Journal of Child Language Acquisition and Development – JCLAD
Vol: 12 Issue: 1 963-987, 2024
ISSN: 2148-1997

Non-referential beat gestures and their function of self-repair in children's narratives

Received : 16.06.2023
Accepted : 14.02.2024
Published : 30.04.2024
DOI: https://doi.org/10.5281/zenodo.11542115

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Abstract

Since children have not yet finished acquiring their linguistic skills, failures in speech are common in their utterances. Thus, repairs are necessary to convey the intended message, but they can also be multimodal. If referential gestures emerge quite early during children's multimodal development, non-referential beats appear later, and they are usually known for their parsing, prosodic and focus-marking function, but they could also have hidden functions. Twenty-two French-speaking children between seven and ten years old were videorecorded while narrating a cartoon to their parents. Verbal and Multimodal Self-repairs were coded. Repairs were analyzed according to their type (lexical, phonological, and syntactic). Gestures were coded based on their nature (non-referential beats, referential and pragmatic gestures). Results show that beats were the most frequent type of gestures used by children during self-repairs, especially for lexical retrieval and syntactic utterance (re)construction. This highlights a new function of beats that we know very little of.

Keywords: gesture, non-referential beats, self-repairs, narratives, multimodality

1. Introduction

Since gesture and speech are considered to be two integral parts of the same underlying system (McNeill, 1992), during children's multimodal development they emerge and develop simultaneously although – for instance – children use pointing even before their first words (Goldin-Meadow, 2007). They later rely more on speech-gesture combinations in order to complete and to complexify their utterances (Capirci et al., 1996). Indeed, children produce iconic gestures around two years old, thus accessing to the referential and symbolic dimension of discourse while interacting with the adult (Behne et al., 2014; Özçalişkan & Goldin-Meadow, 2011), but the more they master the linguistic structures of their language the more they use different types of gestures. As they grow up, children improve their speech planning and studies show that non-referential beat gestures help children structure their discourse, especially during narratives (Graziano, 2009 ; Vilà-Giménez et al., 2019). Thus, children's use of beat

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gestures remarkably increases between five and ten years old, when cohesion and discursive structuring set the ground for more complex narratives (Colletta et al., 2015). However, at this age children do not fully master language as adults might, and their speech is marked by many moments of shifts from one project to another (Evans, 1985; Karmiloff-Smith et al., 1993). Therefore, repairs – either self-induced or signaled by the conversational partner – are quite common in children's speech. These transitional moments of readjustment have been mostly studied through on the verbal component of speech, but we know little about the way multimodality plays a role during repairs. Since beat gestures help plan and structure speech, not only at the lexical and syntactic level but also at the prosodic level (Levy & McNeill, 1992; McNeill et al., 2015), they could also contribute to formulate repairs in speech. In this exploratory study, we focus on multimodal realizations of self-repairs in typically developing French-speaking children aged between seven and ten years old. We hope to shed light on a seemingly forgotten function of beat gestures we know very little of.

1.1. Repairs

Repairs appear during failures in speech. They are defined by Schegloff et al. (1977:361) as 'correction by the speaker of that which is being corrected'. Levelt (1984) conceptualizes three stages of repairs during discourse elaboration: a failure occurs and the speaker or the listener realizes the error (*reparandum*); a silent or a filled pause (*editing term* within the *interregnum*) occurs right after; the error is repaired and replaced by the target form (*reparans*). According to who initiates and signals the repair sequence, repairs can be of two types: self-repairs and other-repairs (Schegloff et al., 1977; Schegloff, 2000). When the first type takes place, the speaker recognizes their incorrect production autonomously and tries to correct it, whereas the second kind is put forth by the interlocutor who – as Goffman (1955) would say in a pragmatic view – tries to save the speaker's negative face at the detriment of their own positive face. Other-repairs are usually overt clarification requests that allow speakers to rectify what they previously said, but the interlocutor can also implicitly recast, therefore correct, the speaker. This occurs especially in adult-child interaction during which children are sensitive to the adult's feedback and their cues for repairs (Clark & Chouinard, 2000; Clark, 2020). In child-directed speech, adult's repairs often occur after they hear a non-conventional form, and they try to lead the child to reach the appropriate form. Thus, adults can either explicitly signal the mistake to the child by overtly rectifying their production, or they can recast the child's construction in order for them to integrate it and re-use it later (de Pontonx et al., 2014; Garvey, 1977). Children generally repair their utterance immediately after being made aware of their non-conventional output or of the speaker's incomprehension (Konefal & Fokes, 1984). Moreover, if Schegloff et al. (1977) observed that other-repairs are found in a higher proportion during parent-child interaction, Morgenstern et al. (2013) found that the rate of self-repairs and other-repairs between two and five years old varies according the child's language development and socio-pragmatic conversational skills.

Moreover, repairs can occur during different types of speech failures (Levelt, 1984). For instance, they can be syntactic, which means that they occur when a change in the syntactic structure is made, thus modifying the way content is conveyed in the speaker's utterance in the speaker's utterance. They can also be associated with lexical 'damages', especially when speakers use 'wrong' words or do not find the target form to complete their sentence, and they often repeat the same linguistic unit several times as a 'stalling' mechanism in order to retrieve the correct word at the same time. Repairs can also be linked to non-conventional phonological forms. Studies show that lexical and syntactic repairs are more common than phonological ones (Clark, 1982; Levelt, 1984).

