Co-speech gesture in anomic aphasia

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CO-SPEECH GESTURE IN ANOMIC APHASIA[1]

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1 Introduction

Why do people gesticulate? How do gesture and language interact? Does gesture carry specific functions during speech production, in general? And, in specific, do people with aphasia benefit from the use of co-speech gestures? Many scholars have attempted to account for the nature of the interaction between verbal and manual expression. The way in which gesture behaviour has been investigated was subject to much debate in the literature resulting in many controversial opinions regarding the classification, the methodology, the analysis and the function in the field of gesture.

The aim of this explorative pilot study is two-folded. On one hand, it attempts to clarify some of the general questions mentioned above. On the other hand, it serves as a starting point to highlight if fluent and non-fluent, impaired speech and gesture production differ indeed with respect to gesture realization, quantity and function. The study describes and compares systematically speech and gesture behaviour of an individual who suffered from anomic aphasia and a non-aphasic counterpart.

Before discussing directly the methodology and data of the project, a brief background is given according to gesture, anomic aphasia and previous research carried out in the field of gesture.

2 Theoretical background

2.1 Aphasia

Many definitions of aphasia exist in the literature. Here, Dharmaperwira-Prins & Maas' (1994, 19) definition is used: "Aphasia is an acquired, (verbal) primary language impairment caused by a one-sided focal brain injury." And, language can be disturbed in at least one of the different productive or perceptive linguistic modalities. Often, aphasia is caused by a stroke: a neurological defect, which is usually caused by a sudden event such as thrombosis, embolism, or cerebral haemorrhage (Snell, 1992). Aphasia manifests itself in different syndromes depending on the gravity of brain injury, its neuronal localization and individual differences. This article focuses on anomic aphasia.

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1 This article is based on the MA-thesis *Afatisch of niet- een pilotstudy: Inventarisatie van het co-speech gesturegedrag in gezonde en anomische taalproductie* of the same author (2003).

2 I would like to give special thanks to Dr. M. Haverkort and Dr. E. Kellerman

For further information on the different aphasic syndromes, the reader is referred to Goodglass & Kaplan (1972) and Obler & Gjerlow (1999).

2.2 Anomic Aphasia

Anomic aphasia is also known as *amnestic* or *nominal* aphasia. As the word *anomic* implies, the core symptom of anomic aphasia is anomia: naming problems caused by the partial or complete disability to activate lexical items referring to a conceptual referent from the mental lexicon (Goodglass & Wingfield, 1997). However, the concept of those words is still intact. Lexical retrieval of content words is severely impaired and exists in both highly frequent and less frequent words.

Generally, problems in lexical processing and retrieval lead to two types of anomia (Goodglass & Wingfield, 1997). According to Benson (1978), in *word production anomia* the aphasic person knows the phonological and lexical elements of the words but is unable to retrieve the word form, which results in hesitant speech. Minimal phonological cues help in lexical retrieval. A more severe naming problem is the *word selection anomia*. The aphasic person cannot select the word from the internal lexicon. While cueing of the initial sound is of no help, the aphasic individual can give a description of the word.

These characteristics of anomic speech production can also be observed in normal, unimpaired speech production. Word production anomia is often comparable with the *tip-of-the-tongue phenomenon* whereas word selection anomia occurs less frequently in unimpaired individuals; for instance in the speech production of elderly people or second language learners.

Problems in language processing have a direct influence on syntax as indicated in the example below[3], where the patient is trying to produce the word *medical dossier*. The speech is non-fluent and characterized by pauses and hesitations, e.g. due to the anomia. As a result, empty speech, long and complicated descriptions and the frequent use of stereotype expressions often function as strategies for continuing the speech flow. Another strategy could be the abruptly change of the subject because of the incapability to continue the interaction. The question that rises here already is how differences in fluency are reflected in gesture?

