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Gesture correction in children

Kazuki Sekine

National Institute of Informatics, Tokyo Japan
sekine@nii.ac.jp

Abstract

Speakers sometimes modify their gestures during the process of production into disguised adaptors. Such disguised adaptors can be treated as evidence that speakers can monitor their gestures. This study investigated when disguised adaptors are produced in Japanese elementary school children. The results showed that children did not produce disguised adaptors until the age of 8. The emergence of disguised adaptors suggested that children start to monitor their gestures when they are 9 or 10 years old. Cultural influences and cognitive changes were considered as factors to influence emergence of disguised adaptors.

Index Terms: spontaneous gestures, adaptors, speech error

1. Introduction

Researchers have examined the development of gestures in children in terms of how their frequency or repertoire increases with age, and when the relationship between a gesture and speech is established semantically and temporally in the developmental process. They have revealed that gestures start synchronizing with speech semantically and temporally during the one-word speech period, and that the frequency and types of gestures change with language development, suggesting that they form a single integrated system since this period (Goldin-Meadow & Butcher, 2003; Mayberry & Nicoladis, 2000; McNeill, 1992). However, research has not shed light on when children start monitoring their gestures, and become aware of gestures as information resources that their listeners can make use of.

Studies on self-repair in speech have asserted that to correct one's speech, the speaker has to monitor his or her speech process continuously, and thus, correction of speech errors is considered to reflect the speaker's ability to monitor speech (Karmiloff-Smith, 1986; Cazden, Micheals, & Tabors, 1985). Based on this assumption, it seems that determining when children start to correct their gestures would provide insight into understanding when they start being aware of their gestures. However, unlike speech in which the message is delivered by aligning linearly linguistic elements that exist independently, a gesture conveys a meaning globally at once, and any decomposition into elements is dependent on the whole (McNeill, 2005). Because of the linearity in speech, it is easier to understand where speech errors occur and how the speaker can correct them than errors in gestures. In contrast, gestures are mostly continuous and some of their parameters changes simultaneously. This makes it difficult to determine whether a gesture has been corrected by a speaker or to detect when the speaker has corrected a gesture. Considering these differences in semiotic characteristics, this study focused on a specific type of gestural correction; i.e., disguised adaptors.

Sometimes in adult conversations a speaker stops making a gesture in the middle of production and switches to an adaptor, such as touching one's hair or adjusting one's glasses. Such movements may be socially preferable. In this study, this kind of behavior is termed a *disguised adaptor*. A disguised adaptor is defined as a gesture that is altered into an adaptor before or during the stroke phase of the gesture. If typically developing children can perform this kind of correction, it is evidence that they can monitor their gestures. If they already know that gestures can be read as information by their listeners and they can detect errors in their gestures or speech for some reason, they may try to modify their gestures into more acceptable ones, such as scratching the neck or wiping the lips.

Suppose that gesture and speech interacts in the production process (McNeill, 1992), then, gestural correction may affect or be affected by speech errors or dysfluencies. Thus, the relationship between disguised adaptors and speech errors should be investigated. Karmiloff-Smith (1986) found that the percentage of repairs denoting sensitivity to the linguistic system, such as the determiner functions of articles, adjectives and possessives, increased during the elementary school period. Given this finding, it is predicted that the number of disguised adaptors also increases during this period. In addition, if disguised adaptors are due to difficulties in retrieving words, they would co-occur with filled pauses, unfilled pauses, or speech errors, rather than with intact linguistic elements, because previous studies have shown that adaptors tend to occur with speech dysfluencies while the speaker is retrieving words (Fujii, 1997; Pike et al., 2007). If a disguised adaptor does not co-occur with speech dysfluencies, it may be related to other factors such as cultural or cognitive factors. Otherwise, view on gestures during speech in a Japanese class room or the cognitive capacity to produce or inhibit gestures may influence the emergence of disguised adaptors.

Thus, the emergence of disguised adaptors implies that children are aware that their gestures can be used as informational resources by their listeners and that they can monitor their own gestures. Under this hypothesis, this study examined when disguised adaptors emerge during the elementary school period and how this emergence is related to speech.

2. Method

2.1. Participants

Sixty elementary school children and their parents participated in this study. There were ten children from each grade (1st through 6th grade); half were boys, and half were girls. In this study, I shall refer to the different groups of children by their age, rather than by their grade, based on the average age of each grade. Those in 1st grade are referred to as 7-year-olds (mean age 6;11, range 6;5-7;4), in 2nd grade as 8-year-olds (mean age 7;11, range 7;6-8;10), in 3rd grade as 9-year-olds (mean age 9;4, range 9;0-9;6), in 4th grade as 10-year-olds (mean age 10;0, range 9;7-10;5), in 5th grade as 11-year-olds (mean age 11;4, range 10;9-11;11), and in 6th grade as 12-

year-olds (mean age 12;0, range 11;5-12;10). All the participants were native monolingual Japanese speakers from middle-class families, and the children attended public or private elementary schools in Tokyo, Japan.