Repairs are also strongly linked to disfluency. During self-repair sequences, speakers can use editing terms such as discourse markers like 'I mean' or 'well' but also adverbs like 'no' or 'sorry', which serve as an overt repair-signaling function (Levelt, 1984). Implicit self-repairs are mostly linked to other types of discourse markers such as silent or filled pauses or word repetition (Bear et al., 1993), which are all different types of disfluency markers. Studies show that disfluent speech is often corrected through the verbal/vocal modality, but gestures also contribute to the fluency-resetting process. In this sense, Seyfeddinipur & Kita (2001) suggested that gestures are possible indicators of speech failures since they stop even before speech is interrupted and repaired right away, whereas Salonen & Laakso (2009) observed that gestures are produced after the verbal self-repair in order to signal it nonverbally and to guarantee the listener's alignment during this shift and change in the speaker's speech. The interplay between gesture and disfluency is especially strong in speakers actively exchanging in their second language (Kosmala, 2021). In particular, Hoshino (2013) found that iconic gestures have a pragmatic and interactive function during self-repairs and are also used by the speaker to signal the end of their conversational turn in order for the interlocutor to intervene.
Multimodal repairs in older children have yet to be systematically observed.

1.2. Known functions of beat gestures

Beat gestures are repetitive up-and-down movements generally produced on the vertical axis, with both hands (figure 1a), or just with the index finger held upwards (figure 1c), and sometimes with the entire torso (Leonard & Cummins, 2011). McNeill (1992:80) suggests a more formal definition of these gestures, as follows:

> *"typically biphasic, small, low energy, rapid flicks of the fingers or hand; they lack a special gesture space, and are performed indeed wherever the hands happen to find themselves, including rest positions" (McNeill, 1992:80)*

Amongst other findings, Bellifemine (2022) observed another form of beat gestures, in particular the use of head nods and head shakes by children (Figure 1b).

Figure 1. Different forms of beats (a: biphasic bimanual beat; b: head beat; c: index emphatic beat)

Head nods or 'nodding' are vertical up-and-down movements, whereas head shakes are left-to-right movements, that accompany 'yes' and 'no' segments (Kendon, 2002). If we consider these head movements without taking into account their conventional and emblematic meaning (affirmative or negative responses), they too – like beat gestures – can have a structuring function through their prosodic coordination with the rhythmic component of the utterance (Al Moubayed et al., 2009; Esteve-Gibert et al., 2017). Goffman (1955) and Goodwin (1979) studied the functions of head movements used to give affirmative and negative answers, and they suggested a backchannel function of these gestures, the goal of which is to signal to the interlocutor that we are listening. Thus, if we consider these gestures as beats, they can convey implicit meaning.

In addition, beat gestures are non-referential in nature, which means that, unlike deictic and iconic gestures, they do not convey semantic meaning – neither concrete nor abstract – but they rather have a parsing function. However, they too have a communicative and interactive metapragmatic role, especially when they signal shifts in topic and speech acts (Bavelas et al., 1995; McNeill, 1992; Prieto et al., 2018). Beat gestures are also closely linked to prosody, especially with pitch accentuation (Kendon, 1980) and they are usually synchronized with the prosodic prominence of their lexical affiliate (Esteve & Prieto, 2013). At the prosodic level, the stroke of a beat gesture generally coincides with, and sometimes precedes, the production of an accentuated syllable (Kendon, 1980). By simultaneously tangling beat gestures and certain vocal or verbal segments (between-words silence, filled pauses or pitch shifts), they highlight and emphasize a word or a phrase that the speaker considers important – thus necessary to mark multimodally – in their utterance (Allen, 2003; McNeill, 2005). Besides this focus-marking of salient and important segments, beats can also be used to oppose two different referents or concepts in speech, thus creating a contrast between alternatives and options (McNeill, 1985, 2014). This is the case for newly mentioned referents, introduced at the same time in speech (Im & Baumann, 2020).

One of the main differences between referential and non-referential gestures is the fact that the formers are based on mental representations, encoded characteristics and qualities of objects, actions and entities, whereas non-referential gestures do not originate from pre-established mental images. Iconic gestures allow speakers to activate or re-activate the

lexical form of a word, then its phonological output, and this retrieval is easily reached by producing complementary gestures in temporal anticipation to their lexical affiliate, as stated by Krauss et al. (1995, 2000). However, these authors only focused on referential gestures as carriers of spatial and motoric information as well as semantic features of the concept to be retrieved. For a long time the 'retrieving' role of beat gestures has not been linked to its possible function of facilitating lexical retrieval, based on the idea that they lack the semantic content otherwise conveyed by the hand configuration of a referential gesture, thus not being able to help in the retrieval of the target word (Krauss, 1998). More recently, some studies have come to link beat gestures to lexical access besides the facilitating action of conceptual planning, and they specifically highlighted the importance of using beat gestures in children's narratives (Igualada et al., 2017 ; Vilà-Giménez et al., 2019). Thus, beat gestures help improve discourse management while recounting a story. Lucero et al. (2014) also compared the role of beats and iconic gestures during word searching in a naming task in two different conditions: one in which gesture use was not allowed, the other where subjects were encouraged to gesture. Since iconic gestures require more time than beat gestures to be produced, the authors found a more beneficial effect of beats, which are faster, thus allowing faster lexical retrieval.

To our knowledge, there is not much research about the relationship between repairs and beat gestures. Only Cassel (1988), who examined five-to-eleven-year-old children's development of narrative and metanarrative skills in comparison to adults' storytelling, found that one quarter of the beat gestures produced by children co-occurred with repair sequences. However, she did not clearly examine what kind of repairs beat gestures accompanied. Our study aims at adding new insight on the matter.

1.3 Research questions

Repairs have a corrective function and can be signaled either by speakers themselves or by their conversational partner. Beat gestures have several functions, namely word recall, speech parsing and planning and focus marking. However, we know little about the function of these gestures during self-repairs, especially in children. Thus, we asked several questions:

- Are multimodal realizations of self-repairs used quite frequently by children or are verbal repairs preferred?
- Do non-referential beat gestures help children express self-repairs, therefore conveying to the conversational partner the metalinguistic process that is taking place in order for them to take into consideration the change in speech planning?

We hypothesize that, of all types of gestures, non-referential beats are indeed the most suited candidates to mark self-repairs in discourse, since they contribute to speech parsing more than referential gestures.

