TOWARDS A PSYCHOLINGUISTIC UNDERSTANDING
OF NON-VERBAL BEHAVIOUR

AGNIESZKA KAMISZNIKOW

1.   Introduction

When the presence of non-verbal behaviour in the process of communication was finally acknowledged, analyses have evolved in two independent directions, each based on the functions of this behaviour in relation to speech. One approach, developed in the field of social psychology, has assumed the functional independence of verbal and non-verbal behaviours. The other approach, pursued by psycholinguists, has affirmed their interrelationship. This basic divergence can be explained by means of how a popular saying that we 'speak with our bodies' is interpreted; for the followers of the first approach, it would indicate that we indeed transmit information by means of the non-verbal channel, but it is the additional connotative and affective information, independent of semantic meanings communicated via the verbal channel. For the adherents of the second approach, the same statement would mean that both channels convey different meanings complementing one another. The aim of the present paper is to show how the third understanding of the above statement is possible, namely, that we not only speak with our bodies, but that 'body talk' is of significance for the process of the so-called 'thinking-for-speaking', i.e., speech generation. In other words, it will be claimed that non-verbal behaviour should be perceived not only as functionally similar, but also computationally related to verbal behaviour.

2.   An outline of non-verbal behaviour studies from historical perspective

The first observations on what in present days is called non-verbal communication date back probably to the ancient Greeks; however, until the second half of the twentieth century no systematic investigation had been carried out. Darwin's *The Expression of Emotions in Man and Animals* from 1872 is considered as the pre-twentieth century precursor of the modern interest in the study of non-verbal communication, and during the first half of the twentieth century the most influential publication was Efron's *Gesture and Environment* (1941).

An increased interest in non-verbal behaviour began in the USA in the 1950s, and was prompted, among other factors, by a new approach to some mental disorders, which started to be conceived as a breakdown of communication, and also by the development of technology (first of all, cinematography). These two elements coincided in a pioneer endeavour, which might as well be considered as a proper starting point of non-verbal behaviour studies, i.e., the analysis of the so-called 'Doris' film, a recording of a conversation between two people conducted by the Palo Alto research group in 1955. This project was an important contribution to the development of methodology in the field of non-verbal studies for at least three reasons. Firstly, it introduced the audio-visual recording technology into the study of non-verbal behaviour, which brought the documentation of non-verbal behaviour to a precise level. Secondly, a micro-analysis of a 'naturally occurring' conversation was undertaken for the first time, which meant that the findings were arrived at on the basis of a perceptual analysis without any a priori assumptions. Thirdly, also for the first time, all aspects of communicative behaviour, that is, both its verbal and non-verbal components, were investigated. Since then, detailed analyses of sound movie recordings of naturally occurring interactions have constituted the basic methodological tool of non-verbal behaviour studies.

Another factor worth mentioning that contributed to the development of non-verbal behaviour studies was the increased general awareness of cultural differences in interpersonal communication after the Second World War. As a result, various aspects of non-verbal behaviour were included into foreign language instruction for diplomats (cf. Asher 1996: 1847). The methodology of teaching was based on the assumption that non-verbal behaviour was patterned in a way similar to that of language[1]. This application of structural linguistics to non-verbal behaviour initiated such new studies as: 'paralinguistics' (concerned

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[1]   Reflecting in this way a pioneering idea of American structuralist Sapir (1927) who ventured that all aspects of human behaviour can be approached as patterned in a mode reflecting the structuralisation of languages.

with the analysis of voice qualities and other paralinguistic aspects of speech; cf. Trager 1958); 'proxemics' (concerned with the analysis of the role of space in interaction; cf. Hall 1963); and 'kinesics' (i.e., the structural analysis of body movements, gestures and facial expressions; cf. Birdwhistell 1970). All the terms have been widely used since then.

It should be made clear, however, that non-verbal behaviour was not incorporated into the first models of the process of communication[2] as a component in its own right. At first, the consideration of such events as paralinguistic aspects of speech, face and body movements, which interfered with the transmission of verbal messages over the communication channel, was introduced in the notion of the so-called 'noise'. It was only after some time, under the influence of, for example, cybernetic theory (cf. Kendon 1990: 29), that this (in a sense pejorative) label was lost and the position of non-verbal behaviour in the very process of communication acknowledged.

