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Verbal and More: Multimodality in Adults' and Toddlers' Spontaneous Repetitions

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ABSTRACT

This study investigated verbal imitation from a multimodal point of view, considering the mutual influence of children's and adults' participation. Sixteen Spanish-speaking children were observed longitudinally at 21, 24, and 30 months of age in natural settings. We analyzed the multimodal characteristics of children's and adults' repetitions, considering whether they were verbal, verbal-gestural, or gestural. In addition, we also analyzed the multimodal characteristics of the utterances that were repeated (source). Measures of vocabulary and grammatical levels were also taken into account at the three points in development. Results showed that verbal-gestural repetitions were frequent in the speech of children and adults, although not as frequent as verbal repetitions. Nevertheless, verbal-gestural speech was reproduced more frequently than verbal speech. Adults were more likely to reproduce children's speech when it included gestures, which was also related to children's linguistic level. Furthermore, children and adults synchronize their multimodal communicative behaviors, coordinating the modality of their repetitions with the modality of the source speech.

The results are discussed taking into account the need to study the multimodal characteristics of child-directed speech, as well as the need to study verbal repetition and multimodal communicative behaviors simultaneously, as forms of interaction that are essential to language development.

Contemporary explanations of language development contemplate different variables that are beyond children's verbal production of linguistic forms and take into consideration contextual aspects such as maternal responsiveness (Tamis-LeMonda et al., 2014), object play (Orr, 2020) or the ability to understand intentions (Tomasello et al., 2005). Among these variables we focus on two: a specific form of verbal imitation called *verbal repetition* and the use of gestures in coordinated verbal-gestural productions.

The supporting role of imitation skills in language development is well documented. For example, Bannard et al. (2013) showed different forms of imitation (from mimicry to versioned imitative behaviors) and their role on language development. At the same time, research has also shown that verbal imitation, as well as actions and gestures, are related to language development because they could be interpreted as forms of joint attention (Rogers & Pennington, 1991). In fact, imitative behaviors provide feedback about the actor's own behavior and are part of conversational practices at different points in development (Charman, 2006; Clark & Bernicot, 2008; Dohmen et al., 2016; Toth et al., 2007; Uzgiris, 1981).

The use of gestures is also well documented as an important variable in language development (Aureli et al., 2017; Capobianco et al., 2017; Rowe & Goldin-Meadow, 2009; Murillo & Belinchón, 2012). Zambrana et al. (2013) showed that imitative actions and pointing gestures interact with

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language production and comprehension at 18 months, and that both abilities predict language production at 36 months. Nevertheless, little is known about the way imitation – specifically, verbal repetition – interacts with the use of gestures during early adult-child interactions. In this study, we examine the role of verbal imitation from a multimodal point of view, by analyzing the coordination of communicative gestures with a form of verbal imitation called spontaneous *verbal repetition*.

Verbal repetition and language development

Verbal repetition is defined as the partial or total reproduction of a preceding utterance (Snow, 1981). During the course of early interactions, children and adults often repeat each other's speech spontaneously using diverse strategies. Verbal repetition helps to establish a common ground between the speakers, since the speaker is effectively following the addressee's lead (Clark & Bernicot, 2008). At the same time, to repeat an utterance, it is necessary to shift the focus of attention to the form (and often the content) of the message. Therefore, verbal repetition highlights some parts of the utterance to the conversational partner, which, in turn, provides direct feedback on the actors' own utterances (Che et al., 2018).

On the one hand, research has revealed that children's verbal repetition of adults' words correlates with vocabulary growth between 17 and 21 months of age (Masur, 1995). Children that presented high rates of repetition at 17 months, continued showing high rates of repetition at 21 months (Masur & Rodemaker, 1999). As children approach their second birthday, their rates of verbal repetition decrease (Snow, 1981; Stine & Bohannon, 1983; Uzgiris et al., 1989) and are no longer related to language abilities (Che et al., 2018).

On the other hand, research has shown that child-directed speech is highly repetitive, which has a positive impact on linguistic development (see Rowe & Snow, 2020, for a review). The imitation and the reproduction of children's actions and vocalizations is a strategy of the so-called "maternal responsiveness" (Tamis-LeMonda et al., 2001). Parental repetitions of children's vocalizations at 9 months have a predictive role on the acquisition of later linguistic milestones. Masur and Rodemaker (1999) showed that more repetitive children had more repetitive mothers at 21 months, which facilitated vocabulary growth. Moreover, experimental research has also shown that repetitive infant-directed speech facilitates word learning at 21 months, when children have already increased their vocabularies and are no longer learning their first words (Schwab & Lew-Williams, 2016). Che et al. (2018) showed that the rate of maternal repetition at 14 and at 20 months, predicts children's vocabulary, lexical diversity and the mean length of their utterances at 32 months. The authors argue that adults' repetitions have a disambiguating function because they drive attention to the relationship between the word and its referent. Nevertheless, adults' repetitions of children's utterances also decrease after 24 months; furthermore, higher rates of fathers' repetition after the second birthday are related to lower levels of vocabulary (Schwab et al., 2018); in fact, Casla et al. (2021) found that parental repetition at 21 months was negatively related to children's linguistic skills 9 months later. During the third year of life, children and adults continue repeating each other in sequences that re-repeat the original utterance. These forms of repetitions, which are more frequent at 40 months than at 27 months, are less focused on the form, and usually extend the content of the former utterance, which suggests that they play an important role for conversational purposes (Clark & Bernicot, 2008). These results suggest that the facilitative function of adults' repetition on language development could be because adults adapt their speech to the linguistic abilities of the child (Tamis-lemonda et al., 2014). Verbal repetition provides important feedback that is different at each developmental stage, and that its influence is not restricted to vocabulary growth, given that adults' repetitions are also related to grammatical development.

It is worth noting that children also learn new words from adult-directed speech, although the effect of child-directed speech declines as children grow older, and more characteristics of the speech that children hear should be taken into account (Ma et al., 2011).