Our second goal was to determine which types of self-repairs were the most frequent in children's narratives, in order to specify the possible repairing function of co-speech gestures and, more specifically, of non-referential beats.

2. Methodology

2.1. Participants

Twenty-two French-speaking children (four girls and eighteen boys) from seven to ten (mean age: 8;9) participated in this study. They were all monolingual and never had issues in language development throughout the years.

2.2. Data collection and processing

Children were videorecorded while recounting a Tom & Jerry episode ('Hatch up your troubles') they watched on a computer moments before, to one of their parents. This excerpt has been used in other studies that focused on children's gestures (Colletta, 2004; Colletta et al., 2010, 2015), thus comparisons between findings can be easily made. In the videoclip an egg falls from its nest and rolls over to Jerry's house. Sleeping, the mouse is awakened when the egg rolls under it. When the egg hatches, a small woodpecker comes out of the shell and starts pecking all the wooden furniture inside the house. Jerry then gives the bird a piece of bread, which it eats, but soon after it keeps on pecking the remaining furniture. Jerry is now angry and decides to bring the woodpecker back to his nest, on the tree near its house.

2.3. Data analysis

We analyzed our data both quantitatively and qualitatively. Video recordings were transcribed in ELAN (Sloetjes & Seibert, 2016) and all occurrences of self-repairs and gestures were annotated.

2.3.1. Coding Repairs

We focused exclusively on children's self-repairs since not all parents actively interacted with children by asking questions or making comments. Moreover, we did not include in our analysis self-repairs that occurred at the beginning of the child's utterance, since this kind of disruption is more strictly associated to hesitation in speech planning. When repairs occurred, we annotated and coded them according to three main types, following Clark's (1982) as well as Bear and colleagues' (1993) labeling system:

- Phonological repairs, which occur after an incorrect phonological form of a word is produced and the child rectifies the word pronunciation and delivers the correct phonological form, as shown in example (5).

(1) Phonological repair – Vivien, 7 y.o.

MER4: à picorer?
MOT4: **to peck?**
ENF15: picorer toute la maison
CHI15: **peck** the whole house

- Lexical repairs, which occur during word searches and hesitations, or when incorrect forms are produced and are replaced by the correct output, and are signaled by the use of filled pauses preceding the right word, or repetition of the same word, as shown in example (6) and (7).

(2) Lexical repair – Arthur, 9 y.o.

et euh après donc elle regarde son ***euh son son réveil***
and hum after then it looks at its **hum its its clock**

(3) Lexical repair – Arthur, 9 y.o.

elle se retourne ce qui fait que l'œuf se met ***euh s(ous) à coté de Jerry***
it turns over so the egg places itself **hum un(der) next to Jerry**

- (Morpho)Syntactic repairs, which include recasts of verb agreement and verb structure, or signaling a change in sentence construction (i.e. example 8), as well as the repair of incorrect forms of subordinate markers such as relative pronouns misused in relation to the function of the subordinate clause based on its position in the utterance (i.e. example 9).

(4): Morphosyntactic repair – Hadel, 9 y.o.

et là l'œuf il va s'installer en dessous de Jerry
And then the egg it places itself under Jerry
et donc du coup (+) ***(en)fin bien sûr*** *il est toujours en train de bouger*
And then so (+) **I mean of course** it is still moving

(5) Morphosyntactic repair – Hanna, 9 y.o.

le euh (+) l'œuf il va tomber dans une fleur et la fleur elle est tellement légère
the hum (+) the egg is falling inside a flower and the flower it is so light
bah ***qui*** *[sub]* ***(+) qu'elle*** **[obj]** *descend*
well **that[sub] (+) that[obj] it** withers

Since we only focused on self-repairs, we did not include in our coding pragmatic repairs because they only occurred when the adult highlighted an incoherence in the child's pronominal use of referring expressions, therefore they were considered as other-repairs.

We also coded if the repairs were exclusively made by speech or also by gesture. Thus, two categories were established, namely VERBAL and MULTIMODAL repairs.

2.3.2. Coding Gesture

Gestures were coded according to three main types, following McNeill's (1992) as well as Kendon's (2004) and Müller and colleagues' (Müller, 2017; Bressem & Müller, 2014; Ladewig, 2011, 2014; Ladewig & Bressem, 2013) classifications:

- Referential gestures: this category includes iconic and metaphoric gestures on one hand, representing the shape, size and salient features of an object, reproducing an action, or embodying an abstract concept by metaphor analogy; and deictic gestures on the other, such as pointing and locative gestures that hold spatial relations to objects and referents in speech by anaphora.

- Non-referential gestures: otherwise beat gestures, that do not have any semantic relation to discourse units and linguistic segments but help structure speech through prosody and parsing.
- Pragmatic gestures, also called recurrent gestures, that have conventional forms as well as emblem-like meaning, such as the shrug, the palm up open hand, the cyclic gesture, the lexical search gesture but also other less observed types like the thinking gesture, the so-so hand gesture and the counting gesture.

2.4. Statistical analysis

Statistical quantitative analysis included non-parametric U tests (Mann & Whitney, 1947) and Chi-squared test (Kruskal & Wallis, 1952). We also used regression models to observe the weight and the interaction between each parameter considered in this study. Repair types and gesture types were submitted to inter-rater agreement and we found an almost-perfect agreement for these two categories (repair type: k = 0.83; gesture type: k = .91).

3. Findings

3.1. Repairs

Over a total number of 636 utterances, we identified 173 self-repairs. We then obtained a rate of self-repairs, that is 0.27, almost a self-repair per three utterances. Figure 1 below show the proportion of each type of self-repair.

