speech-like'. Moore (2004) has also proposed that motor development is a 'likely rate-limiter' (p. 191) in the emergence of speech and suggests that developing coordination of mandibular movement could provide the basis upon which more complex speech movements can be established. Therefore, providing children with solid foods from the onset may strengthen craniofacial muscles and provide greater experience with the oral-motor skills which may subsequently aid in the emergence of speech.

There are also a number of fine and gross motor skills which are required for children to engage in self-feeding. For example, the ability to stabilise the head and balance the trunk are necessary for a child to sit without support and to utilise hand and arm movements for feeding (Carruth et al., 2004). Self-feeding is a skill that is gradually improved in an iterative, experience-based learning process; initial

unsuccessful efforts to bring food to the mouth using fingers, a spoon or fork are followed by subsequent attempts which gradually become more accurate. van den Engel-Hoek et al. (2014) note that unlike oral-motor development, which relies on the efficient transition from basic sucking and swallowing to biting and chewing, the process of motor-learning for self-feeding requires improving the smoothness and accuracy of extraneous movements to bring foods to the mouth. Self-feeding is greatly dependent on emerging hand-eye coordination as well as accuracy of gross motor movements (i.e., moving the arm to the mouth) and fine motor movements (opening and closing the mouth, chewing and swallowing). It is therefore possible that infant-led complementary feeding could help develop the skills necessary for successful self-feeding and that this could contribute to honing of other motor skills, such as speech production.

The language that infants are exposed to when weaned using an infant-led approach—that is, within the context of ‘family mealtime’—may also provide a unique experience, which benefits subsequent language development. Indeed, mealtimes provide the opportunity for talk that children are not exposed to elsewhere (Weizman & Snow, 2001). Furthermore, an infant-led approach to participate in family meals provides opportunities for modelling language and vocabulary to children, which may be related to improved literacy skills (Snow & Beals, 2006). Aukrust and Snow (1998) note that mealtimes offer the opportunity for children to be exposed to a wide range of ‘narratives and explanations’ (pp. 221–222), to explore both concrete and abstract topics, learn the cultural rules that regulate discourse (e.g., turn-taking and appropriate topics) and engage in collaboratively produced conversation. Furthermore, specific guidance on politeness is a frequent tenet of mealtime etiquette to which children are exposed, for example, ‘*what’s the magic word?*’ may serve a socialisation function as well as a linguistic one (Pan et al., 2000). Mealtimes may therefore provide a unique opportunity for children to explore their developing language and communication skills.

Despite these strong theoretical reasons to believe that a more infant-led approach to complementary feeding may benefit language, there is significant debate about the benefits and costs of different approaches to complementary feeding. For example, Toyama (2014) has suggested that when feeding is parent-led, infants and caregivers engage in an ‘inherently collaborative and interactive process’ (p. 203) where the caregiver assists the infant by choosing food, picking it up and spooning it directly into their mouth. Traditional parent-led feeding is usually structured so that a single caregiver and child sit opposite each other, with parents often opening and closing their mouths to indicate to their child when to do so and this synchrony may also lead to greater modelling of mouth-movements and verbalisations (Harrist & Waugh, 2002; Negayama, 1993).

Despite significant debate in this area, there has been no direct examination of whether differences in the approach to complementary feeding are related to differences in language development during infancy, and no investigation of the different mechanisms by which such a relationship may be explained. In our previous research (Addessi et al., 2021), we have begun to explore associations between infant-led complementary feeding and developmental outcomes in a

sample of 1245 Italian mothers with their 6- to 12-month-old infants. We found that the amount of family-food feeding predicted sitting unsupported at an earlier age and a lower use of spoon feeding predicted crawling at an earlier age, but none of the feeding variables measured predicted the age at which infants uttered their first words. However, the language measure used in this study was not sophisticated enough to capture differences between participants and the infants in this sample were unlikely to be developmentally ready to speak because they were under 1 year of age.