Gesture-speech combinations and language development

Multimodal communication is defined as the coordination between gestures and vocal or verbal production in a single communicative behavior. The link between oral and gestural components is also important in order to understand the nature of language development (Perniss, 2018). Children synchronize their vocalizations with their actions from very early on. For example, research has shown that the coordination between gestures and vocalizations at 12 months is related to vocabulary growth at 15 months (Murillo & Belinchón, 2012) and at 18 months (Igualada et al., 2015). Moreover, the relationship between the meaning of the gestures and the words predicts linguistic abilities at 24 months (Capobianco et al., 2017). In fact, the production of utterances that combine gestures and words in which there is a relationship between the semantic meaning of both components is related to the transition to two-words productions (Özçalışkan & Goldin-Meadow, 2009).

Interestingly, adults are more prone to label children's utterances when they are produced with gestures than when they are produced without them (Goldin-Meadow et al., 2007). Olson and Masur (2015) found that mothers labeling of children's word-gesture combinations predicted vocabularies at 1;1 and 1;5. In the same line, Ger et al. (2018) found that adults' relevant responses to children's actions were more frequent when children coordinated vocalizations and pointing gestures at 10 months. Moreover, being responsive to the coordination of children's pointing and vocalizations at 10 months, was related to children's pointing frequency at 12 months. In fact, Olson and Masur (2015) argue that it is possible that children's speech-gesture coordination is related to lexical development because of the impact that this coordination has on adults' labeling. Furthermore, the authors showed that mothers' labeling of children's gestures predicted their vocabulary levels shortly after the first birthday, whereas the responses to children's non-gestural communicative behaviors were not. In addition, this study demonstrated that mothers disambiguated the meaning of the word by accompanying it with an action or a gesture that highlighted word-referent relations. Thus, the need to analyze language development from a multimodal point of view is not restricted to children's communicative behaviors and their impact on adults' labeling. Adults also coordinate their speech with gestures, using a variety of gestures that are relevant to convey different meanings (McNeill, 1992). They also adapt the use of gestures when they are interacting with young children (O'Neill et al., 2005), specifically, they adapt their gesturing and their speech to children's gesturing more than children's actions and speech alone (Rodrigo et al., 2006; Wray & Norbury, 2018).

Iverson et al. (1999) found that adults' gestures directed to children are more redundant than gestures directed to other adults and tend to appear more synchronized with speech. Child-directed gestures are comparable with child-directed speech, so it has been claimed that the communicative functions of '*motherese*' are equivalent to '*gesturese*' (Gogate et al., 2015; O'Neill et al., 2005). In fact, higher levels of adults' gestures are also related to higher levels of children's gestures (Iverson et al., 1999), and these are related to higher levels of vocabulary (Goldin-Meadow et al., 2007). Although it is possible that these results are related to interactional styles of mother's gesturing (Rodrigo et al., 2006), it is also possible that there are indirect cascading effects that go beyond the redundancy provided by multisensory information (Suanda et al., 2016).

As children increase their linguistic abilities, adults also adapt their multimodal communicative strategies to the linguistic level. Gogate et al. (2015) found that adults' synchronized movements of objects during lexical labeling tend to disappear as children reach 20 months old. Kuchirko et al. (2018) also found that mothers tend to respond to children's gestures with gestures, and that this synchronization with children's modality decreases between 14 to 24 months. In this line, the authors also demonstrated that children responded more often with gestures to their mother's gestures at 14 and 24 months, which shows that adults and children multimodally synchronize their communicative behaviors in ways that reflect some form of imitation (Kuchirko et al., 2018).

The contributions of multimodal communication and of verbal repetition are usually analyzed separately, even if both are related aspects of joint attention that promote language development (Salo et al., 2018). Thus, it is important to analyze the way in which speech and gestures are synchronized as well as the way in which adults and children are attuned when they repeat each other's utterances. Suanda et al. (2016) showed the need to go beyond the verbal properties of individual utterances. In particular, they analyzed the verbal properties of parental discourse that are associated with nonverbal communicative acts (for example, a child's object holding), and found that extended discourse (that is, repetitive reformulated utterances that characterize child-directed speech) was associated with better word learning because of its link with children's nonverbal actions. They conclude that multisensory events in which verbal production overlaps with nonverbal behavior increase the quantity and the quality of child-directed speech. Thus, adults produce multisensory and multi speech discourse that is essential to language development.

Since verbal repetition is a characteristic of children's and adults' speech, the question is: To what extent do children and adults use verbal and multimodal repetitions as a communicative strategy? Do they use both strategies separately? What kind of expressions do children and adults repeat? Do they repeat more multimodal than unimodal communicative bids? Moreover, since verbal repetition has a disambiguating function that could be equivalent to the function of speech-gesture combinations – Which are the outcomes of multimodal repetitions in language development?

The aim of this work is to analyze verbal repetition from a multimodal point of view, considering the mutual influence of children's and adults' participation. For this purpose, we designed a longitudinal study of toddlers aged from 21 to 30 months, a period in which children usually combine words (Ambridge & Lieven, 2011) and words with gestures (Goldin-Meadow et al., 2007; Murillo et al., 2015).

The current study extends the previous research in several ways. First, we consider the participation of adults and children simultaneously, so we analyze the multimodal characteristics of the communicative bids that both participants repeat (source communicative bids) as well as the repeated utterances. Second, adopting a multimodal point of view involves expanding the definition of speech beyond vocal or verbal production, as any communicative bid can be a gestural, verbal or verbal-gestural (Capobianco et al., 2017). Finally, we examine the potential relationship between multimodal communicative bids (source and repeated) and children's linguistic level, considering several measures that are taken from standardized tests (vocabulary, morphosyntax and mean length of utterance).