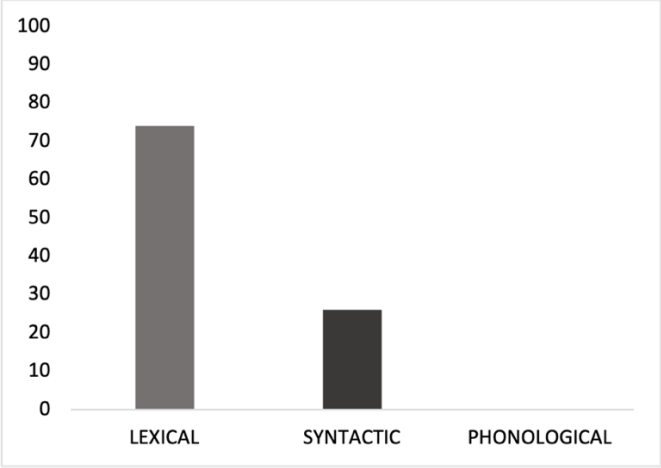

Figure 1. Proportion of self-repairs based on their type

Our findings show that phonological self-repairs were absent in our data. Children did not have any problems with mastering pronunciation, so they did not resort to this kind of correction. Moreover, lexical self-repairs (proportion: 74%, rate: 0.20) were more frequent than syntactic repairs (proportion: 26%, rate: 0.07). Statistical analysis showed a significant difference between the two types of repairs ($p < .0001$), confirming that lexical repairs were more frequent than syntactic repairs. Hesitation markers such as 'hum', 'well' and 'I mean' (*enfin* in French) were the most frequent units preceding the actual lexical repair through which children retrieved the target word. Not only hesitations were frequent, but word repetitions were also often used. In this way, children could take their time to mentally

(re)activate lexicon and find the word(s) they were searching for. As for syntactic repairs, they were mostly explicit: children gave repairs cues particularly through the discourse marker 'I mean' in cases where the sentence project was being completely changed. On the contrary, syntactic implicit self-repairs were mostly characterized by the repetition of the relative pronoun used to resume the utterance the child had already begun to produce.

Below we report an example of lexical self-repairs found in our data.

(6) Lexical self-repair – Hanna, 9 y.o.

ENF5: et donc du coup el(le) elle part et donc du coup après l'œuf il bouge
CHI5: and then i(t) it takes off and then after the egg it moves

ENF6: et euh bah il tombe euh enfin il fait une petite attraction je me souviens plus
CHI6: and hum well it falls **hum I mean** it does a little flip I don't remember it was at the beginning and then it falls
c'était sur le début et après il tombe

In (6) Hanna is describing the moment the egg starts hatching and falls down the nest after moving around it. After she says that the egg has fallen, she realizes she forgot the part when it rolled around the nest before falling. She immediately interrupts her first sentence and produces a filled pause ('uh') followed by an explicit self-repair expressed by the discourse marker 'I mean'. This transitional moment allows her to formulate a new structure, thus changing the event sequence and adding the omitted information, also explaining that she forgot this part because it happened at the beginning of the extract.

Although we did not focus on other-repairs, we found some occurrences in our data. In (7), Merwan is telling his mother that the egg has hatched and Jerry sees a woodpecker's legs while the rest of its body is hidden by the other half of the egg shell. The child uses a non-conventional noun phrase, 'the hat of the egg', instead of 'egg shell'. Thus, his mother corrects her son's lexical mistake and he accepts it by repeating the exact segment suggested by his mother.

(7) Other-repair followed by the child's repetition – Merwan, 7 y.o.

*ENF24: non la la petit(e) souris a enlevé son *chapeau euh (+) de l'œuf*
CHI24: no the the small mouse took off its *hat hum (+) of the egg

MER12: ***la coque de l'œuf***
MOT12: **the egg shell**

ENF25: la coque de l'œuf
CHI25: the egg shell

In (8), Vivien is telling her mother about the woodpecker causing trouble by pecking all the wooden furniture in Jerry's house.

(8) Other-repair followed by the child's recast – Vivien, 7 y.o.

ENF13: il a éclos et après il il i(l) et après il il a commencé (+) à picoter (+) tou:t
CHI13: it hatched and then it it i(t) and then it it started (+) to *pick (+) everything

MER3: à quoi?
MOT3: to what?

*ENF14: à à à *picoter*
CHI14: to to to *pick

MER4: à picorer?
MOT4: **to peck?**

ENF15: picorer toute la maison
CHI15: **peck** the whole house

Vivien uses a non-conventional phonological form of the verb 'to peck'. He replaces the phoneme /r/ with a /t/ which does not exist in French (*picoter). Her mother does not understand what her son is saying and she requests an overt clarification (MOT3). Vivien repeats the same phonological form, but now her mother seems to grasp its meaning, so she suggests the correct form ('to peck'). Since she is not exactly sure, she asks a question while offering the conventional form of the verb. Then, Vivien accepts his mother's repair and resumes his narrative by completing his utterance.

3.2. Gestures

We found 450 gestures in our data. On a total number of 636 utterances, the gesture rate for the group was 0.70, almost one gesture per utterance. Figure 2 illustrates the proportion of referential, non-referential and pragmatic gestures produced. Overall, children produced mostly referential gestures (proportion: 74.44%, rate: 0.52) in their narratives. The second most frequent type of gestures were non-referential beat gestures (proportion: 15.11%, rate: 0.10). Pragmatic gestures (proportion: 10.44%, rate: 0.07) were the least used type of gestures.

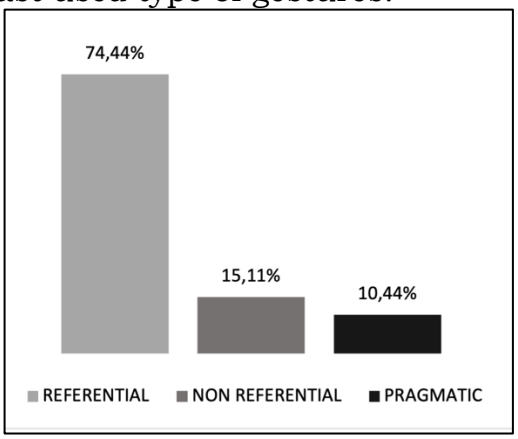

Figure 2. Gesture types produced during children's narratives

Statistical analysis shows that children were indeed sensitive to the way they conveyed information through gestures. Chi-squared tests showed a significant effect of the type of gestures used in children's narratives ($p < 0.0001$): we found a significant difference between the use of referential gestures and non-referential gestures ($p < 0.0001$), referential and pragmatic gestures ($p < 0.0001$), but not between non-referential and pragmatic

gestures (p = 0.11). This confirms our results: iconic gestures are more frequent than beat gestures, but beats are more frequent than pragmatic gestures.