2.3 Co-speech gesture

The word gesture, generally, refers to a variety of hand movements: a pantomime act, sign language, or a politician who gesticulates to accentuate his opinion. Co-speech gestures, more specifically, refer to unconscious movements of hands and arms accompanying speech production (McNeill, 1992). In addition, they give insights in the underlying processes of language production (Gullberg, 1998). These movements can be either extensive or small and refer to a visible object (or person) or describe something imaginary. Co-speech gestures meet several conditions that distinguish them from conventional gestures (e.g. waving) and independent sign language systems (McNeill, 1992):

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[3] uh uh can can we maybe self once to uh to the uh to to go uh Maartenskliniek and well then you can instantly yes maybe uh then you can instantly write down and well then I'm not supposed to look for **it** and uh well

- Gestures co-occur with speech 90% of the time.
- Gestures are idiosyncratic in nature.
- Gestures are realized with one or two hands.
- Gestures are functional, semantically and temporally in close relationship to speech; they can be synchronous.
- Each gesture has three main phases: preparation - stroke - retraction.
- The stroke of a gesture contains its meaning.
- The stroke synchronizes with the speech segment with which it is co-expressed.
- Gesture and speech can semantically and pragmatically complement each other.
- There exists no co-speech gesture database from which gestures can be drawn.

There exist a myriad of gesture types, which has accordingly been classified in many different ways. The classification system adopted for the present study stems from McNeill (1992). It is widely used and incorporates distinctions that were also made in the influential classifications by Efron (1941) and Ekman & Friesen (1969). McNeill (1992) refers to Kendon's continuum (Kendon, 1988) for better comprehension and interpretation of co-speech gestures in unimpaired, fluent speech. As shown in Figure 1, the necessity of a verbal component decreases from the left to the right whereas the linguistic value increases from the left to the right. That will say that in contrast to co-speech gestures, sign languages can be realised without verbal input by means of conventionalised entities.

Gesticulation → *Language-like gestures* → *Pantomimes* → *Emblems* → *Sign languages*

Figure 1: Kendon's continuum (applied version, Kendon, 1988)

In addition, the *gesticulation* part of Kendon's continuum (Kendon, 1988) has served as framework for McNeill's (1992) classification system. In the following, the gesture types that are used in the present study are distinguished.

Deictic gestures (deictics) are gestures that refer to locations or directions. Most deictic gestures are pointing gestures. McNeill (1992) distinguishes between *abstract* and *concrete* deictics. Concrete deictics are gestures that refer to an object or direction in the real physical world. Abstract deictics create or refer to discourse markers in the *gesture space* in front of the speaker's body. A frequently occurring gesture is 'on the one hand' [open hand moves to the right] and 'on the other hand' [open hand moves to the left].

Iconic gestures (iconics) have a close relationship with the linguistic element in speech production. Iconics are like an imaginary sculpture shaped by the speaker's hands. However, the gesture and language may each carry meaning that is not necessarily embedded in the other. An iconic can be interpreted by its form and function without referring to the corresponding linguistic element. An example may be a motion verb like 'he is rolling down the street' [rotating arc movement of a hand or finger].

Metaphoric gestures (metaphorics) form a separate category in McNeill's classification system. Metaphorics are similar to iconic gestures but depict abstract instead of real objects. In the present study, both gesture types are included in the same group whether the individual refers to an abstract or a concrete entity is not so important.

Beat gestures (beats) are rhythmic entities dependent on speech rate and apparently do not carry specific meaning. McNeill (1992) claims that beats serve a meta-narrative function, like topic marking or turn taking in speech. A beat has only two phases of

movement: vertical (up-down/ahead-back) or horizontal (side-to side), for instance: 'I think…' [one hand moves up and down in front of the body].

Two additional types of gestures have been added in this overview that were observed during data transcription of hesitant and non-fluent (anomic) speech production (Orgassa, 2003): the *beat-like* gestures and the *iconic-component*. These gesture types were not classified in previous literature. In order to determine the specific function of gesture, both types seem to play an explicit role during non-fluent speech production. A discussion on this follows in the discussion of the data.

Beat-like gestures are similar to beats with respect to their shape of movement. They differ from beats in that they only seem to occur during naming problems.