We hypothesized that children and adults will combine verbal repetition with gestures, repeating each other's utterances multimodally. Following previous research on the influence of adults' repetition, we expect adults' repetitions to have more impact on children's linguistic level than children's repetitions, especially if repetitions are multimodal. Therefore, we expect adults' multimodal repetitions to have a clear effect on children's linguistic level. Specifically, since combinations of words and gestures resemble some, but not all, characteristics of two-word combinations (Capobianco et al., 2017; Murillo et al., 2015), we expect that multimodal repetitions will have more influence on grammatical level than on vocabulary level.

Given that adults respond more often to multimodal than to unimodal speech (Olson & Masur, 2015), we expect that the probability of repeating source communicative bids is higher when it is multimodal than when it is unimodal.

Finally, since children and adults coordinate the modality of the speech during early interactions (Kuchirko et al., 2018; Rodrigo et al., 2006), we expect the modality of source utterances to influence the modality of repetitions, both in children and adult repetition.

Method

Participants: We followed longitudinally sixteen child-parent dyads (10 girls and 6 boys) in naturalistic settings and recorded them at three points in development (21, 24 and 30 months). We had to omit from the study one of the dyads at 24 months because of technical problems. Table 1 shows children's mean ages and standard deviations at the three times of assessment.

We selected the two points in development that are before and after the second birthday. We considered it to be a very important stage in linguistic development in which children already produce two-word utterances, although they still produce many one-word utterances, which are often linked to adults' speech production (Veneziano, 2013). Moreover, before 21 months, Masur and Rodemaker

Table 1. Number of children, mean age -years; months (days)- and standard deviations.

	21 Months	24 Months	30 Months
M	1;9 (3)	2;1(5)	2;6 (10)
SD	.320	.590	.570
Min	1;8 (19)	1;10 (17)	2;5 (20)
Max	1;10 (5)	2;2 (9)	2;7 (15)
N	16	15	16

(1999) found a positive correlation between children's repetition and their vocabulary level. Nevertheless, other studies with older children did not find such a relationship (Casla et al., 2021; Che et al., 2018). At the same time, a relationship has been found between adult repetition and language development in children at two years of age, though not in all cases (Schwab et al., 2018).

Children were recruited from middle-class nurseries in the Madrid area and parents were required to give informed consent. Of the 16 mothers who participated, 15 had a university degree and of the 16 fathers 12 also had a university degree. The remaining mother and four fathers had a high school qualification.

Parents received the Spanish version of the MacArthur Communicative Development Inventories (MCDI) (European version, López-Ornat et al., 2005) and were asked to participate in the longitudinal study. The children had no history of hearing problems or developmental delays. We administered the Spanish version of the Battelle Developmental Screening test (De La Cruz & González, 1996) at each point of development. The range of scores is shown in Table A3 (Appendix A), according to the test, all children were typically developing children in terms of cognitive, motor and communicative abilities.

The University Research Ethics Committee approved all the study procedures.

Procedure

Children and their mother or father were video-recorded in their homes, or in a quiet room at their nurseries, during a15-minute free-play session. A camcorder was fixed on a tripod at approximately two meters from the dyad.

All dyads received the same set of toys: a set of plastic animals, a set of plastic meals, a box with blocks, a small ball, and a small book with images of actions. If the child did not show interest in these objects, she could use other toys or objects at their homes or nurseries. The adults were requested to play with their children as they normally would.

Mean session durations were: 15 minutes and two seconds (*min* = 5′ 38"; *max* = 17′ 18"; *SD* = 3′07") at 21 months; 15 minutes and 58 seconds (*min* = 10′ 23"; *max* = 19′ 05"; *SD* = 2′41") at 24 months; and 15 minutes and seven seconds (*min* = 12′ 15"; *max* = 20′ 05"; *SD* = 2′37") at 30 months.

Coding

All recordings were transcribed using the CHAT conventions of the CHILDES project (MacWhinney, 2000). The program allows the transcription of each verbal utterance on separate lines. Since we transcribed gestures and verbal production and the term "utterance" is not appropriate for gestures, in what follows, we use the term "communicative bid" to refer to the production of verbal utterances, gestures, and verbal-gestural combinations Thus, we transcribed all the communicative bids produced by each speaker on a separate line.

Verbal communicative bids were identified with the prosodic and the syntactic completion criteria, and the temporal criteria (a pause no longer than three seconds) (MacWhynney, 200).

We defined a gesture as a motor action, that is not an instrumental action (with or without an object), carried out to convey a meaning to others (Murillo & Belinchón, 2012). The definition of gestures includes deictic gestures (e.g., pointing, reaching or showing), symbolic gestures (gestures that represents actions or objects depicting some characteristic or attribute of the referent), and conventional gestures (e.g., thumbs up, hand waving to say "goodbye," etc.). More details and picture examples about gesture classification can be found at Murillo et al., (2018). For the purposes of the present study, we did not analyze the type, the content, the meaning or the communicative function of the gestures.

Since the focus of this research is on verbal repetition, we first transcribed verbal production and then we coded whether each utterance was or was not accompanied by a gesture or not. We transcribed gestures following CHAT conventions and added the interpretation of each gesture, so we could further encode whether they were repetitions or were repeated in the next line. Gestures were transcribed on the same line of a verbal production, or on separate lines. The following example shows a verbal-gestural communicative bid in which the mother of a 24-month-old produces the word "here" and adds a pointing gesture.