3.3. Multimodal repairs

We then observed the rate of verbal self-repairs and multimodal self-repairs on the total number of utterances. Boxplots in Figure 3 below show the group general tendency.

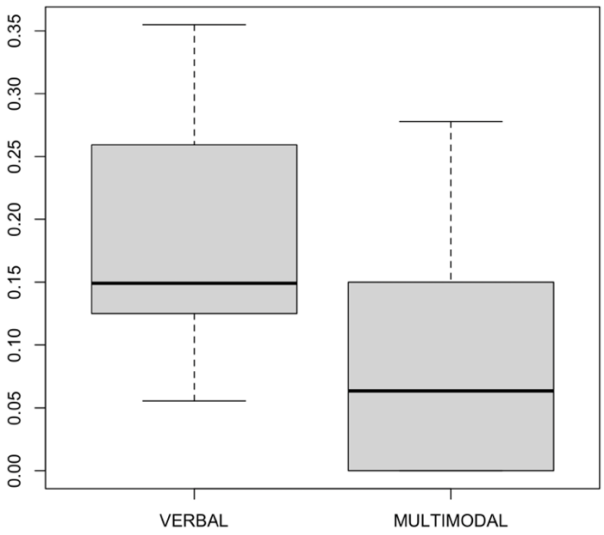

Figure 3. Rate of verbal and multimodal self-repairs

On a total number of 173 self-repairs, the majority of them were made throughout the verbal modality only (rate: 0.17), with a frequency of one repair per almost five utterances. Multimodal self-repairs were less frequent, that is around one repair per ten utterances (rate: 0.09). Statistical analysis showed a significant difference between verbal and multimodal repairs (p = 0.001), the first type being more frequent than the second. Moreover, since self-repairs are frequently conveyed by interjections and discourse markers (hum, uh, well, I mean…) expressing disfluent portions of speech (Levelt, 1984; Postma et al., 1990) it would be more common to find co-speech gestures with content words rather than this kind of vocal output.
We also sought to see which type of gestures occurred more frequently during multimodal self-repairs, as shown in Figure 4.

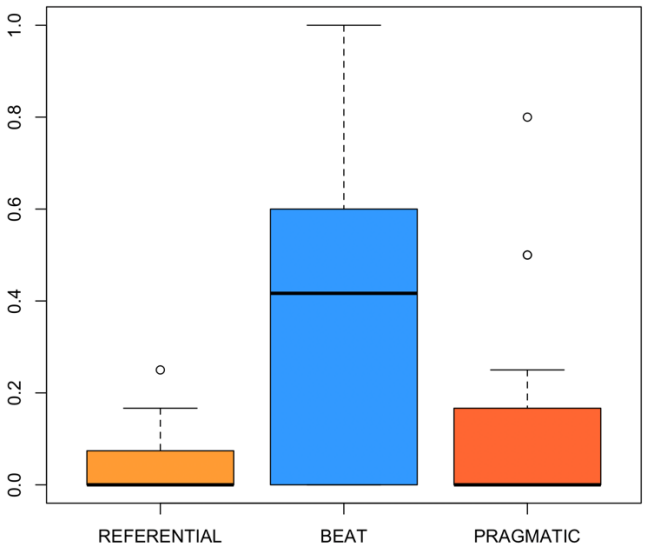

Figure 4. Types of gestures used during children's multimodal self-repairs

Non-referential beats are the most frequent type of gestures used during multimodal self-repairs: 31 occurrences out of a total of 61 multimodal repairs were beats, representing half of the cases observed (rate: 0.45). Moreover, on a total number of 68 beat gestures, almost half of them contributed to multimodal self-repairs, whereas the remaining 37 were used mostly for speech planning and for focus shift on new referents introduced or reintroduced in children's narratives. The second type of gestures more frequently associated with multimodal self-repairs were referential gestures (rate: 0.05): although they were the most used type throughout children's narratives (335 total occurrences), only 18 (15 iconic and three deictic gestures) out of the 61 total multimodal repairs of them were used for this corrective process. Finally, pragmatic gestures were the least used type in connection to multimodal self-repairs (rate: 0.25): only 12 occurrences, out of the 61 speech-gesture repairs and out of a total absolute number of 47 pragmatic gestures, were used by children to correct their utterance and its content. Half of them were palm up open hand gestures (six in total), only two of them were lexical search gestures, three of them were thinking gestures and only one of them was a so-so gesture.

Chi-squared analysis showed a significant effect of the type of gesture used in multimodal self-repairs ($p = 0.01$). Indeed, U tests confirmed that non referential beat gestures were more frequent than referential gestures ($p = 0.007$) as well as pragmatic gestures ($p = 0.01$), whereas no significant difference was found between referential and pragmatic gestures ($p = 0.95$). Thus, we can conclude that referential gestures have a more symbolic function used to convey semantic content to reinforce speech, whereas non-referential beat gestures have rather a grammatical and metalinguistic function that helps the speaker structure their speech. Pragmatic gestures have both functions, since they can convey a semantic meaning but they also structure speech throughout their rhythmic and prosodic component.

The last type of analysis we conducted focused on the type of repairs each type of gesture was related to. Thus, we calculated the rate of phonological, syntactic and lexical multimodal self-repairs for the total

number of each type of gestures produced during repairs. Figure 5 shows our results.