The aims of the current study were therefore to (1) explore whether differences in the approach to complementary feeding (specifically the age of introduction to solid foods and a more independent infant-led approach to complementary feeding) are related to infant language development, (2) evaluate whether feeding practices associated with infant-led complementary feeding (i.e., less spoon feeding and purée feeding, a greater prevalence of the child eating family foods) are related to infant language development and (3) establish whether a greater prevalence of the child eating family foods mediates the relationship between independent self-feeding and language outcomes (as shown in hypothetical model in Figure 1).

## 2 | METHODS

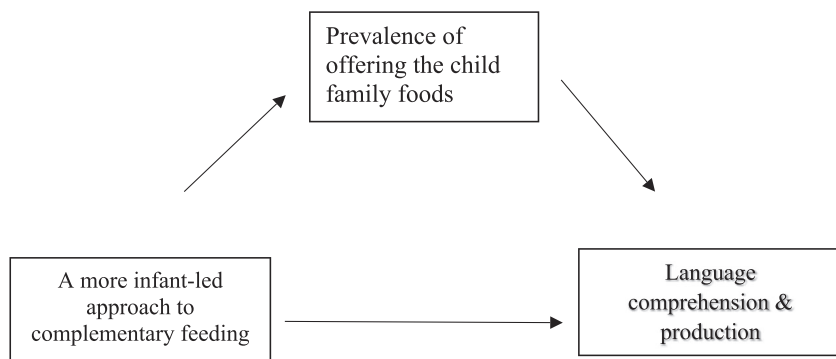
### 2.1 | Participants and procedure

Participants were 131 parents (93 female and 38 male) of UK children (59 boys and 72 girls) aged between 8 to 24 months (mean = 14.68, standard deviation [SD] = 4.88), who responded to an invitation to complete questionnaires online through Prolific: an online recruitment platform that participants can sign up to in order to receive alerts about behavioural research studies. Participants were parents that had pre-registered interest in taking part in research surveys and had reported that they had a child in this age range. Parents were on average 31 years old (SD = 5.20, range 19–45 years) and had a mean of 5.38 (SD = 2.53) years education post-16. Attention checks were used throughout the study to ensure participants were attending to the questionnaire (e.g., ‘So we know you are paying attention, please select option 3.’). This study was given a favourable ethical opinion from Aston University University Life and Health Sciences Ethics Committee (project #1605, title: ‘An observational study of infant mealtime experiences’).

### 2.2 | Measures

Parents completed a background demographics questionnaire about their age, gender and education. In addition they completed questions about their child’s age, gender and whether the child had any siblings. They also completed the following measures:

- **Questionnaire about complementary feeding experiences:** Parents completed a questionnaire asking retrospectively about their



**FIGURE 1** Hypothetical model for mediation

approach to complementary feeding. They were asked about their experiences of any breastfeeding and formula feeding, about the age of their child when they first introduced foods other than milk and about independent self-feeding at the onset of complementary feeding ('When your child first started eating solid foods, did they feed themselves unaided?'), response options ranged from *never* to *always*. In terms of current feeding practices, parents were asked about the prevalence of offering the child family foods ('How often do you offer your child 'family food' i.e. food eaten by the rest of the family?'), their use of puréed food ('How often do you offer your child puréed food?') and spoon feeding ('When your child eats food how often are they spoon-fed, or fork-fed, by an adult?'). Items were adapted from previous questionnaires assessing baby-led approaches to weaning (Brown & Lee, 2011b; Cameron et al., 2012). These three questions about current feeding practices were answered using a sliding scale with response options ranging from *never* 0 to *always* 100.

- **Language questionnaire:** The MacArthur Communicative Development Inventory (CDI short form; Fenson et al., 2000) was used to assess child language comprehension and production. The MacArthur Inventories are widely used as measures of language development and the short versions are both reliable and valid (Fenson et al., 2000). The CDI Infant Form is valid from 8 months of age (Level 1); it contains an 89-word vocabulary checklist with columns for comprehension ('does the child understand?') and production ('does the child say?'). Of the 89 words in the inventory, 62% are nouns, 15% are verbs, 12% are adjectives and adverbs and 11% are pronouns, sound effects and other parts of speech (Fenson et al., 2000). Percentile scores are provided, and children's scores were standardised according to the child's gender and age in months.