**MOT:aquí [= gesto señ].*	**MOT: here [= pointing gesture].*
**MOT:aquí (.) mira.*	**MOT: here (.) look.*
**MOT:está aquí [= gesto señ].*	**MOT: it is here [= pointing gesture].*
**CHI: aquí.*	**CHI: here.*

We transcribed gestures in a separate line when there were more than two seconds between the verbal production and the gesture. When a speaker used a gesture and no verbal utterance, as in the following example, the gesture was included in the speaker's line:

**CHI:no!*	**CHI: no!*
**FAT:no?*	**FAT: no?*
**CHI:0 [= niega con la cabeza].*	**CHI: 0 [=denies with head].*

In order to encode the variables under study, each communicative bid was manually coded with a dependent tier that followed the transcription of each communicative bid, and later analyzed with QWAL and FREQ commands with the CLAN program of the CHILDES project (MacWhinney, 2000). We did not use the CHIP command to identify the frequency of repetitions because the command does not allow the identification of gestures and verbal-gestural repetitions. Nevertheless, we used the definition of the command in order to identify verbal and verbal-gestural repetitions (see Che et al., 2018 and Casla et al., 2021, for further details), that is, 'the number of utterances in which there is an overlap for at least one word in the source utterance and the response utterance' (MacWhinney, 2000, p. 71). The command automatically compared each utterance and the six preceding utterances; therefore, we also identified verbal and verbal-gestural repetitions following the same criteria.

Each communicative bid, produced by the child or the adult, was coded in terms of the modality:

- *Verbal (V)*: any communicative bid including at least one intelligible word without any temporal overlap with a gesture.
- *Gestural (G)*: a communicative gesture produced without temporal overlap with a verbal production.
- *Verbal-gestural (V + G)*: overlap between verbal and gestural production within the window of a communicative bid.

Once all the communicative bids were coded in terms of their modality, they were coded as repetition, source communicative bid or independent communicative bid:

- *Repetition*: a spontaneous repetition was defined following previous research in verbal repetition (MacWhinney, 2000; Snow, 1981) but adding the possibility that it could be multimodal. Thus, it was defined as the communicative bid in which there was an overlap for, at least, one word, one gesture, or one word + gesture that reproduced a word, a gesture or a word + gesture in the preceding communicative bid produced by a different speaker. This definition also includes extended repetitions in which the speaker repeats the whole or part of the preceding utterance and adds one or more words or gestures. The three types of repetition (exact, reduced and expanded) were computed as repetitions.

We coded children's repetitions of adults' communicative bids and adults' repetitions of children's communicative bids.

- *Source*: a communicative bid that was repeated by the conversational partner within the window of the six subsequent communicative bids.

- *Independent communicative bid*: a communicative bid that was not source communicative bid or repetition.

Thus, any communicative bid, produced by the child or the adult, could be a repetition (verbal, gestural or verbal-gestural), a source (verbal, gestural or verbal-gestural), or an independent communicative bid (verbal, gestural or verbal-gestural). Table 2 shows examples of adult-child and child-adult repetitions of each type of combination:

The relationship between children's linguistic abilities and repetition was analyzed using the following measures:

(a) Vocabulary and Morphosyntax raw scores taken from the Spanish adaptation of the MCDI (II) (López-Ornat et al., 2005). The Spanish version of the MCDI is an adaptation that is not a direct translation of the English one. Vocabulary production is registered through a sample of 588 words that includes different sections (body parts, social words, meals, etc.). The section "Morphosyntax Complexity" evaluates grammatical development by presenting examples of sentences of increasing syntactic and morphological complexity (a total of 34). The average scores for each age group at each point of development, as well as the percentiles associated with them, are found in Appendix A.

(b) Mean length of utterance in words (MLUw), calculated using the CLAN program of the CHILDES project.

Reliability

Two independent observers coded 15% of the recordings, 5% per each time of development. The inter-observer agreement was $k = .767$ ($p < .001$) for 21 months (n = 308); $k = .857$ ($p < .001$) for 24 months (n = 237); and $k = .958$ ($p < .001$) for 30 months (n = 298).

Table 2. Examples of verbal and verbal-gestural sources and repetitions.

Source: verbal **Repetition**: verbal 24 MONTHS-BOY	*CHI:Tivia [: Silvia] a mano. *MOT:¿a Silvia?	*CHI: Tivia [: Silvia] to (the) hand. * MOT: To Silvia?
Source: verbal **Repetition**: verbal-gestural 21 MONTHS- GIRL	*MOT:¿dónde está Belén? *CHI:a@fs no tá [: está] [= gesto negar].	*MOT: Where is Belén? *CHI: a@fs (she) is not there [= denying gesture].
Source: verbal-gestural **Repetition**: verbal 21 MONTHS- GIRL	*CHI:mamá [= gesto señalar]. *MOT:mamá.	*CHI: Mom [= points]. *MOT: Mom.
Source: verbal-gestural **Repetition**: verbal-gestural 30 MONTHS – BOY	*MOT: ¿y esta? [= gesto moviendo la mano]. *CHI: eta [: esta] [= gesto moviendo la mano].	* MOT: and this one? [= gesture moving the hand]. *CHI: this one [= gesture moving the hand].

Analyses

In order to test our research questions, we conducted four sets of analyses.

(1) General speech:

The **multimodal characteristics of children's and adults' speech** were analyzed first. Therefore, we calculated the proportion of all verbal, gestural and verbal-gestural communicative bids over the total number of communicative bids produced by each speaker at each developmental point.

(2) Repetitions:

Secondly, the **proportion of repetitions** over the number of each type of communicative bid were calculated. Therefore, we calculated the proportion of verbal repetitions out of the total number of verbal communicative bids, the proportion of gestural repetitions out of the total number of gestural communicative bids and the proportion of verbal-gestural repetitions out of the total number of verbal-gestural communicative bids. We also analyzed differences between verbal and verbal-gestural communicative bids and repetitions and their relationships with children's linguistic skills at each point of development. These analyses of each type of repetition were independent of the type of source that was reproduced.

(3) Source communicative bids:

Thirdly, the multimodal characteristics of source communicative bids, including the proportion of verbal, gestural and verbal-gestural sources over the total number of communicative bids were analyzed. We also examined the relationship between children's linguistic skills at each point of development and the proportion of each type of source. As we did with repetitions, these analyses of the type of source were independent of the modality of the repetition. Note that the number of source communicative bids does not determine the number of repetitions, since a verbal source utterance could be repeated either verbally or verbal-gesturally. Therefore, we examined the relationship between children's linguistic outcomes and each type of utterance separately.