An *iconic component* is a partially realised gesture movement that is disrupted by an anomia. More specifically, it seems to indicate the transition of the start of lexical retrieval resulting in a lexical breakdown. Furthermore, the *iconic component* is not completed by a gesture stroke.

The different gesture types described above belong to a group of *referential* and *non-referential* gestures. Referential gestures, such as deictics, iconics and metaphorics, are directly related to a referent e.g., like a character, object or action. They carry a form-function relationship and can be realised without speech. Thus, they substitute or accompany nouns, verbs or adjectives, or refer to a whole phrase or sentence. Beat or beat-like gestures, in contrast, are examples of non-referential gestures. They do not carry any meaning; however, they seem to play an important role in discourse.

2.4 Assumptions about the function of co-speech gestures

Followed by the specification of the different types of co-speech gestures, the communicative aspects of gesture will be discussed. We already know that during normal, fluent speech production gesture carries a referential function among other possibilities. What could be a possible function of gesture in aphasic or non-fluent speech? Every speaker has the same aim: to transmit a message and to be understood successfully. A speaker uses a variety of strategies to this end.

Tarone (1983, 65) defines communication strategy in terms of strategic awareness during interaction: "a mutual attempt of two interlocutors to agree on a meaning in situations where requisite meaning structures do not seem to be shared." This holds also for the interaction between a healthy and an impaired speaker, where adaptation takes place in both directions. The healthy individual adapts his speech production in complexity, speech rate, and use of alternative communication channels, while the aphasic individual also uses language and other communicative channels adapted to his impairment. Gullberg (1998) formulated two assumptions about gesture function that also seem to fit gesture into Tarone's (1983) framework:

- Gesture and language must be associated such that gesture can compensate for an oral linguistic deficit and express the same meaning.

This assumption refers to a facilitative or compensatory gesture function when lexical retrieval in speech is no longer possible.

- Gesture must have a communicative value for listeners. This in turn implies that gesture can be performed for the benefit for the interlocutors, such that speakers can exploit them to enhance their performance, i.e. gestures can be used strategically.

This assumption could refer to a possible discourse function realised by the non-referential beat or beat-like gestures that are used strategically.

2.5 The module debate

The discussion around the interaction between the manual and verbal expression mode has resulted in the module debate. A variety of hypotheses (Feyereisen, 1987; Rauscher e.a, 1996) and models (De Ruiter, 2000) exist to explain the interaction of language and gesture and their underlying mental processes; too many to discuss here. A form of interdependence between the two modes seems to be the most common vision in recent gesture research.

To clear up this debate, McNeill introduced the *Growth Point Theory*, where he shares Kendon's (1980) opinion that gesture and language form an entity. This theory describes the cognitive base of both modes as an integrative and self-organizational process: "the growth point is a unit of verbally engaged thinking based on speech-gesture correlations. It is a unit in which both imagery (from gesture) and language content (present in the form of linguistic categories) are combined" (McNeill & Duncan, 1998, 23).

2.6 Gesture in aphasic speech production

How do the different theories account for gesture realisation in non-fluent aphasic speech production? McNeill claims that language and gesture break down in aphasia. Pedelty's data (1987) seem to support McNeill's hypothesis. In contrast, Corina e.a. (1992) assume that gestures are still intact in aphasia.

Quantitative investigation of gesture in aphasic speech production (Ahlsén, 1991; Lott, 1999) supports the assumption that aphasic individuals have a more frequent use of gesture than their healthy counterparts.

Evidence also exists that gesture behaviour depends on the aphasic syndrome (Pedelty, 1987; Lott, 1999). Contradictions exist however considering the type of gesture produced in different aphasic syndromes: While Lott (1999) assumes that patients with non-fluent aphasia use more non-referential beat gestures, Pedelty's data (1987) refer to a higher use of beats in fluent aphasics by the meaningless content of beats.