3.   Two main approaches to the function of non-verbal behaviour in relation to speech

With the above-mentioned methodological and theoretical developments, the field burgeoned in the 1960s. The analyses have proceeded in two independent directions based on the nature of the relationship of non-verbal behaviour to speech. One approach has assumed the independence of the two channels of communication and the other approach their interrelationship.

3.1. Independent channels approach

This traditional perception of non-verbal behaviour has especially guided the research conducted by psychologists and social psychologists. It assumes the functional dichotomy between verbal and non-verbal behaviours. It has been argued (cf. Argyle 1969; Argyle et al. 1979) that the two modes of expression constitute two separate and independent channels of communication, where the verbal channel transmits denotative meanings (semantic information) and the non-verbal channel communicates connotative meanings (e.g. interpersonal attitudes and affective states). Therefore, non-verbal behaviour is believed to be the exclusive, or at least the most powerful medium of management of the social aspects of communication. Consequently, the research conducted within this approach has focused on correlating non-verbal features with such variables as the personal and social characteristics of speakers. For example, attitudes of speakers towards listeners as displayed by means of non-verbal cues were

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[2]   Conceptualised within information theory by Shannon and Weaver (1949).

investigated and the general characteristics of body movements specific for positive and negative attitudes of a communicator specified[3] (cf. Mehrabian 1969). The cues of positive (warm) attitude that were found include: more forward lean; closer proximity; more eye-gaze/direct eye contact; more openness of arms and body; more direct body orientation; more touching; higher level of gestural activity (smiles, head-nodding); warmth cues connected with the verbal reinforcement 'mm-hmm' (cf. Knapp 1978: 227). A linear correlation was also drawn between the attitudes and how communicative or persuasive a communicator is perceived to be (cf. Mehrabian 1972). The influence of social roles (e.g. inferiority vs. superiority) and social distance (e.g. the level of acquaintanceship; friendliness vs. unfriendliness) on non-verbal behaviour was also analysed. In the case of gaze, for example, the general findings were that a higher amount of gaze is displayed in the presence of people that we like (cf. Argyle and Cook 1976) and also that speakers with more gaze are evaluated higher, as more natural, friendly, extrovert, persuasive, truthful, sincere and credible (cf. Mehrabian 1972). Ekman and Friesen (1972) found that the more excited and enthusiastic a speaker is and the more dominant is his role in the interaction, the more likely it is for gesticulation to appear.

Methodologically, this research has applied mostly the so-called single variable analysis (cf. Duncan et al. 1985), investigating the amount of behaviour irrespective of its patterning in relation to speech or the system of turn-taking, that is, a sequence or system in time.

3.2. Interdependent channels approach

The functional distinctiveness between the two channels of communication does not seem correct for the adherents of the second major stream of non-verbal behaviour studies, which has been developing simultaneously to the independent channels approach.

This line of studies commenced in the 1960's. The statements: '(...) language, in its natural occurrence as speech, is never disembodied but is always manifested through behaviour (...)' (Condon and Ogston 1967: 221), and the more recent one by Kendon (1980: 210): '(...) speech production process is manifested in two forms of activity simultaneously: in the movement of vocal organs and also in bodily movement (...)', may be taken as the basic premise of this approach.

The research within this approach was initiated with the analysis of natural conversations at micro- (i.e., phonological) and macro- (i.e., discourse/turn-

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3   Other researchers (cf. Knapp 1978) have analysed corresponding behaviours under the labels 'warm' and 'cold'.

taking) levels. Several phenomena were discovered. For example, Condon et al. (1967) found that 'the body dances in time with speech' (ibid., p.225), that is, the speaker's verbal and non-verbal behaviours are synchronised; moreover, the synchronised behaviour of the speaker is matched with the synchronised behaviour of the listener in the so-called 'interactional synchrony', i.e., sharing patterns of bodily changes in precise harmony between interlocutors. Other researchers, e.g., Birdwhistell (1970) related body and hand movements to various linguistic units, as a result of which certain characteristic patterns were found. Scheflen (1964) and Kendon (1972) discovered that the hierarchy of gestures reflected discourse hierarchy. Also analyses of the distribution of eye-behaviour in relation to speech were carried out. One of the first investigations conducted concentrated on the regulatory function of gaze in conversation. It was noticed (cf. Kendon 1967) that gazing or looking away may demand or suppress responses in interaction. Duncan (1975) concluded that gaze is one of the turn-yielding cues, or aversion of gaze one of the turn-maintaining cues.