(4) Adult – child coordination:

Finally, the coordination between the modality of source communicative bids and repetitions in children and adults was analyzed, before calculating the contingency between the type of source and the type of repetitions.

Results

What are the multimodal characteristics of adult – toddler conversations?

In order to analyze the multimodal characteristics of children's and adults' repetitions, we first examined the frequency of verbal and verbal-gestural communicative bids in their speech.

To test the differences between each type of communicative bid, a repeated measures 3 × 3 ANOVA was carried out, taking the proportion of each type of communicative bid (V, G or GV) and the age as factors. Children's results are shown in Table 3a.

In the case of children, results showed an effect of modality ($F(2,14) = 180.676$ $p < .001$, $\eta^2 = .965$), but no age effect and no interaction. Bonferroni post-hoc pairwise comparisons revealed that children produced more verbal communicative bids than gestural ($p < .001$), more verbal-gestural than gestural ($p < .001$), and more verbal than verbal-gestural ($p < .001$) communicative bids.

Table 3a. Mean proportion and standard deviations of each type of communicative Bid at each time of development: Children.

	21 Months		24 Months		30 Months	
	M	SD	M	SD	M	SD
Verbal	.63	.15	.73	.11	.69	.09
Gestural	.15	.13	.08	.08	.10	.08
Verbal+Gestural	.22	.07	.19	.08	.21	.01

In the case of adults, as shown in Table 3b, results showed the same pattern, since we found an effect of modality ($F(2,14) = 736.505$ $p < .001$, $\eta^2 = .981$) and no age effect or interaction. Pair-wise comparisons using Bonferroni correction also revealed that adults produced more verbal-gestural than gestural ($p < .001$), and more verbal than verbal-gestural ($p < .001$) communicative bids.

What are the multimodal characteristics of repetitions?

The frequency of verbal-gestural repetitions

In order to test to what extent each type of communicative bid is a repetition and, in particular, to what extent adults and children produce verbal-gestural repetitions, we calculated the proportion of each type of repetition out of the number of each type of communicative bid. Absolute mean numbers of repetitions are shown in Appendix B.

Table 4a shows that children's proportion of repetitions was very low. In the case of children, verbal repetitions reached 13% of verbal communicative bids at 24 months, gestural repetitions were not over 1% of gestural communicative bids, and verbal-gestural repetitions were between two and 3% of verbal-gestural communicative bids.

In order to test developmental and type of repetition differences, we conducted a repeated measures 3×3 ANOVA that took the modality of the repetition and the age as factors, and the proportion of verbal repetitions out of the total number of verbal communicative bids, the proportion of gestural repetitions out of the total number of gestural communicative bids and the proportion of verbal-gestural repetitions out of the total number of verbal-gestural communicative bids as dependent variables.

Table 3b. Mean proportion and standard deviations of each type of communicative Bid at each time of development: Adults.

	21 Months		24 Months		30 Months	
	M	SD	M	SD	M	SD
Verbal	.80	.07	.80	.09	.77	.07
Gestural	.02	.02	.19	.09	.02	.01
Verbal+Gestural	.18	.01	.01	.00	.21	.07

Table 4a. Mean proportion and standard deviations of each type of repetition at each time of development: Children.

	21 Months		24 Months		30 Months	
	M	SD	M	SD	M	SD
Verbal	.08	.06	.13	.09	.08	.04
Gestural	.01	.03	.00	.01	.01	.02
Verbal+Gestural	.03	.02	.02	.01	.02	.02

In the case of children, results showed an effect of modality ($F(2,14) = 46.715$ $p < .001$, $\eta^2 = .981$) and no age or interaction effects. Pairwise comparisons applying Bonferroni correction revealed that the proportion of verbal repetitions was higher than the proportion of gestural repetitions ($p < .001$), and that the proportion of verbal-gestural repetitions ($p < .001$). Although the proportion of verbal-gestural repetitions was higher than the proportion of gestural repetitions, the difference did not reach significance ($p = .071$).

Table 4b shows that adults' proportion of each type of repetition was higher, since at 21 months the proportion of verbal-gestural repetitions reached 24% of verbal communicative bids, gestural repetitions reached 23% of gestural communicative bids at 30 months, and verbal repetitions reached 11% of verbal-gestural communicative bids at 30 months.

In order to test developmental and type of repetition differences in adults, we conducted a similar ANOVA to the one carried out with children. Results showed an interaction effect of modality and age ($F(4,12) = 17.431$ $p = .002$, $\eta^2 = .650$), so we proceeded to analyze lower level interactions as recommended by Heiman (1995). We did not find age effects for verbal and gestural repetitions. We found an age effect for the proportion of verbal-gestural repetitions ($F(1,14) = 12.786$ $p = .003$, $\eta^2 = .477$), since adults produced a higher proportion of verbal-gestural repetitions at 21 months than at 24 months ($p = .009$), and at 30 months than at 21 months ($p = .045$). There were not significant differences between the proportion of verbal-gestural repetitions at 21 and at 24 months. We found an effect of modality at 21 months ($F(1,15) = 4.093$ $p = .047$, $\eta^2 = .427$), since adults' proportion of verbal-gestural repetitions was higher than the proportion of verbal repetitions ($p = .036$). We did not find differences between the proportions of verbal-gestural and gestural repetitions, and between the proportion of verbal and gestural repetitions. We found no modality effects at 24 and at 30 months.

In sum, in adults' and children's speech, the proportion of verbal communicative bids is higher than the proportion of gestural and verbal-gestural communicative bids. Nevertheless, when we analyze the proportion of repetitions considering the modality of the communicative bid, results show that adults repeat verbal-gestural communicative bids more frequently than verbal communicative bids, and that there is a developmental effect in which the proportion of verbal-gestural repetitions decreases from 21 to 30 months.