### 3 | RESULTS

#### 3.1 | Data analyses

Descriptive statistics were computed. Kolmogorov–Smirnov tests indicated that the majority of the data were non-normally distributed; therefore, non-parametric tests were used where possible. Child age

and gender were controlled for in the computation of standardised scores of child language production and comprehension. Spearman's correlations were used to explore whether feeding variables were inter-related. The data were screened to explore the influence of other potential covariates including parental education and siblings using Mann–Whitney tests and Spearman's correlations. Next, correlations were run, controlling for significant covariates, to explore whether independent self-feeding at the onset of complementary feeding, current feeding practices and offering family foods were related to language development. Finally, we tested our theoretical model and explored whether the prevalence of offering family foods mediated the relationship between independent self-feeding at the onset of complementary feeding and current child language comprehension and production.

#### 3.2 | Descriptive statistics

The majority of the sample described themselves as White British (88.5%) with 4.6% Asian and 3.8% Black, Black African or Black Caribbean. Parents had on average 5.39 years of education after the age of 16 years ( $SD = 2.53$ ). Annual household income ranged from £10,000 per year to £150,000 per year (mean = £52,582,  $SD = 32,856$ ). Most parents were currently employed (81.6%), while 18.4% were not employed at the time of completing the questionnaire. The majority of children did not have siblings (92.4%) and 7.6% of children had one or more sibling. The majority of children had been breastfed (72.3%) with a mean length of any breastfeeding to 6.75 months ( $SD = 6.00$ ). The mean age of introducing food other than milk was 5.62 months ( $SD = 1.36$ ). The descriptive statistics for child language scores, independent self-feeding at the onset of complementary feeding and current feeding practices are presented in Table 1. Median scores for the MacArthur CDI indicate that children's percentage rank score for language comprehension standardised for child age and gender were above population averages, but scores for language production standardised for child age and gender were lower than population averages. This likely reflects the fact that many of the younger children cannot yet speak their first words. Median scores for independent self-feeding at the onset of complementary feeding suggest that most families allowed their children to sometimes feed

themselves unaided when they began complementary feeding. Median scores for current feeding practices suggest that many parents regularly offer family foods, sometimes use spoon feeding but rarely use puréed food for current mealtimes.

### 3.3 | Relationships between feeding measures

Spearman's rho correlations were run to compare relationships between the feeding measures. As shown in Table 2, measures of child independence at the onset of complementary feeding and at the time of the survey were significantly inter-correlated, with children who ate unaided more often at the onset of complementary feeding currently being spoon fed significantly less often and being offered family foods significantly more often. Greater use of spoon feeding was also significantly correlated with greater consumption of puréed food, and both were significantly correlated with a lower prevalence of being offered family foods.

### 3.4 | Exploring the role of potential covariates

Spearman's rho correlations indicated that parental years of education was not significantly correlated with language production, language comprehension or any of the feeding variables. Household family income was not significantly correlated with language production or comprehension but was correlated with how often the child was fed unaided at the onset of complementary feeding ( $r_s = -2.36$ ,

$p < 0.05$ ). Maternal length of breastfeeding was not significantly correlated with language production or comprehension, but it was correlated with introducing solid foods later ( $r_s = 2.13$ ,  $p < 0.05$ ) and with the child eating unaided more often ( $r_s = 2.10$ ,  $p < 0.05$ ). There were no significant differences between children who had siblings compared with those who did not in terms of language production, or any of the mealtime measures. However, children with siblings had significantly higher language comprehension compared with those without ( $z = -2.90$ ,  $p < 0.01$ ). Following the recommendations to increase precision in regression analyses, we chose to control for confounds that are predictive of outcome variables and not to control for variables that are predictive of independent variables but not predictive of our outcome variables (VanLunen, 2020). Therefore, we controlled for whether children had siblings or not in subsequent analyses. Child age was adjusted for in the computation of language comprehension and production scores as per Fenson et al.'s (2000) scoring criteria.