Despite the assumption of functional interdependence between verbal and non-verbal modes of expression, and the examination of non-verbal behaviour in relation to various linguistic units, these studies were still devoid of any relevance to mental processes underlying the structure and occurrence of gestures and other non-verbal behaviours, and, consequently did not undertake their psycholinguistic analysis. Nevertheless, it was a springboard for the truly psycholinguistic enquiries that began to flourish afterwards, in the late 1970's.

4.   Interdependent channels approach extended: towards a psycholinguistic understanding of non-verbal behaviour

Research carried out by, e.g., Butterworth et al. (1978); Beattie (1979); Kendon (1982), McNeill (1985) posed the question of the function of the non-verbal mode of expression in cognitive activities (i.e., in the so-called 'thinking-for-speaking'), and initiated an endeavour of a psycholinguistic understanding of non-verbal behaviour.

This approach has been based on the assumption that the function of many movements that people perform while speaking is cognitively related to the concurrent speech, i.e., related to mental processes that underlie it. This means that the function of such movements as e.g., averted gaze, gesticulation, wrinkled forehead or posture shifts performed when we are engrossed in cognitively demanding activities (e.g. when we are trying to recall or imagine something) is not epiphenomenal. On the contrary, they are resultant of the same programmes generated by the central production system, the assumption of which has, in fact, a long historical standing. For example, Washburn already in 1928 espoused the

notion that: '(...) the motor innervations underlying the consciousness of effort are not mere accompaniments of directed thought, but an essential cause of directed thought' (Washburn 1928: 105).

The central production system in which programmes for both language and motor activities (non-verbal behaviour) originate may be identified with a neurally controlled motor system, as the motor theory of language and language origins contends. According to this theory (cf. Allott 1989), both speech and non-verbal behaviour are interdependent at the neurological level, at least as a part of the same central system of coordination, which is motor in nature[4]. Language is assumed as inherently analogous to muscular activity. It is in fact a behavioural motor action, and, therefore, all the distinct features of language 'can be approached in motor terms' (Allott 1989: 31). Less radical approaches, the so-called gestural theory of language origins[5] (see, for example, Armstrong et al. 1995; Corballis et al.1999) assume gestural origins of language, and therefore limit 'the motor programmes' to those accounting for gestural activities, i.e., they suggest that only voluntary movements of hands formed a platform on which language developed much later in evolutionary terms.

Any evidence for motor or even gestural origins of language would provide support for the computational link between verbal and non-verbal behaviours. Nonetheless, it seems that this line of investigation will never offer conclusive evidence, since the question of language origin resembles that of the origin of human beings. Because of the understandable lack of a fossil record, they are reduced to mere speculation and it appears that neither can be approached in scientific terms. The experimental examination of gestures and eye-behaviour occurring in relation to natural speech, however, has turned out very fruitful means for the verification of the hypothesis of the computational link between verbal and non-verbal behaviours.

4.1. Towards a psycholinguistic understanding of gestures

A link between mental processes that underlie the production of gestures and speech was hypothesised by Wundt (1900/1973) already at the beginning of the twentieth century. He espoused the notion that gestures and speech may be different ways of expressing the same idea and therefore they originate in the thinking process that underlies both motor and verbal activities. The earliest

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4   The synchronisation between gestures and speech serves as evidence for the derivation of the components of speech from the same motor programs as those for body movements (Allott 1989: 47).