2.2. Materials and Apparatus

Each child watched a seven-minute animated color cartoon of the Tweety and Sylvester series, titled 'Canary Row' (Warner Brothers, Inc.). The cartoon consisted of eight scenes, and in each one, *Sylvester the Cat* attempts to catch *Tweety Bird* in a different way. This cartoon was displayed on a 14-inch color computer monitor (Panasonic CF-F8). A mini-DV camcorder (Sony HDR-HC9) was used to record the children's gestures and speech.

2.3. Procedure

The experiments were conducted in a quiet room in the participant's home or a local community center. At the beginning of the experiment, the child and the child's parent were told by an experimenter that the purpose of this research was to study a person's memory. The child would have to remember the cartoon story shown on the computer monitor and retell it to the listener (parent) in as much detail as possible. The child watched the entire cartoon once. Next, (s)he was instructed to watch the first half of the same cartoon twice in order to more clearly remember the scenes and then tell their parent what they had seen. While retelling the cartoon, the child was seated in a different location from the one in which (s)he viewed it. The parent was not allowed to ask any questions or provide any prompts such as 'Then?' or 'Next?' unless the child appeared to be stalled or distracted. They were allowed to respond to the child by nodding their head or by using back channels during the child's narration. Immediately after the first half of the episode was retold, the child repeated the procedure for the second half of the story. The whole session, including the instructions, was recorded using the mini-DV camcorder on a tripod. The narratives of the first and the second halves of the story the child told were combined and analyzed.

2.4. Coding

Speech data. The first author transcribed all the narratives verbatim. From the transcriptions, the *mean number of clauses* was then calculated. A clause was loosely defined as a combination of a noun phrase and a verb phrase. The *mean number of unfilled pauses*, which was defined as periods of silence longer than 200 msec., *filled pauses*, such as 'unttoo' (umm) or 'eeetto' (ehhh), and *speech errors*, including repetitions, replacements or false starts, were measured in order to ascertain the relationship between speech fluency and production of gestures.

Gesture data. First, the spontaneous gestures were identified. Hand movements were classified as gestures only when they had an identifiable beginning and a clear end and were synchronized with speech. After identifying which movements were gestures, the total number of gestures was counted. Next, *disguised adaptors*, i.e., gestures that are altered into adaptors before or during the stroke phase, were identified.

3. Results

The analysis was conducted as follows. First, the number of gestures, clauses, pauses, and speech errors were calculated. Next, the relationship between the age of the children and their production of disguised adaptors was examined. Finally, the relationship between disguised adaptors and the fluency of speech accompanying them was analyzed. Because children's gender did not affect any of the results, the data was analyzed without regard to gender differences.

3.1. Number of gestures, clauses, pauses, and speech errors

To calculate the frequency of gestures and the proportion of unfilled pauses for each age, the total number of gestures and the total amount of time spent for unfilled pauses were divided by the total speaking time. To calculate the frequency of filled pauses and speech errors, the total number of filled pauses and speech errors were each divided by the mean number of clauses.

After performing an arcsine transformation on the proportion of unfilled pauses in the speaking time, an ANOVA was conducted on the gesture frequency, the mean numbers of clauses, and the proportions of unfilled pauses, filled pauses, and speech errors (Table 1). A main effect of age group was found for the gesture frequency, F (5, 54) = 3.86, p= .005, the proportion of unfilled pauses in the speaking time, F(5, 54) = 2.44 p= .046, and the proportion of speech errors in clauses, F(5, 54) = 2.49, p= .042. A post hoc comparison (Tukey, $p < .05$) showed that 12-year-olds produced gestures more frequently than 7-, 9- and 10-year-olds did and that the proportion of unfilled pauses during the speaking time was significantly greater for 7-year-olds (47%) than for 12-year-olds (33%). There was no significant age-group difference in the total number of clauses or frequency of filled pauses. These results indicate that the proportion of unfilled pauses gradually decreases during the elementary school period, whereas the frequencies of gestures and speech errors increase in the late elementary school period. However, the number of clauses did not significantly change during this period.