Verbal-gestural repetitions and children's linguistic level

In order to test the relationship between verbal-gestural repetitions and children's linguistic level we conducted a series of Pearson's correlations that took raw scores in vocabulary and morphosyntax from the MCDI and the MLU from the CLAN program. Appendix C shows the results of these analyses, indicating those correlations that were significant at alpha level corrected by Bonferroni Method.

In the case of children, we found no significant correlation between the number of verbal repetitions and linguistic scores. In the case of adults, we found that the number of verbal-gestural repetitions correlated significantly with the morphosyntax scores at 21 months ($r(16) = .742$, $p = .002$) and MLU ($r(16) = .744$, $p = .001$), but no significant correlations at 24 and 30 months were found.

Table 4b. Mean proportion and standard deviations of each type of repetition at each time of development: Adults.

	21 Months		24 Months		30 Months	
	M	SD	M	SD	M	SD
Verbal	.10	.05	.12	.05	.11	.03
Gestural	.11	.31	.13	.21	.08	.07
Verbal+Gestural	.24	.18	.18	.13	.23	.41

What are the multimodal characteristics of the source communicative bids?

Frequency of source communicative bids

In order to analyze the multimodal characteristics of source communicative bids, we calculated the proportion of verbal, gestural and verbal-gestural source communicative bids out of the total number of communicative bids. The proportion of gestural sources was below .01 for children and for adults at the three points in development. Therefore, we analyzed the proportion of verbal and verbal-gestural source communicative bids, as shown in Tables 5a and 5b. Tables B3 and B4 in Appendix B show the absolute frequencies of each type or source communicative bid at each age.

To test developmental changes and differences in the modality of each source communicative bid, we conducted a repeated measures 3 × 3 ANOVA that took the modality of the source and the age as factors, and the proportion of each type of source as dependent variable. In the case of children, we found an effect of modality ($F(1,14) = 16.154$, $p = .001$, $\eta^2 = .563$), since children produced significantly more verbal-gestural source communicative bids than verbal source communicative bids. We also found an age effect ($F(1,14) = 5.796$, $p = .008$, $\eta^2 = .293$). Pairwise comparisons applying Bonferroni correction revealed that children produce significantly more source communicative bids at 21 months than at 24 ($p = .014$) and at 30 months ($p = .049$). We found no differences between the proportion of sources at 24 and at 30 months.

In the case of adults, we found an effect of modality ($F(1,14) = 21.131$ $p < .001$, $\eta^2 = .601$), since adults produced more verbal-gestural than verbal source communicative bids. We found no age effect and no interactions.

Source communicative bids and children's linguistic level

In order to test the relationship between each type of source communicative bid and children's linguistic level we conducted a series of Pearson's correlations that took vocabulary and morphosyntax scores from the MCDI, as well as the MLU. Appendix D shows the results of these analyses.

In the case of children, we found that, at 21 months, the number of verbal source communicative bids correlates significantly with the MLU ($r(16) = .679$, $p = .004$). At 30 months, we found a positive and significant correlation between the number of verbal-gestural source communicative bids and the MLU ($r(16) = .557$, $p = .006$).

In the case of adults, we found no correlations between the number of source communicative bids and the linguistic measures.

Table 5a. Children's mean proportion and standard deviations of each type of **source communicative Bid** at each time of development.

	21 Months		24 Months		30 Months	
	M	SD	M	SD	M	SD
Verbal	.30	.14	.27	.10	.26	.12
Gestural	.00	.00	.00	.01	.01	.02
Verbal+Gestural	.47	.17	.36	.17	.32	.16

Table 5b. Adults' mean proportion and standard deviations of each type of **source communicative Bid** at each time of development.

	21 Months		24 Months		30 Months	
	M	SD	M	SD	M	SD
Verbal	.03	.01	.05	.03	.04	.01
Gestural	.01	.02	.00	.01	.00	.01
Verbal+Gestural	.08	.07	.08	.06	.10	.04

Are source communicative bids and repetitions coordinated from the multimodal point of view?

In order to test the coordination between the modality of source communicative bids with the modality of repetitions, we calculated the number of verbal source communicative bids that were repeated verbally and the number of verbal-gestural source communicative bids that were verbal-gesturally repeated. As we have shown in previous analyses, the mean number of gestural source communicative bids was below .01. Therefore, we did not include gestural source communicative bids in the following analyses.

Table 6 shows the results of these analyses for children's repetitions (and adults' source communicative bids).

A Chi-square test was performed to examine the independence between the modality of source communicative bids and the modality of repetitions. We found a significant association between adults' type of source communicative bid and children's type of repetitions. Children were likely to repeat verbally when adults' source communicative bids were verbal. We found this association at 21 months (χ^2 (1) = 8.507; p = .004), at 24 months (χ^2 (1) = 11.431; p = .001) and at 30 months (χ^2 (1) = 41.533; p = .001).

Therefore, the modality of children's repetitions is not independent of the modality of the source communicative bids they reproduce. Furthermore, Table 7 shows that this association is stronger as children reached 30 months, given that the contingency coefficient at this age was higher than at 24 months and at 21 months.

Regarding the relationship between adults' repetitions of children's source communicative bids, Table 8 shows the number of adults' repeated communicative bids that matched with each type of children's source communicative bids.

Table 6. Number of Verbal (V) and Verbal-Gestural (V + G) adults' source communicative bids followed by verbal (V) and verbal-gestural (V + G) children's repetitions at each point of development.

		21 Months		24 Months		30 Months	
		CHILD REPEATS		CHILD REPEATS		CHILD REPEATS	
		V	V + G	V	V + G	V	V + G
ADULT'S SOURCE	V	120	29	136	21	152	28
	V + G	30	20	37	19	46	34

Table 7. Contingency coefficients at each age for children's repetitions.

21 Months	24 Months	30 Months
.202, (N = 199) p = .004	.226, (N = 213) p = .001	.280, (N = 280) p < .001

Table 8. Number of Verbal (V) and Verbal-Gestural (V + G) children's source communicative bids followed by Verbal (V) and Verbal-gestural (V + G) adults' repetitions at each point of development.