5   A wealth of evidence for common internal processes of the two channels of communication comes from gesture studies. This is probably the reason for which the theories of language origins narrowed to the gestural antecedent are more common than the radical approach of motor theory.

experimental trace of this line of thinking may be found in Dobrogaev's experiment from 1927, in which it turned out that when subjects were asked to restrain from any gesticulation while speaking, 'no one could carry out such an inhibition completely (...) furthermore, the speech lost its intonation, stress and expressiveness; even the very selection of words needed for the expression of content became labored; there was a jerkiness to the speech, and a reduction in the number of words used' (Dobrogaev 1927 after Kendon 1990: 225).

Since the 1960s several theories of why speech and gestures are far from being psychologically distinct have been proposed. The view that speech and gestures are interrelated is rather widely held. The differences between researchers appear in the exact understanding, i.e., modelling of this link. Two hypotheses, based on the idea of the inhibitory or excitatory nature of the interrelationship, have been offered (see, for example, Feyereisen et al. 1991; Mayberry et al. 2000). The three main areas of controversy within these two frameworks include: a stage of gesture incorporation into the speech production process, relation of gestures to speech in terms of their synchrony with the concurrent lexical item, and function of gestures. Since the last aspect is controversial even between the followers of the same framework, it will be discussed separately. The theories presented below refer only to lexical (representational) and motor gestures (beats)[6], since it is hypothesised that different types of gestures serve different functions and are probably of different origins.

4.1.1. Inhibitory hypothesis

According to the inhibitory hypothesis (also known as the 'competition hypothesis', Feyereisen et al. 1991: 75), there is a rival relation between speech and gestures, which means that the appearance of one is predicted in the absence of the other. It is assumed that the link between the two occurs at the formulation stage where the characteristics of the gestural and vocal outputs are specified. The best-known model within the framework of the inhibitory hypothesis is that by Butterworth and Hadar (1989), based on Levelt's (1989) speech production model[7]. A key premise of this model is that the shared process is verbal. Gestures

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6   These two groups together with symbolic and deictic gestures constitute the four basic categories of gesture classification (for details, see, for example, Krauss et al., 2000: 262-264).

7   In fact, the majority of models constructed to account for the exact relationship between gestures and speech are extensions of Levelt's modular model (1989), which means that a gesture module is attached at some stage of the speech production process, either with or without the modification of Levelt's original speech processor. According to that model, the process of speech production comprises three stages: conceptualization, formulation and articulation. During the conceptualization stage, a communicative intention is constructed by means of references to declarative and procedural knowledge, i.e., the relevant information is

are generated from a common plan and this is the verbal plan of the utterance. Consequently, gestures are generated *after* the early message construction, as a translation of some linear-segmented qualities of the sentence into imagistic qualities of the gesture. Since they are based on the output of the sentence, they convey the same information as their verbal counterpart. Therefore, in terms of Levelt's model, the initiation of gesture according to the inhibitory theory takes place in the process of lemma retrieval, which is the sub-process of the formulation stage. First, computation of a sentence takes place and on the basis of it, computation of a gesture proceeds. It is claimed (cf. Hadar et al. 1997) that gestures appear during word retrieval difficulties experienced by the speaker. When the sought-for word is accessed they are said to terminate.

Consequently, within this approach the lack of a temporal relationship is hypothesised, since gesture production is inhibited by speech production and conversely. In essence, gesture production is considered as accessory with respect to the speech flow.

4.1.2. Excitatory hypothesis

The theories based on the excitatory hypothesis (also known as the 'co-activation hypothesis', Feyereisen et al. 1991: 75) assume that gestures and speech are generated and, consequently, occurring simultaneously. The theories still differ on modelling the exact realisation of the computational link between the two. Most models within this approach (e.g. de Ruiter 2000; McNeill 1992, 2000) assume the conceptualisation link between gestures and speech. McNeill's (1992, 2000) Growth Point theory[8], following the assumption that the utterance has both imagistic and linguistic sides, even predicts that the gesture, which is a representation of the imagistic side of the message, precedes the linguistic plan, being a demonstration of the most 'primitive' form of communicative intention. Still, not all the theories based on the excitatory hypothesis view gestures and speech as initiated by the speaker's communicative intention (see, for example, Krauss et al., 2000 and his hypothesis of preconceptual link taking place in working memory).