Table 1: *The Number of Clause, Gesture, Pause, and Speech Error*

Age	7	8	9	10	11	12
Frequency of gestures per second	0.12 (0.06)	0.14 (0.09)	0.10 (0.09)	0.09 (0.06)	0.19 (0.13)	0.27 (0.17)
Total number of clauses	62.4 (29.93)	69 (20.42)	77.8 (24.68)	77.3 (15.58)	91.9 (20.90)	78.6 (19.47)
Proportion of unfilled pause in speaking time	0.47 (0.19)	0.40 (0.11)	0.38 (0.08)	0.34 (0.06)	0.36 (0.08)	0.33 (0.08)
Filled pause per clause	0.38 (0.25)	0.29 (0.17)	0.26 (0.07)	0.39 (0.31)	0.31 (0.18)	0.25 (0.10)
Speech error per clause	0.26 (0.15)	0.20 (0.10)	0.21 (0.12)	0.38 (0.19)	0.28 (0.11)	0.36 (0.20)

3.2. Number of children who produced a disguised adaptor

In total 22 disguised adaptors were observed. The absolute number of disguised adaptors produced by each age group was three times for 9-year-olds, three times for 10-year-olds, twelve times for 11-year-olds, and four times for 12-year-olds. Three 9-year-olds, three 10-year-olds, five 11-year-olds, and two 12-year-olds produced a disguised adaptor at least once during their narrations. There were no 7- or 8-year-olds who produced disguised adaptors (see an example in Figure 1). A Fisher's exact test was used to examine the relationship between the age of the group and the number of children who produced disguised adaptors. There was a significant association between them (Fisher's exact test, $p = .03$). A residual analysis was conducted to find out where the significant differences among age groups were. The analysis indicated that 11-year-olds produced disguised adaptors more often than the other age groups did.

(1) (2) sono (3)sagasi ni

[de **mita** **mi**ta nekotan] ttsutte: sorede [(1) (2)sono]
and see.PAST see.PAST cat say-and then INJ
'and (he) said that (I) saw saw the cat, then'

(3)sagashi ni itta tokoro wa: inu: toka neko no omise
find DAT go.PAST place TOP dogs and cats GEN shop
'the place where (he) went to find it was a shop of dogs or cats'

Figure 1*: A disguised adaptor in an 11-year-old girl*

3.3. Temporal relationship between speech and a disguised adaptor

In all disguised adaptors observed in this study, the beginning of the preparation phase of a gesture that ended up a disguised adaptor preceded the beginning of linguistic elements that accompanied the disguised adaptor.

To see whether disguised adaptors were related to word searches, disguised adaptors were classified into two groups in terms of speech fluency. If a disguised adaptor co-occurred with speech error or (un)filled pause, it was categorized as *dysfluenct speech combination*. If it synchronized with intact speech element, it was categorized as *fluent speech combination*. The number of children who produced each combination was counted for each age group.

Three 9-year-olds, three 10-year-olds, three 11-years-olds, and one 12-year-old produced fluent speech combinations. Five 11-year-olds and one 12-year-old produced dysfluent speech combinations. No children aged 9 or 10 produced dysfluent speech combinations. A Fisher's exact test was used to examine the relationship between age group and each combination. A significant association was found only in the dysfluent speech combination (Fisher's exact test, $p = .002$). In contrast to the fluent speech combinations produced by 9- to 12-years-olds, dysfluent speech combinations were not produced by 9- and 10-year-olds, and all of 11-year-olds produced dysfluent speech combinations.

4. Discussion

Research on the development of gestures in children has mainly focused on the frequency or repertoire of gestures as an index of development. Only looking at the increase in the range of gestures may not be enough to reveal when children become aware that their gestures are an informational resource. To tackle this problem, this study investigated disguised adaptors as an index of a child's ability to monitor his or her own gestures by focusing on the relationship between disguised adaptors and speech flow.

The results showed that the gesture frequency and the proportion of speech errors increase with age, especially in the late elementary school period, whereas the proportion of unfilled pauses decreases with age. The increase in speech errors suggests that children tend to dedicate much effort to planning coherent narratives especially from the age of 10. Considering pauses may reflect cognitive processes underlying speech planning including word search, syntax, conceptual and articulation planning (Schönpflug, 2008), it is considered that children gradually acquire the ability to plan speech quickly during their elementary school years. The fact that gesture frequency increases and unfilled pauses decrease during this period implies that producing gestures facilitates speech production by helping the child to retrieve a word or plan a sentence. This speculation is partly supported by previous studies showing that gestures help a speaker to retrieve words or to make conceptions (Krauss , Chen, & Gttoesman, 2000).

In this study, disguised adaptors were produced by children who were more than 9-years-old. None of the 7- and 8-year-olds used disguised adaptors at all. This result indicates that children become aware of their gestures as an informational resource for listeners from the age of 9 onwards. In other words, they acquire the ability to monitor their gestures from the age of 9.