		21 Months		24 Months		30 Months	
		ADULT REPEATS		ADULT REPEATS		ADULT REPEATS	
		V	V + G	V	V + G	V	V + G
CHILD'S SOURCE	V	298	82	295	57	310	66
	V + G	91	71	84	40	83	58

Table 9. Contingency coefficients at each age for adults' repetitions.

21 Months	24 Months	30 Months
.221, (N = 542) $P < .001$	.172, (N = 476) $p = .001$	.239, (N = 517) $p < .001$

A Chi-square test was performed in order to examine the independence between the modality of children's source communicative bids and the modality of adults' repetitions. In these analyses we also found a significant association between children's type of source communicative bid and adults' type of repetitions. As children, adults were also likely to repeat verbally when children's source communicative bids were verbal, and they were more likely than expected by chance to repeat verbal-gesturally when children's source communicative bids were verbal-gestural. We found this association at 21 months (χ^2 (1) = 27.749; $p < .001$), at 24 months (χ^2 (1) = 14.585; $p < .001$) and at 30 months (χ^2 (1) = 31.277; $p < .001$). The data show that when the source-communicative bid is verbal, the repetition is verbal-gestural in 20% of the observations. When the source is gestural-verbal, the repetition is gestural-verbal in 40% of the observations, even if children produced more verbal than verbal-gestural repetitions, as they produced more verbal communicative bids than verbal-gestural bids in their speech. Thus, adults were likely to repeat verbally when children's source interventions were verbal, and they were likely to repeat verbal-gesturally when children's source interventions were verbal-gestural.

Table 9 shows the contingency coefficients at each point of development. In this case, we did not find a linear increase, since the coefficients were lower at 24 months than at 21.

In order to test to what extent both members of the dyad share the same modality (in other words, the sensitivity to the modality of the conversational partner) we correlated the contingency coefficient of every dyad when the child repeats and when the adult repeats. Spearman's Rho correlation showed a positive and significant relationship between the contingency coefficients of children's and adults' repetitions ($\sigma = .59$; $p = .016$).

Discussion

The aim of this research was to analyze two communicative strategies that are part of child-directed speech as well as toddlers' speech: verbal repetition and the use of gestures. In order to answer our first research question (to what extent children and adults accompanied their repetitions with gestures), we first had to analyze the frequency of each strategy separately. The results of the present study show that children and adults reproduce each other's unimodal and multimodal communicative behaviors (that is, verbal and verbal-gestural communicative behaviors), and that gestures and verbal-gestural communicative bids are part of the conversations they share around the second birthday. Even if children and adults produce unimodal verbal communicative bids more often when they talk to each other, taken together, gestural and verbal-gestural communicative bids accounted for more than 40% of their communicative bids. This pattern of results is in line with previous research that shows that gestures and speech interact during language development (Iverson, 2010) and that gestural and verbal components should not be studied separately (Perniss, 2018). Moreover, the fact that we did not find age differences between 21 and 30 months shows that the verbal-gestural communicative bids that children use do not decrease as children reach their second birthday. At the same time, the verbal-gestural speech directed to children did not decrease during this period. Rodrigo et al. (2006) also found that maternal and child deictic and representational gestures did not decline in their two-year-old group. The authors argue for an explanation that contemplates maternal gestures as input to produce gestures in children.

Regarding repetitions, we found that children and adults repeat each other using both verbal and verbal-gestural communicative behaviors at the three developmental points. Moreover, adults also repeated children's communicative bids using gestures. Children's repetitions presented the same pattern found for the rest of the speech they produce, given that they tended to repeat more verbally than multimodally. We found that adults' verbal-gestural repetitions were more frequent than verbal or gestural repetitions alone, even if verbal-gestural repetitions decreased from 21 to 30 months. It has been claimed that verbal repetition is a form of joint attention, given that it provides feedback to the conversational partner because it retakes the whole or part of the sentence produced (Clark & Bernicot, 2008; Masur, 1995; Olson & Masur, 2012). Furthermore, adults adapt their verbal repetitions to children's linguistic level (M.L. Rowe & Snow, 2020; Schwab et al., 2018). At the same time, from the multimodal point of view, it has been shown that adults adapt their gestures to children's linguistic level and that this may help to focus on the relevant aspects of the speech (Gogate et al., 2015O'Neill et al., 2005). Our results suggest that adults are providing multimodal feedback to children's specific communicative bids in a way that varies depending on the situation, adapting their speech to children's increasing linguistic abilities (Kuchirko et al., 2018). Thus, it seems that it is important to consider multimodal components of repetitions in order to explain their role in language development (Olson & Masur, 2015).

Regarding unimodal repetitions, children hardly repeated adults' communicative bids only with gestures, whereas adults' nonverbal repetitions reached 13% at 24 months. Interestingly, there were no differences between the proportion of both types of unimodal repetitions at this age in adults, even if their general speech is characterized by being mainly verbal. Further research should analyze the content of gestural repetitions in order to draw conclusions about their functions. It is possible that most of the adults' nonverbal repetitions are assertions of children's affirmations and negations, which would increase the ratifying function of repetitions (Che et al., 2018; Clark & Bernicot, 2008). In our data, adults also repeated children's communicative bids using representational gestures that imitated or reproduced the word produced by the child. Therefore, these gestures could be interpreted as repetitions that label children's communicative bids, highlighting word-function relationships that are so important for language development (O'Neill et al., 2005).

In terms of our second research question, our study also contributes with new analyses on the type of communicative bid that children and adults prefer to repeat and shows which are the characteristics of the communicative bids that are more likely to be repeated. Both children and adults produced significantly more verbal-gestural source communicative bids, which means that the probability of repeating a communicative bid increases when the verbal production is accompanied by gestures. These results are very interesting to give a more complete explanation of the characteristics of child-directed speech. Goldin-Meadow et al. (2007) showed that adults labeled more frequently a verbal-gestural communicative bid than an unaccompanied verbal communicative bid, and this helped vocabulary development because it underlines word-referent relationships. In our data, adults also *repeated* children's communicative bids more often when they were multimodal, which may also reinforce these relationships.