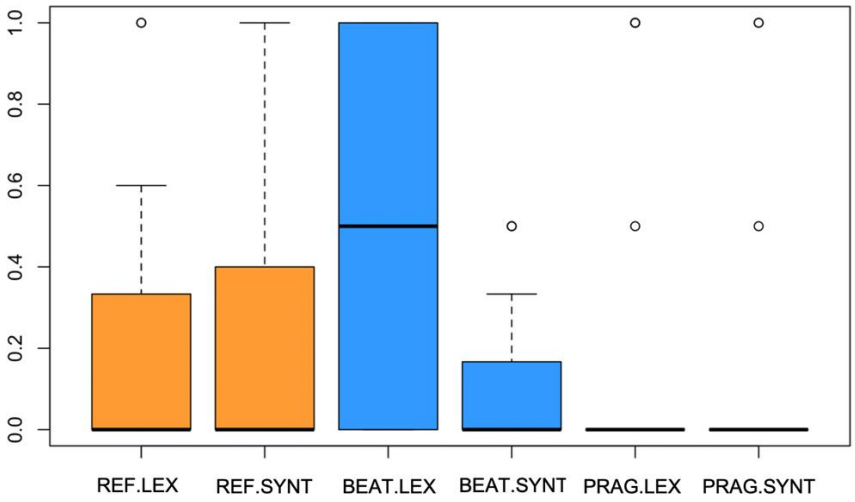

Figure 5. Rate of children's multimodal self-repair types (phonological, syntactic, lexical in referential, non-referential, pragmatic gestures)

With regard to the types of gestures used for each self-repair category, we found several phenomena. First, we did not find any differences linked to the type of self-repair for pragmatic gestures. Finer analysis showed that the same sub-group of children used pragmatic gestures for syntactic (rate: 0.66) as well as lexical (rate: 0.33) self-repairs, therefore statistical analysis was not conclusive ($p = 0.06$). Secondly, there was a significant effect of the type of self-repair occurring with referential gestures ($p = 0.02$): referential lexical repairs were more frequent than phonological repairs ($p = 0.009$), but syntactic repairs were also more frequent than phonological ones ($p = 0.0009$). This is not surprising since there were no phonological repairs. However, U tests did not show any significant difference between referential syntactic and lexical repairs ($p = 0.98$).

As for non-referential beat gestures, there was a significant effect of the type of repair on the use of beats ($p < 0.0001$). U tests confirmed that non-referential lexical self-repairs were more frequent than phonological ($p < 0.0001$) and syntactic non-referential repairs ($p = 0.004$). Furthermore, although expected, there was a significant difference between phonological and syntactic non-referential repairs ($p = 0.009$), since phonological repairs were absent in our data. In other words, besides the parsing and discourse structuring function of beat gestures, we found that they also helped lexical retrieval and had a repairing function during speech failures.

Moreover, we found a significant effect of the type of gestures used in multimodal lexical self-repairs ($p = 0.02$). Indeed, non-referential beat gestures were used more frequently for this type of repair than referential gestures ($p = 0.03$) but they were also more used than pragmatic gestures ($p = 0.03$). On the contrary, we did not find any significant difference between the use of referential and pragmatic gestures ($p = 0.91$), nor did we find a significant effect of gesture type on syntactic self-repairs ($p = 0.32$). This would mean that not only beat gestures have a predominant role in

word finding and speech planning, but they also contribute to children's corrections and recasts in case of speech failure. Examples (9), (10) and (11) illustrate how children rely on multimodal non-referential self-repairs.

(9) Arnaud, 10 y.o.

et bah ça l'embête Jerry et. ***(+) après*** *elle essaie de elle euh*
and well it bothers Jerry and **(+) after** it tries to it uh
[BEAT]
l'oiseau part directement ***(+) pour euh casser*** *du bois dans la maison du coup les*
the bird leaves suddenly **(+) to uh break** some wood in the house so the
[LOC] [ICO] [BEAT]
meubles les lumières euh les murs
furniture the lights uh the walls

Figure 6. Non-referential beat gestures accompanying lexical self-repair in verb retrieval

In (9) Arnaud, a ten-year-old boy, is recounting the cartoon sequence during which the little bird pecks all the wooden furniture in Jerry's house. His first beat gesture occurs after a coordination marker (*et*, 'and') and a silent pause, after which the child produces another coordination element (*après*, 'then') synchronized with the beat in Figure 6a. This gesture is made with both hands, the palms facing one another, and the fingers held downwards touching his legs. This first repair helps Arnaud find the words to structure his coordinate clause linked to the subject of the main clause, Jerry. Another speech failure takes place soon after, when the boy does not seem to complete at first glance the infinitive clause linked to the verb 'to try' (*elle essaie de elle euh*). A syntactic repair occurs, since Arnaud changes his sentence project and resumes his storytelling through a new independent clause accompanied by referential gestures, namely a deictic locative gesture and an iconic one. When Arnaud tries to structure a new infinitive clause expressing the goal and the reason why the little bird 'leaves suddenly', he briefly hesitates. The hesitation is for the choice of the verb, which turns out to be the verb 'to break', preceded by a pause filled with a discursive marker ('uh'). As the child produces a new beat gesture, by lifting his right arm and then lowering it in an up-and-down movement and bringing his right hand in his left hand (Figure 6b), he expresses the verb in his speech. Thus, the beat gesture would mark, within the utterance, the repair characterized by his hesitation in the lexical choice of the verb.

Journal of Child Language Acquisition and Development – JCLAD
Vol: 12 Issue: 1 963-987, 2024
ISSN: 2148-1997

In (10), we can see ten-year-old Eva recounting to her mother the cartoon sequence where Jerry climbs up the tree next to its house in order to take the little woodpecker back to its nest.