### 3.5 | Relationships between approach to self-feeding at the onset of complementary feeding, current feeding practices and language development

As shown in Table 3, partial correlations (controlling for presence or absence of siblings) indicated that age of introduction to foods was not significantly correlated with language production or comprehension. Children who were first exposed to complementary feeding using a more independent approach (i.e., eating unaided more often) were significantly more likely to have higher scores on language production and comprehension. In addition, parents who reported currently offering their children family foods more often were also more likely to have children with higher language production and comprehension scores. Current use of spoon feeding was significantly and negatively associated with language comprehension. How often parents reported using puréed food currently and language outcomes were not significantly associated.

### 3.6 | Mediation analysis

In order to test our theoretical model, we used PROCESS Model 4 to explore whether the prevalence of offering children family foods mediated the relationship between a more independent approach to complementary feeding and current child language comprehension and production. We tested models for how often the child ate

**TABLE 1** Descriptive statistics

Language development	Median	Range
CDI percentile—language production	25	99
CDI percentile—language comprehension	65	99
How often child ate unaided at onset of complementary feeding (0 <i>never</i> to 4 <i>always</i> ):	2 <sup>a</sup>	4
Current feeding practices		
Spoon feeding child (0 <i>never</i> to 100 <i>always</i> )	51	100
Feeding child puréed food (0 <i>never</i> to 100 <i>always</i> )	22	100
Offering child family foods (0 <i>never</i> to 100 <i>always</i> )	82	100

<sup>a</sup>2 = child sometimes fed themselves unaided.

**TABLE 2** Spearman's rho correlations between feeding variables

	Current use of spoon feeding	Current use of puréed food	Offering child family foods
Eating unaided at onset of complementary feeding	-0.269**	-0.142	0.284**
Current use of spoon feeding		0.576**	-0.399**
Current use of puréed food			-0.504**

unaided when they were introduced to complementary feeding. In all analyses, we controlled for whether the child had siblings or not.

### 3.6.1 | Language comprehension

The prevalence of the child eating unaided at the onset of complementary feeding was a significant positive predictor of current child language comprehension (*c* path)  $b = 5.55$ ,  $t(127) = 2.54$ ,  $p < 0.05$ . The prevalence of the child eating unaided during complementary feeding was also positively related to the prevalence of offering the child family foods (*a* path)  $b = 7.36$ ,  $t(128) = 2.93$ ,  $p < 0.001$ , and the prevalence of offering the child family foods was positively related

to child language comprehension (*b* path)  $b = 0.16$ ,  $t(127) = 2.07$ ,  $p < 0.05$ . The relationship between eating unaided at the onset of the complementary feeding period and child language comprehension was reduced and non-significant when the prevalence of offering the child family foods was included in the regression model (*c'* path)  $b = 4.40$ ,  $t(128) = 1.97$ ,  $p > 0.05$ . The indirect effect indicated that the prevalence of offering the child family foods significantly mediated the relationship between the child eating unaided at the onset of complementary feeding and child language comprehension as shown in Figure 2: Indirect = 1.16, 95% CI[0.15, 2.92].