The third research question was devoted to analyzing possible synergic effects of repetition and multimodal communicative behaviors on children's linguistic development. On the one hand, children's verbal repetitions were not related to children's vocabulary and grammatical level at any of the three points in development. This result is in line with previous research that suggests that the influence of children's repetitions is stronger at a time when they are building their first vocabularies and practicing their first multi-word sentences (Masur & Rodemaker, 1999; Stine & Bohannon, 1983), whereas they do not seem to be related to children's linguistic outcomes after the second birthday (Casla et al., 2021; Che et al., 2018). Our study started when children were already 21 months, and the results of the MCDI show that their vocabularies were stable enough to not need verbal repetition as much as in previous stages. Thus, gestural-verbal repetition is not directly related to vocabulary growth or grammatical achievements at each point of development.

On the other hand, we found, not only that at 21 and at 30 months were adults more likely to repeat children's verbal-gestural communicative bids, but also that these source communicative bids that children produced correlated positively with children's MLU. This result shows also that adults repeated those children who produced longer sentences during the recording session that we analyzed. It would be interesting to further analyze whether longer sentences are the ones that are more often repeated. Nevertheless, at 30 months, adults' verbal-gestural repetitions correlated significantly with children's morphosyntactic levels. This suggests that the relationships between adults' repetitions and children's grammatical development is stronger after the second birthday (presumably when they are already producing two-word expressions), and that children's verbal-gestural communicative bids are increasing the probability of being repeated. Therefore, the effects found in vocabulary, morphosyntax and MLU should be considered in relation to children's and adults' interactions and the way they match their verbal and verbal-gestural communicative bids.

Thus, it is not just repetition *per se* or multimodality *per se* that explains the correlation with children's vocabulary and grammatical growth, it looks as if it is the combination of both strategies. It is worth noting that children's verbal and verbal-gestural repetitions are not directly related to grammatical development, which has been previously found in the literature regarding two-year-olds' verbal repetitions (Che et al., 2018). Therefore, it could be that the feedback that adults provide to children's communicative bids (via verbal and verbal-gestural repetition, especially verbal-gestural source communicative bids) is more important than other variables that have typically been analyzed separately (Olson & Masur, 2015).

The present study shows the need to consider multicausal explanations for language development, going beyond isolated analyses of children's verbal production and taking into account nonverbal behaviors as well as adults' communicative behaviors during the interaction as factors (Hockema & Smith, 2009). Multimodal repetitions could be characterized as multisensory events (Suanda et al., 2016) that improve the quality of child-directed speech, given that our data show that these repetitions are synchronized with children's multimodal communicative bids. Therefore, the fact that children and adults coordinate their gestures and verbal behavior during development suggests that cognitive and linguistic development is also tied to motor development (Iverson, 2010), which is also related to brain and behavior development (Sheya & Smith, 2018).

As has been pointed out, adults adapt their verbal and gestural productions to children's communicative skills in responsive ways (Tamis-LeMonda et al., 2014; MacGuire et al., 2013; Rowe & Snow, 2020; Wray & Norbury, 2018). However, it is not just a unidirectional adaptation of adults' speech (Ma et al., 2011). Our data suggest that there is a coordination between adults and children in the modality of the speech that both produce and repeat. Our results show that adults and children repeat each other's source communicative bids using the same modality (the proportion of verbal-gestural repetitions of verbal-gestural source communicative bids was higher when compared to the proportion of verbal repetitions of verbal-gestural source utterances). Kuchirko et al. (2018) found that children and adults also synchronize their multimodal communicative behaviors at 14 and 24 months, and that children increase their responsive behaviors during the second year. Therefore, their results, and the results of the present study, suggest that responsiveness is not restricted to adults, and that children also coordinate their communicative behaviors to the type of communicative bid that they are exposed to.

Nevertheless, our study has some limitations that should be taken into account before drawing conclusions about the role of multimodal repetition on specific linguistic achievements. On the one hand, the correlations we found between verbal-gestural communicative bids and linguistic measures were weak, albeit significant, which was possibly due to the size of our sample. Further research should increase the sample size and longitudinally analyze the impact of the multimodal characteristics of source communicative bids.

On the other hand, we did not analyze the meaning of the gestures that were part of verbal-gestural communicative bids, and their relationship with words. The study of these relationships would shed light on the influence of verbal-gestural communicative bids on grammatical development (Goldin-Meadow et al., 2007; Murillo et al., 2015). In the same line, specific analyses of gesture-gesture, word-gesture and gesture-word repetitions will expand our understanding of child-adult multimodal responsiveness. These analyses should include the type of gesture and the way representational gestures are synchronized with verbal utterances (Murillo & Casla, 2021). Furthermore, the analyses of the type of gestures would shed light on the differences between pragmatic functions of adults' and children's verbal repetitions. Moreover, increasing the time of interaction beyond 15 minutes in different contexts, such as bath-time or meals would provide more opportunities to analyze these pragmatic functions.

Finally, previous research has shown that mothers' responses to the repetitions of unfamiliar words were more frequent than with familiar words, which provides more opportunities to be exposed to these words (Olson & Masur, 2012). Since verbal repetition and verbal-gestural repetition also increase the feedback provided to children's repetitions, further research could analyze the familiarity of the words and the structure of the repeated utterances.

In spite of these limitations, our study contributes to research in the field with new data in Spanish Language that allows for the possibility of crosslinguistic comparisons, and shows the need to consider both verbal repetition and verbal-gestural communicative behaviors simultaneously, as forms of interaction that are essential to language development. Our analyses provide a first step to a deeper understanding of different forms of imitation in language development from a multimodal point of view.

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