With respect to the function of gesture, the majority of researchers share the opinion that gesture compensates for or facilitates linguistic limitations in aphasia (Pedelty, 1987; Feyereisen, 1987; Feyereisen & De Lannoy, 1991; Ahlsén, 1991; Lott, 1999). The findings differ however strongly according to a specific type and use of gesture within a specific aphasic syndrome. Systematic investigation of gesture behaviour and its function related to the specific aphasic syndrome are lacking to data.

3 The present study

3.1 Introduction

The previous discussion on the relation between manual and verbal mode has shown that combining and investigating gesture in anomic aphasia require specific restrictions with respect to fluency, the different aspects of gesture and its possible function.

The purpose of the study is choosing a single anomic individual, collecting and analysing speech and gesture data based on three different language production tasks and comparing his data to data of one well-matched unimpaired counterpart in order to test the following hypotheses:

I. The quantity of gesture use is higher in the aphasic subject in all fluency levels.
II. During fluent speech production, the gesture behaviour of both subjects is related identically to type, synchrony and function.
III. During hesitant and non-fluent speech production, the gesture behaviour of both subjects differs in type, quantity and synchrony, and gesture carries a facilitative lexical retrieval function in the speech of both subjects.
VI. During non-fluent speech production, the gesture behaviour of the aphasic subject differs from that in fluent and hesitant speech production. In addition, gesture compensates for naming problems.

In order to guarantee the reliability of the analysed data, a second investigator was asked to analyse 11% of the qualitative data and two minutes of recordings of the quantitative data. She focused on gesture type and synchrony. Outcomes of the interrater reliability are discussed in section 4.1.

3.2 Subjects of investigation

Subject of investigation was a Dutch male (62 years), who suffered from anomic aphasia caused by a left hemispheric stroke in September 2001. At the start of data collection, he had reached a ceiling effect, i.e. he will not undergo any further linguistic improvement. For between subject comparisons a male counterpart was chosen. Both subjects were matched for age (state of health), gender, right-handedness, socio-economic and educational background and the amount of gesture use. Speech production of both subjects was also observed to be almost similar with respect to the fluency of speech.

3.3 Fluency levels

Data (Orgassa, 2003) showed that for reliable comparison of speech and gesture within and between subjects, it is necessary to group speech utterances in the three different fluency levels: fluent, hesitant and non-fluent (anomic). Only then gesture behaviour can be properly compared. The different levels of fluency could be observed in both subjects.

For reliable and easy separation, the AAT standards (Aachener Aphasie Test, Huber e.a., 1980) of fluency were used: *Fluent* speech refers to speech utterances where pauses and hesitations do not disrupt the speech flow and are not longer than two seconds. *Hesitant* speech production is characterized by pauses and hesitations longer than two seconds without influence on the context. In *non-fluent* utterances, naming problems

(anomia) are longer than two seconds and disrupt and influence speech flow and content.

3.4 Language tasks & test environment

The data were collected using three different language production tasks: (1) Informal interview: the subjects were invited to answer several open-ended questions. (2) Retelling of *Canary Row* (for a detailed description, see the appendix of McNeill, (1992)): The subjects were asked to watch and retell a cartoon to an independent third person. (3) Action description without picture material (such as baking pancakes; repairing a bicycle). The three tasks differ in naturalness, abstractness and complexity.

To create a testing environment that is as natural as possible, data collection took place in a home situation. Data were recorded with a digital camera, but the subjects did not know that gesture was the focus of interest. The recordings resulted in an extended database of fluent, hesitant and non-fluent (anomic) speech and gesture data.

3.5 Variables of analysis

Data were analysed qualitatively and quantitatively by judging the different variables related to the different levels of fluency. *Qualitative* refers to an in-depth study of an isolated co-speech gesture separated from the linguistic context while *quantitative* refers to an analysis based on the selection of consecutive and contextually related chunks of gesture and speech data per fluency level.

No subject however produced a continuous chunk of hesitant speech; therefore, the mean length of a naming problem was taken into account in order to guarantee that the speech samples of both subjects were long enough for analysis and comparison. This resulted in a 4.30-minute long fluent/non-fluent speech sample of the aphasic and a three-minute long speech sample of his counterpart.