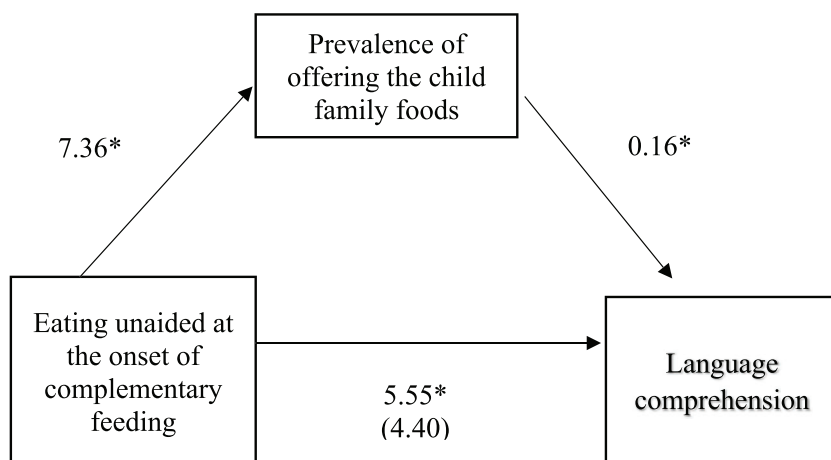
### 3.6.2 | Language production

The prevalence of the child eating unaided at the onset of complementary feeding was a significant positive predictor of current child language production (*c* path)  $b = 6.95$ ,  $t(127) = 2.61$ ,  $p < 0.05$ . The prevalence of the child eating unaided at the onset of complementary feeding was also positively related to the prevalence of offering family foods (*a* path)  $b = 7.36$ ,  $t(128) = 2.93$ ,  $p < 0.001$ , and the prevalence of offering family foods was positively related to child language production (*b* path)  $b = 0.29$ ,  $t(127) = 3.25$ ,  $p < 0.01$ . The relationship between eating unaided at the onset of complementary feeding and child language production was reduced and non-significant when the prevalence of offering the child family foods was included in the regression model (*c'* path)  $b = 4.78$ ,  $t(128) = 1.80$ ,  $p > 0.05$ , suggesting full mediation as shown in Figure 3. The indirect effect indicated that the prevalence of offering family foods significantly mediated the relationship between the child eating unaided during complementary feeding and child language production as shown in Figure 3: Indirect = 2.16, 95% CI[0.54, 4.33].

**TABLE 3** Partial two-tailed correlations between language development and approach to complementary feeding (controlling for whether the child has siblings)

	Child language production N = 131	Child language comprehension N = 131
<b>Approach to self-feeding at the onset of complementary feeding</b>		
Age of introducing foods other than milk	-0.01	0.03
How often did your child eat unaided?	0.225*	0.219*
<b>Current feeding practices</b>		
How often do you spoon-feed your child now?	-0.153†	-0.171*
How often do you offer your child purée food now?	-0.158†	-0.145†
How often do you offer your child family foods?	0.318**	0.225*

\*\* $p < 0.01$ . \* $p < 0.05$ . † $p < 0.10$ .



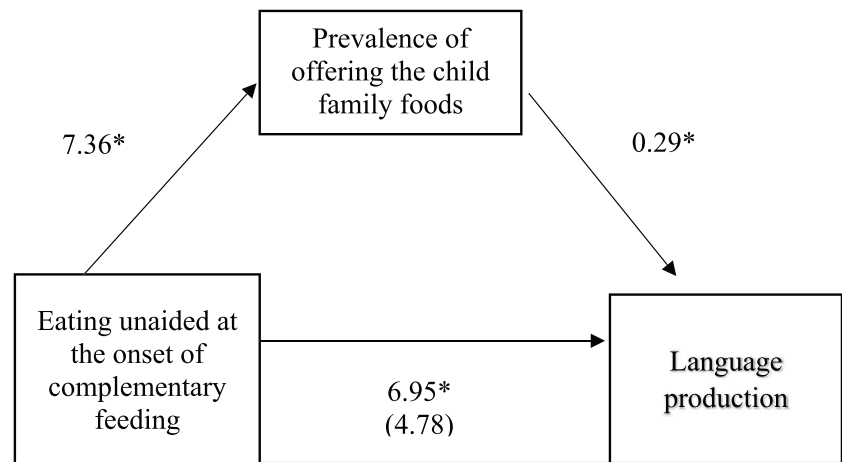
**FIGURE 2** Standardised regression coefficients for the relationship between eating unaided at the onset of complementary feeding and language comprehension as mediated by the prevalence of offering the child family foods. The standardised regression coefficient between eating unaided and language comprehension, controlling for offering family foods, is in parentheses \* $p < 0.05$