(10) Eva, 10 y.o.

elle monte et elle pose le nid euh elle pose le euh ***le bébé pic*** *dans le nid*
it climbs and she lays the nest uh it lays the **uh the baby woodpecker** in the nest
[ICO] [ICO] [BEAT] [BEAT] [LOC]
et elle lui remet sa couverture
and it covers it with its blanket
[ICO]

Figure 7. Non-referential beat gesture accompanying lexical self-repair in noun retrieval

At the gestural level, referential gestures are used not only to place referents around the child's visual space, where she assigns entities specific positions in order to oppose them through deictic gestures, but they are also used to reproduce the actions performed by the characters in the story, as shown by the iconic gesture Eva uses in coordination with the verbs "to climb" and "to lay". The non-referential beat gestures produced reinforce and emphasize certain linguistic elements conveyed through speech. Moreover, they help the structuring and cohesion of the story, as well as the establishment of intersubjectivity with her interlocutor. The first beat is produced during a moment of uncertainty expressed by the discourse marker 'uh' (Figure 7a and 7b), when she realizes she made an error in the choice of the referent mentioned in her coordinate clause. The beat, performed in a downward movement, helps the girl visualize her self-repair so that she can signal it to her mother, who may not have understood who does what and where. When this first self-repair is done, Eva fills a pause with another 'uh' and then produces a second beat gesture synchronized with the noun phrase 'the baby woodpecker' (*le bébé pic*) and redirects her mother's attention to the new and exact focus of her sentence, which is not the nest but the woodpecker (Figure 7c).

The third and final example shows how hand and head beat gestures can be coordinated. Here, nine-year-old Arthur is recounting the first sequence of the cartoon and is describing the moment the mama-woodpecker is about to leave the nest to look for food.

(11) Arthur, 9 y.o.

et euh après donc elle regarde son euh son son réveil
and hum after then it looks at its **hum its its clock**
[handBEAT][headBEAT]

Figure 8. Hand and head non-referential beat gesture accompanying lexical self-repairs

A lexical self-repair is observed in the sequence, when Arthur starts assembling in his speech the noun phrase 'its clock' (*son réveil*) composed of the possessive determiner and the substantive. After pronouncing the determiner 'its', Arthur produces a filled pause ('uh') followed by the same linguistic unit which is repeated twice. During this repetition, the boy produces a complex non-referential beat gesture composed of a head beat and a left-hand beat synchronized together: the boy's head is lifted upwards, whereas his hand – almost held in a palm up configuration – is moved downwards, as shown in Figure 8. Thanks to this head-hand configuration, Arthur retrieves the word he is looking for, namely the 'clock'. This example shows that beat gestures are not only produced with the hands but also with head movements and together they contribute to the lexical phrasing of children's speech. McClave (2000) found the same lexical retrieval function of head movements in her data, with the only exception that lexical repairs co-occurred usually with horizontal head movements such as head shakes which she considered to have an 'erasing' or 'swiping-away-the-error' function of the incorrect output.

These three examples are representative of the children's multimodal self-repairing behaviors in our study: statistical Chi-squared analysis showed a significant effect of the type of lexical affiliate non-referential beat gestures accompanied during self-repairs ($p < 0.0001$). Indeed, finer analysis showed that nouns (48.38%) and verbs (22.58%) were more frequently retrieved in the repair process than the other types of words (6% of adverbs, prepositions and discourse markers; 0% of adjectives and pronouns). However, this result has to be nuanced since we know that nouns and verbs are the most common classes of words used in speech.

Finally, a generalized mixed model confirmed a significant effect of the use of beat gestures during multimodal self-repairs ($p < .0001$), that syntactic repairs are less frequent than lexical repairs in children's narratives ($p = 0.01$).

Table 1
Generalized mixed model showing the factors influencing multimodal repairs

Fixed Effects	Est*	S.E.	z	p	Random Effects	Var.	S.D.	C-Value
Multimodal Repairs								0.97
Intercept	-1.4118	0.4260	-3.314	.0009	Children	1.2121	0.4605	
Repair Type: Syntactic	1.5127	0.6197	-2.441	.01				
Gesture Type: BEAT	4.3048	0.8587	5.013	5.35e-07				

*Est.: Estimate; S.E.: Standard Error; Var.: Variance; S.D.: Standard Deviation.
N° observations: 188, Group: Children (22)

4. Discussion

The goal of this exploratory study was to determine whether non-referential beat gestures have a systematic function in seven-to-ten-year-old French speaking children's self-repairs. We observed children's narratives of a Tom & Jerry episode. The choice of the task was based on the fact that children had to recount a story without the visual support, but only trusting their mnemonic skills and their cognitive abilities to process information. Moreover, narratives are a complex discursive genre, especially in interaction, because the speaker has to take into consideration their conversational partner's shared knowledge, thus establishing common ground.

As far as self-repairs are concerned, children did not produce any phonological repair. This finding indicates that seven-to-ten year-old typically developing children do not struggle with the phonological aspect of language, which is usually still the case for younger children, as previous studies highlighted (Morgenstern et al., 2013). Indeed, phonological repairs have been found to already decrease at the age of four (Salonen & Laakso, 2009). Moreover, lexical self-repairs were more frequent than syntactic repairs and this was confirmed by statistical analysis. Thus, children struggled more with finding the right word to complete their utterance rather than the actual speech planning of the sentence, as observed in previous study on younger children (Clark, 1982; Salonen & Laakso, 2009).