With respect to the qualitative analysis, totally 76 speech utterances were grouped by subject, task and fluency level. Here, data analysis took place with respect to four specific aspects of gesture that form the variables of interest: (1) The determination of gesture type (iconic, deictic, metaphoric, beat and beat-like); (2) The investigation of *synchrony* between gesture and speech realisation. Normally, an integration of a gesture with a linguistic structure takes place in the gesture stroke, where the verbal and manual linguistic elements appear together temporally; (3) The gesture *function* analysed in every fluency group. Within every fluency level, gesture function is determined by its referential, additional, or communicative-functional (compensatory or facilitative) value in speech production.

With respect to the quantitative analysis, a continuous chunk of fluent and fluent/ hesitant gesture and speech data was analysed in both subjects while an continuous non-fluent (anomic) chunk could only be separated in the anomic subject due to his large amount of naming problems. Separating continuous chunks made also possible the determination of the fourth variable (4) *gesture quantity* (number).

4 Results

4.1 Introduction

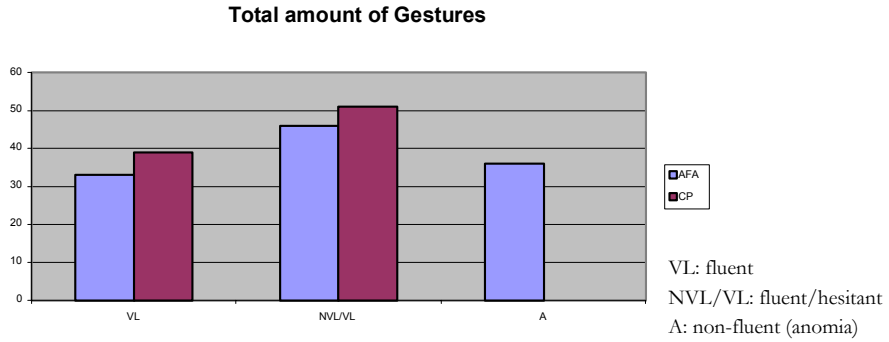
For improved investigation, interrater reliability was carried out. With respect to the variable synchrony, interrater reliability was 100% while gesture type only had 67% agreement. The low interrater reliability underlies two reasons. First, the second rater had little time for instruction and analysis. Secondly, interrater differences were also based on the second rater's lack of experience in the analysis of hesitant and non-fluent data.

Before discussing the data, it has to be kept in mind that the results of this explorative investigation are descriptive observations based on a data collection from two subjects only. As a result, it was not possible to analyse the data with statistically procedures ending up by formulating generalisations. Nevertheless, the following observations serve as a well-founded database for further investigation in the field of gesture in non-fluent aphasia.

In the following sections, the hypotheses will be discussed in terms of the variables gesture quantity, type, synchrony and function. The figures report the distribution and quantity of realised gesture types in both subjects, indicated by the numbers on the left.

4.2 The quantity of gesture use is higher in the aphasic subject in all fluency levels

As mentioned before, 'between subject differences' in gesture behaviour (quantity, form e.g.) are common and caused by the idiosyncrasy of gesture. It was still expected however that the aphasic subject realised gestures more often due to his language impairment than the non-aphasic subject. In this case, the results do not support for the first hypothesis. Figure 2 shows that the counterpart realises more gestures than the aphasic subject: 39/33 in the fluent data and 51/46 in the fluent/hesitant data. This comparison seems not to indicate that an anomic aphasia is a marker for a higher quantity of gesture use. Another explanation refers to the idiosyncrasy of gesture in that the data simply indicate that the non-aphasic subject uses generally more gestures than the aphasic subject does.