## 4 | DISCUSSION

The aims of this study were to explore whether differences in the approach to complementary feeding are related to language



**FIGURE 3** Standardised regression coefficients for the relationship between eating unaided at the onset of complementary feeding and language production as mediated by the prevalence of offering the child family foods. The standardised regression coefficient between eating unaided and language production, controlling for offering family foods, is in parentheses  $*p < 0.05$



development in children, to establish whether the prevalence of offering family foods is related to language development and to explore whether the prevalence of the child eating family foods mediates the relationship between self-feeding and language outcomes. Overall, the findings of the study suggest that the use of more independent, infant-led approach to complementary feeding, which involves the child feeding themselves unaided more often at the onset of complementary feeding, is positively related to language comprehension and production. Moreover, the significant mediational models identified suggest that a more infant-led approach to complementary feeding leads to a feeding dynamic which involves the child more often in family mealtimes, which in turn benefits the child in terms of language comprehension and production.

The age at which infants were first introduced to foods other than milk was not significantly related to either language measure in the current sample. Although the advanced oral-motor movements required for the mastication of solid foods may be beneficial for craniofacial development (Abed et al., 2007) and the skills required for subsequent language production (Cichero, 2016), the current findings suggest that the age at which infants are introduced to foods other than milk is not related to later language outcomes. Current UK guidelines recommend that by 12-month-old infants should be consuming three meals a day, which contain a variety of different solid foods (NHS, 2020b; NHS, 2020c); therefore, it is likely that the majority of children will have access to solid foods, and the experience of chewing, within the period that they can be expected to begin rudimentary language production (10–15 months old). The current findings suggest that the age at which parents initiate complementary feeding may not be an important determinant of subsequent language outcomes but that their later experiences with foods do have important relationships with this area of development.

Indeed, the prevalence of children eating unaided at the onset of the complementary feeding period was significantly and positively correlated with language production and comprehension. It has previously been suggested that the development of motor skills associated with self-feeding, including the coordination of hand-to-mouth movements, are different from those associated with being spoon-fed,

which requires fewer motor skills (van den Engel-Hoek et al., 2014). The more complex motor movements that develop within the iterative process of learning to self-feed unaided may aid the development of oral and motor skills required for language production through strengthening of related neural pathways. Alcock (2006) found that children with poor oral motor movements before the age of 2 also displayed poorer speech and language skills and that more complex oral motor movements are more closely related to language skills, possibly because they are more ‘speech-like’. Both spoken language and oral motor control may rely on adjacent neural areas, which develop in parallel and may therefore be indirectly related (Alcock & Krawczyk, 2010). It is possible then that children who start engaging in independent eating earlier in their development may gain greater cumulative oral-motor experience and develop greater oral-facial control at an earlier age, leading to the greater language development compared with children who are predominantly fed by their caregiver from the onset of the complementary feeding period. However, it is important to note that, in order for infants to feed themselves unaided, they must display a certain level of developmental readiness such as the ability to sit up unsupported, to pick up and hold small solid food items and to engage in rudimentary chewing skills which minimise the risk of choking (Brown & Lee, 2010). It is possible then that infants who display signs of achieving these milestones at a younger age are more likely to be offered finger foods by their caregivers; these children may also be more likely to achieve language outcomes at an earlier age simply due to the rate of their developmental trajectory. Similarly, children who show slower progression through developmental milestones may be perceived by caregivers as being less equipped to feed themselves unaided and may be preferentially fed by their caregiver instead. The cross-sectional nature of this study means that the direction of the relationship between eating unaided during the complementary feeding period and language outcomes is not clear and prospective, and experimental studies are needed to ascertain causality in the relationship between these two variables.