The analysis of the temporal relationship between a disguised adaptor and speech fluency suggest that disguised adaptors may be caused by different factors as the child grows older. Children from 9- to 12-years-old produce fluent speech combinations, but only the higher graders, i.e., 11- and 12-year-olds, produced dysfluent speech combinations. In addition, the higher graders produced gestures after a disguised adaptor, and the hand shape was the same as in the preparation phase before the disguised adaptor. This implies that disguised adaptors of 11- and 12-year-olds are partly caused by the act of searching for an adequate word or planning a sentence. After deciding what they will talk about and starting to talk about it, children may have more problems with word searches. Because they notice that they have to stop speaking to retrieve a word or re-plan a sentence, children may modify their gestures to a disguised adaptor in the middle of gesture production. Furthermore, after they find an adequate word, they reproduce the gesture with the intended word. Children in higher grades may find disguised adaptors useful, for instance, to disguise a gesture they originally intended or to make children concentrate on the retrieved word that they just found. In fact, previous studies showed that an adaptor tends to occur when a speaker is performing lexical retrieval (Pine, Bird, & Kirk, 2007).

Based on these results, I will discuss why disguised adaptors appear around the age of 9 years. In what follows, two factors, cultural and cognitive, are shown to influence the emergence of disguised adaptors. The theoretical implications on the development of gestures from disguised adaptors are then discussed.

1) Cultural influence

The findings of studies on the gestures of elementary-school-age children suggest a cultural influence. Many studies have reported that the frequency of gestures consistently increases during the elementary school years. These trends appear across cultures, although most of the studies were on children in Indo-European language cultures (e.g., Colletta, 2009).

However, this study on Japanese elementary school children showed that the frequency of gestures decreases temporarily in the middle grades (9- and 10-year-olds) compared with in the lower grades or higher grades. This difference may come from their educational environment. Japanese teachers instruct students to keep their postures constant during listening or writing. Even some researchers view the elementary school years as a period in which a child learns posture systematically (Fujimoto, Fujiwara, Yonetani, & Kimura, 1996). Sometimes, pupils are implicitly and explicitly warned by their teacher to avoid fidgeting or moving their hands when the teacher or another child is speaking or sometimes even when they themselves speak. A teacher often conveys this message by simply telling children that they should not move their hands or by indirectly indicating that they should put their hands on their thighs. In fact, speakers in Asia sometimes learn not to gesticulate, and gesturing is regarded as impolite in Chinese culture.

From these finding, it seems that children as young as 9-years-old attempt to embody the rule about hand movement by modifying gestures into disguised adaptors. This may be related to why disguised adaptors produced by 9- and 10-year-olds do not synchronize dysfluences. Because they seem to start noting that their hand movements can be read by someone as symbols, even when they do not have a problem with word search, they may try to suppress their hand movements.

2) Cognitive change

As a factor influencing the emergence of disguised adaptors from the age of 9 or 10, one may consider cognitive changes occurring during this period. For example, in Piaget & Inhelder's (1969) model, the period is considered to be the concrete operational stage at which abstract logical thought is first applied to the physical world. Karmiloff-Smith (1986), who investigated the development of metalinguisitc awareness in 4- and 12-year-olds, found that many children from 9 years onwards explicitly have metalinguistic awareness. Thus, children in the middle grades of elementary school seem to develop metacognitive knowledge to notice that there are underlying rules or mechanisms in the physical world and human communication. At same time, they may also become aware that gestures are informational resources for the listener. Because children in this period are sensitive to such rules, they start monitoring their expressions to check whether the message in the expression is adequate given the communicative context. This awareness seems to result in the emergence of disguised adaptors and an increase of speech errors in children in the later years of elementary school.

This speculation is partly supported by the previous studies**.** For example, Ito and Tahara (1985) and Nakamura (1993) found that 10-year-olds had poorer usage of the postpositional particle *WA* in comparison with other age groups. As Ito and Tahara suggested, because children in this period are just beginning to notice and attempt to grasp the multifunctional nature of language devices, their performance seems to decline temporarily. From these studies, the ages of 9 and 10 can be seen as the transitional period in which Japanese children begin noticing the communicative function of gesture and linguistic system, and monitoring them.

However, it will be necessary to examine whether 9- and 10-year-olds are really in the transitional period or easily affected by cultural factors experimentally, while observing children's communication in their classrooms. Furthermore, we should also determine whether other age groups produce disguised adaptors in the same way as the children in this study produced them and study the relationship between speech fluency and the emergence of disguised adaptors.

Examining when children suppress gestures contributes to an understanding of children's gestural development. Just as certain self repairs in speech that are spontaneously made by children during narratives reflects metalinguisitc awareness that they have acquired (Karmiloff-Smith, 1986), the emergence of disguised adaptors would also suggest that children have an awareness of gestures. This study showed that although the production of gestures may be mostly an unconscious process (McNeill, 1992), the speaker can notice that she is producing a gesture after she raises her hand for a gesture, and that this awareness begins at about 9 years of age.

5. Conclusions

This study found that children produced disguised adaptors from age of 9. This suggested that children start having ability to monitor their gesture from 9- or 10-year-olds.

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