VL: fluent
NVL/VL: fluent/hesitant
A: non-fluent (anomia)
AFA: aphasic subject
CP: counterpart

Figure 2: Total amount of co-speech gestures

4.3 During fluent speech production, the gesture behaviour of both subjects is related identically to type, synchrony and function

Quantitative and qualitative analyses support in all variables for the second hypothesis. The aphasic subject, in spite of his language impairment, does not show inappropriate gesture behaviour compared to his non-aphasic counterpart in fluent speech production. Figure 3 shows that both subjects follow a quite similar tendency according to gesture type. The only marking difference occurs in the higher frequency of beat gestures (10/5) in the non-aphasic subject. This may be explained by his ability to use language more natural expressed by more extra-linguistic features (beats) in contrary to the aphasic subject.

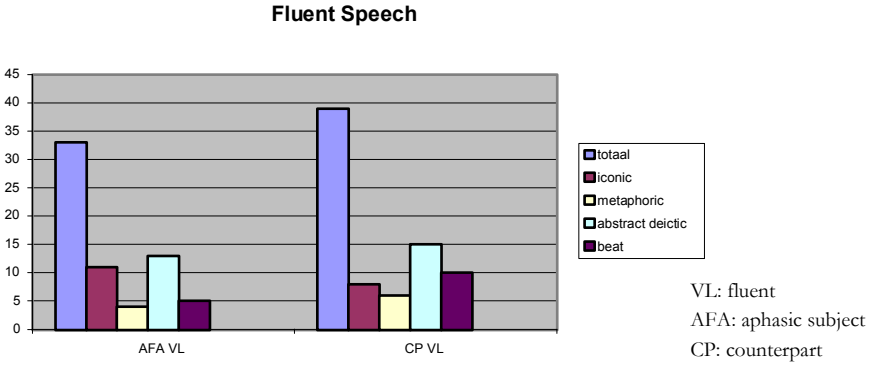
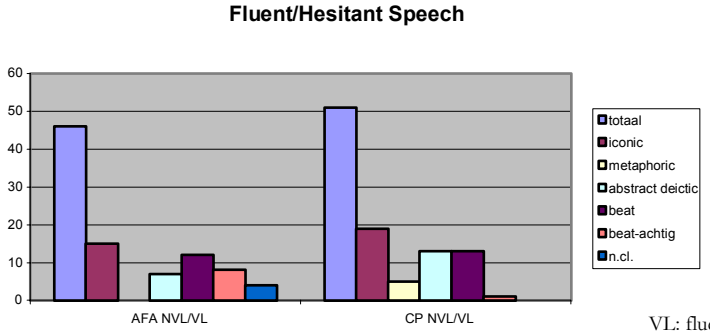


Figure 3: Co-speech gestures in fluent speech

Both subjects agree also in gesture realisation with respect to synchrony and function. In a gesture phrase, the lexical speech element synchronises with the gesture stroke, where gesture indicate a referential, descriptive and/or additional function.

4.4 During hesitant and non-fluent speech production, the gesture behaviour of both subjects differs in type and synchrony. Gesture carries a facilitative lexical retrieval function in the speech of both subjects

The third hypothesis is only partially supported by qualitative and quantitative speech and gesture data. Here, a significant difference shows up with respect to the use of beat-like gestures reported in the fourth figure. While the aphasic subject performs eight beat-like gestures, the non-aphasic subjects realises only one instead. By recalling chapter one, it was assumed that beat-like gestures help continuing the discourse during a naming problem. The data support this assumption in that all beat-likes correlate with naming problems. A less striking difference refers to the higher amount of metaphorics (13/7) in the non-aphasic subject that could be explained again by the idiosyncratic character of gesture.



VL: fluent
NVL/VL: hesitant/fluent
AFA: aphasic subject
CP: counterpart

Figure 4: Co-speech gestures in fluent/hesitant speech

With respect to the aspect of synchrony in hesitant speech, we would have expected a loss of synchrony in the aphasic speech. Surprisingly, the data show a similar pattern in both subjects during the occurrence of a hesitation. First, a hesitation in gesture is similar to a word production anomia (*tip-of-the-tongue phenomenon*) in speech resulting in a delayed transition between word search and word retrieval. Secondly, the tip-of-the tongue phenomenon in both subjects is realised by two types of hesitations in gesture: a *pre-stroke hold* and a *repetition*. Kita (1990) introduced the term pre-stroke hold by investigating gesture behaviour in Japanese-English bilinguals. This term is also suitable within the framework of hesitant gesture behaviour. Here, the pre-stroke hold refers to a static, continuous hand movement before the realisation of the lexical element within the gesture stroke. A repetition on the other hand refers to multiple repetitions of similar hand movements before lexical retrieval occurs.