In the current study, an ongoing preference for allowing self-feeding and consuming food in its solid form rather than puréed showed some associations with language comprehension and

production, although only weakly so. We were also able to explore the role of the child consuming family foods as a potential mediator between approach to introduction to solid foods and language development. Mediation analysis revealed that the relationship between eating unaided at the onset of complementary feeding and later language outcomes was mediated by the prevalence of offering the child family foods. These findings suggest that more independent feeding at the onset of complementary feeding might in turn facilitate a greater frequency of family mealtime experiences, which has positive implications for language outcomes. It may be that, when parents take (and maintain) a more infant-led independent approach to feeding, this allows the parent to eat, serve food and engage with the rest of the family while the infant is eating unaided and this facilitates the likelihood of offering the child family foods. When children eat these more family foods, they may be more likely to do so with the rest of the family where there is an opportunity for interactive exposure to language. Indeed, previous research has already highlighted the positive impact that family mealtime interactions can have in terms of eating behaviour and other aspects of cognitive and social development (Skinner et al., 1998). It appears that these mealtimes may also play an important role in supporting language development through exposure and modelling of the unique language that this family experience provides (Snow & Beals, 2006; Weizman & Snow, 2001).

In summary, this study aimed to assess the potential links between different approaches to complementary feeding and language outcomes in infants. It has been shown that the features of a more infant-led, independent approach (i.e., the infant eating unaided, using less spoon feeding and eating more family foods) show associations with language comprehension and production. Many parents encourage their children to consume finger foods, to feed themselves and to eat family foods, irrespective of whether they follow a particular weaning approach. This research suggests that these behaviours, which are more infant-led, may facilitate the prevalence of eating family foods and as a result may be beneficial for language development.

To our knowledge, this is the first study to explore the relationship between approaches to complementary feeding and language comprehension and production. However, this study is not without limitations. First, participants were recruited via an online platform, which, although providing access to a large participant pool, may have limited the diversity of the sample. However, we did find a considerable range in terms of income and education and online recruitment appears to provide greater diversity compared with voluntary studies which typically attract higher socioeconomic status (SES) samples (e.g., Paolacci et al., 2010). There are other confounding factors that further research should consider; for example, it is likely that parents who talk to their children more at mealtimes also talk to their children more at other times and that parents who provide more autonomy for children during mealtimes also interact with their children differently in other ways that may promote language development outside of the mealtime experiences. In addition, the study is cross-sectional in nature, and, without a longitudinal element, it is not possible to establish the direction of the relationships between approach to complementary feeding and language development. This study also utilised

self-reported data, which may be open to inaccuracies (i.e., it may be difficult for parents to remember when they first offered food to their infant, especially for older children) or socially desirable reporting. Participants in this study were not specifically asked if they had adopted a 'baby-led' weaning approach as we were interested in the experiences of complementary feeding rather than the choice to follow a particular plan per se and this may have helped to eliminate any bias, which may arise from participants wishing to report a socially desirable response. Future research using observational methodologies is needed to more accurately explore and categorise mealtime behaviour on a more objective basis. In particular, research is required to measure the prevalence of family mealtimes and distinguish between the use of family foods and the prevalence of the family eating together, which are distinct variables.

The literature exploring the links between approaches to introducing solid foods and language development is in its infancy, and there have been no studies, to our knowledge, which explicitly examine the links between aspects of infant-led complementary feeding and language comprehension or production. The findings from this study indicate that using a more independent infant-led complementary feeding approach may lead to a greater likelihood of eating family foods, which in turn is associated with more sophisticated child language comprehension and production. These findings highlight the need for a randomised controlled trial to explore the impact of different approaches to complementary feeding for subsequent developmental outcomes in children. Future research is also needed to ascertain more fully which aspects of the family mealtime environment, such as the frequency of infant directed speech or the influence of other agents such as siblings, facilitate the language skills that are associated with family mealtime experiences.

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#### CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

#### CONTRIBUTIONS

EA, AG and CF conceptualised the study, and JB and LS contributed to project design. CW collected, coded and analysed data and contributed to write up of manuscript. CF supervised the research, analysed data and wrote the paper. All authors contributed to reviewing and editing of paper.

#### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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