As for gestures, it is known that children, as well as adults, mainly use referential gestures during narratives (Alamillo et al., 2013; Levy & McNeill, 2013; McNeill & Levy, 1982; So et al., 2013). Overall, our findings align with these results. In particular, iconic gestures are used to represent features of the referents mentioned in speech as well as the characters' actions (Colletta & Pellenq, 2005; Stites & Özçalışkan, 2017). The second most frequent type of gestures were non-referential beat gestures: this is in line with children's developmental multimodal trajectory, since they start to master these gestures around five years old and their use enhances narrative performance speech planning (Rohrer et al., 2022; Vilà-Giménez et al., 2020, 2021; Vilà-Giménez & Prieto, 2020). Pragmatic gestures were the least used gestures: since they have two main functions, namely an interactive function (Bavelas et al., 1992) and a stance-taking function (Debras, 2013, 2015) we can explain this result in two ways. First, children's narratives were not really co-constructed with their parents. The child recounted the story without

addressing backchannel or questions to be certain of their parent's understanding of the story, thus the interactive component was less present during the task. Second, stance-taking is a slow developmental process acquired by children with time (Mills, 2013).

We hypothesized that children would oftentimes use multimodal occurrences of self-repairs. This was partially confirmed in our study: often, not always, self-repairs were accompanied by gestures and, therefore, they were multimodal. As Morgenstern et al. (2013:162) stated, since interaction is multimodal, the child also uses nonverbal cues during repair sequences, in order to be sure of their interlocutor's comprehension. In our data, self-repairs were mostly expressed verbally: this could be explained by the fact that we observed older children than those observed in Morgenstern and colleagues' study. Moreover, if verbal self-repairs are conscious and intentional (Levelt, 1983, 1984), and children are sensitive to their conversational partner's discursive alignment, gestures are not: they are spontaneous unintentional nonverbal configurations that actively participate in discourse construction, and they are less likely to be the sole intentional means of self-repairs. It is also possible that multimodal repairs are not only made by gesture-speech orchestration, but by other nonverbal resources such as gaze or postural changes which we did not take into account in this study. When self-repairs occur, the cognitive load is perhaps too demanding for speech to be used alone and, while children are (re)constructing and changing utterances and linguistic units, gestures help not only in the retrieving process but they are also important in communicating to the listener that a shift is taking place. Thus, even though repairs are self-induced, gestures and the verbal and vocal component of the disfluent sequence are probably selflessly expressed for the conversational partner. Furthermore, unlike what Seyfeddinipur & Kita (2001) found – that is gestures stop before repairs – our study showed that gestures are actually synchronized with self-repairs, in accordance to what has been found in Salonen & Laakso's (2009) study.

We also hypothesized that, of all types of gestures, non-referential beats could be the most suited candidates to mark self-repairs in discourse. Since they have not only a rhythmic and prosodic function, but they also contribute to speech parsing more than referential gestures, their role in self-repairs could be at the crossroad between the grammatical and the semantic-lexical dimension of discourse. If we consider the fact that children's narratives were mostly characterized by the use of referential gestures, our findings highlight a potential new function of non-referential beat gestures, as previously stated by Cassel (1988). Overall, if the main function of gestures during narratives is to embody actions and story characters by portraying nonverbally their movements and their features, in our study the function of the gestures used in multimodal self-repairs was to help children convey not only the metalinguistic process of correction taking place during speech, but also semantic and lexical content expressed both verbally and nonverbally in repair sequences. This is the case for referential gestures, which were second in line in children's multimodal self-repair instances. In other words, children did not show a specific use of referential gestures during multimodal self-repairs as shown in previous studies

(Finlayson et al., 2003; Hostetter & Alibali, 2004; Kita et al., 2017). On the contrary, non-referential beat gestures were the most used type of gestures during this process. If we take into account that cognitive-driven studies focused mainly on iconic gestures to shed light on their role in lexical access (Krauss et al., 1995, 2000) and speech planning (Kita, 2000), the beat gestures analyzed during self-repair sequences in children's narratives significantly increased, more than referential gestures, the lexical retrieval of words during speech. Moreover, significant differences were also found as for the use of beat gestures during syntactic utterance (re)construction, modification and/or recast. This result confirms the role non-referential beats have in enhancing cohesion and coherence in narrative discourse (Colletta et al., 2015; Vilà-Giménez et al., 2021; Vilà-Giménez & Prieto, 2020) but puts forth a rather riveting communicative value of these gestures, as stated by Prieto et al. (2018) in their function labeling of non-referential gestures.

Again, our study is exploratory and more can be done. For instance, it would be interesting to systematically analyze other-repairs and compare them to self-repairs through the multimodal approach we adopted for this study. If the same results were to be found as far as beat gestures are concerned, this comparison could confirm their interactive and communicative function of signaling and visualizing nonverbally repair sequences in reaction to the listener's perception of disfluent or non-conventional segments in children's speech. It could also be interesting to compare two different types of activities, or more precisely two types of narratives: in this study we focused on cartoon narratives, but we could draw a comparison with narratives of personal experience during spontaneous adult-speech interaction and, by doing so, monological discourse could be opposed to co-constructed dialogue. In this case, other-repairs during spontaneous conversation could be more frequent than during cartoon retelling. Another comparison could be made between typically developing children and children with developmental language disorder. Studies show that children with DLD use more gestures than controls (Mainela-Arnold et al., 2014), they are also more disfluent (Befi-Lopes et al., 2014; Miranda et al., 1998) but are also known for using less non-referential beat gestures and more iconic gestures (Bellifemine, 2019; Blake et al., 2008). It is possible that these children resort to more multimodal self-repairs but, since they use more iconic gestures, either referential gestures have a more important role in DLD children's repair sequences, or the few beats they produce are indeed used for self-repairs. Additionally, we know that children with DLD struggle with lexicon (Leonard & Deevy, 2004) as well as syntax (Bellifemine, 2022; Bishop & Donlan, 2005), therefore the types of multimodal repairs could be more diverse than those found in the present study. Investigating this lead could also add new information on gesture use for clinical intervention and speech therapy.

5. Conclusion

In conclusion, speech failures can be adjusted, revised and rectified both verbally and nonverbally, thus confirming the strong relation between speech and gesture during different moments in conversation and

communication. Non-referential beat gestures are especially useful for lexical and syntactic (re)adjustment and the retrieval of linguistic units during discourse elaboration, but we have yet to fully understand their communicative potential.

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