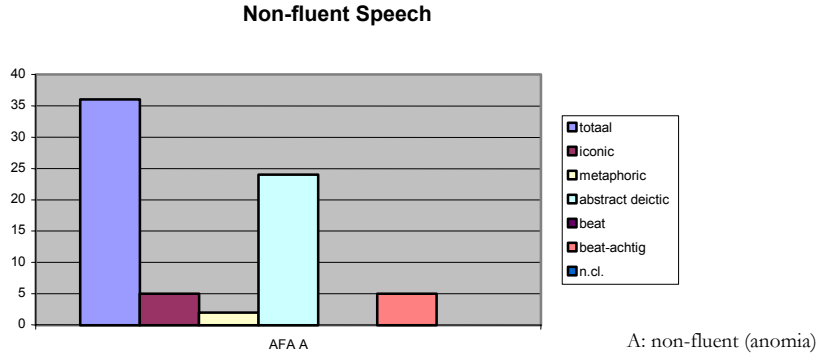
According to gesture function, both types of hesitation in manual movement seem to carry a supportive function that helps maintain the concept by cross-modal priming before the stroke correspondents with the lexical element again. The only difference between the subjects is of a quantitative nature. The aphasic subject produces more hesitant utterances and needs also more time to retrieve the lexical element than the healthy counterpart does.

4.5 During non-fluent speech production, the gesture behaviour of the aphasic subject differs from that in fluent and hesitant speech production. In addition, gesture compensates for naming problems

With respect to gesture type, the hypothesis is indeed confirmed. Figure 5 shows a significant increase of abstract deictics (24) and beat-like (5) gestures during naming problems compared to other gesture types. According to the proposed compensatory function of gesture, however, data analysis resulted in a clear rejection of the second part of the hypothesis. A breakdown in lexical retrieval correlates with a breakdown in gesture. There is no lexical element in speech or in gesture left despite of the appearance of an iconical component (recall § 2.3) during gesture. The higher quantity of abstract deictics and beat-likes does also not seem to support lexical retrieval.

Moreover, the deictics seem to have lost their referential function because they do not longer refer to a lexical element. Instead, these gesture types seem to carry a more communicative or strategic function. It is strategic for the listener in that he knows that the aphasic is leading the communication and is trying to allow the communication to continue.

By recalling that beats also seem to carry a kind of discourse function (McNeill, 1992), one would have expected a higher use of them during naming problems. Instead, no beat gestures are realised while they occur with a reasonable frequency during fluent and hesitant speech.



A: non-fluent (anomia)
AFA: aphasic subject

Figure 5: Co-speech gestures in non-fluent (anomic) speech

4 Concluding remarks

Summarising the observations, a general result is that speech and gesture seem to be tightly coupled. During fluent and hesitant speech production of both subjects, there are no remarkable differences found according to the gesture behaviour and function. While in fluent speech, gesture refers to or adds information to speech, in hesitant speech, gesture seems to carry a supportive function. The concept is actively maintained by realizing repetitive or continuous (*repetition/pre-stroke hold*) hand movements.

Contrarily, during naming problems, there is a breakdown in both modes without synchrony in time or meaning until word retrieval or a restart takes place and the communication continues. In addition, more non-referential types of gesture (abstract deictics and beat-likes) are realized without speech. These gestures seem to have a more communicative value by describing the communicative effort of the aphasic subject.

A proportional relationship regarding fluency can be explained as follow: In fluent utterances, gesture and speech fall together whereas in hesitant speech, there is a delay in gesture and speech processing and in non-fluent speech production asynchronously occurrence exists persistently.

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