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retrieved. A preverbal message, the product of this stage, is then transformed in two ways during formulation. In essence, the individual words are selected to match the content of the preverbal message in the process known as lexicalization and by means of the syntactic planning the conceptual structure is transformed into a surface structure. Then words are turned into sounds using a phonological encoder, that is, a detailed phonetic plan (a set of instructions for the articulatory system) is prepared. The process is accompanied by monitoring one's own speech for error detection and one's interlocutor response for constant adaptation to the flow of interaction (cf. Levelt 1989).

8   At the moment, this is the only non-modular account of the processing involved in gesture production.

An important implication of the assumption that there is a co-activation of gestures and speech during the shared computational stage is that gestures and speech are synchronous. The specific linguistic segments that are co-expressive with the gesture are co-temporal. The most meaningful segment of the gesture, the stroke (cf. McNeill 1992) lines up in time with the equivalent linguistic segment. Such synchrony implies that the speaker is presenting the same meaning in both channels at once. The two channels however are not a translation one of the other, as the inhibitory theory would insist, but complement one another in terms of meaning. Having a shared meaning provides the basis for integrating gesture and speech into a single performance.

4.1.3. The comparison of the inhibitory and excitatory hypotheses

Several arguments have been proposed against the inhibitory theory. First of all, it seems unlikely that gestures are translations of single lexical items. Gestures (iconic gestures, to be more specific) generated in the process of lemma retrieval (as the above-mentioned theory by Butterworth et al. 1989 states) should be associated with single lexical items. However, if this were the case, gestures would have to carry the exact meanings of their lexical affiliates, and, in reality, the meaning of iconic gestures accompanying spontaneous speech does not relate to single words but rather to some 'conceptual' affiliates.

Another argument against the grammatical encoder (lemma retrieval is the sub-process of grammatical encoder) as the place of gesture initiation arises from the structure of Levelt's model. Gestures convey the imagistic (i.e. spatial) information, which is retrieved by means of working memory. The formulator, however, and consequently the grammatical encoder do not have access to working memory in terms of Levelt's model, therefore gestures cannot be generated at this stage.

Also the evidence that comes from speech disturbance studies seems to contradict the assumptions of the inhibitory theory. It was observed (cf. Mayberry and Jaques 2000) that in the case of stuttering gestures, instead of their increased production during word retrieval difficulties, which the inhibitory theory would suggest, they were co-produced during fluent and not disfluent speech. Only speech related gestures (beats) were disrupted by stuttering.

It was also found (e.g. already-mentioned Dobrogaev 1927; and more recently, Rime et al. 1991) that preventing subjects from gesturing interferes with fluency of speech production. This would not be the case if gestures were simply derived from speech. Finally, when the speech is repaired, the gesture anyway is repeated in the original form (cf. Kita 2000), which again implies that it cannot be the mere output, or 'translation' of the sentence.

It seems therefore more likely that gestures perform the complementary function in relation to the concurrent speech. This, in turn, suggests a different stage

of gesture incorporation into the speech production model. The excitatory hypothesis, the second framework within which the gesture-speech relationship is modelled, instead of the formulation stage proposes the stage of conceptualisation. Four arguments have been proposed in support of the excitatory approach (after McNeill 1985: 351): (1) gestures are synchronised with concurrent flow of speech, (2) gesture and speech perform simi-lar pragmatic and semantic functions; (3) linguistic and gestural abilities in aphasics dis-solve simultaneously, and (4) developmental studies point to the integration between the two channels of communication, since gestures develop together with speech in children.

It must be admitted, however, that the basic issues concerning the gesture-speech relationship are still unsolved. Moreover, because, first of all, the field is very diverse, and only recently have some attempts been made to unify and systematise its methodology, so that results become comparable to a larger extent, in many cases there is empirical evidence supporting opposing views. This is the case, for example, with the question where exactly gestures appear in relation to speech. The fact of tight synchronisation or its lack is assumed as conclusive evidence for each of the two theories (cf. de Ruiter 2000). Though empirically verifiable, the issue whether they are synchronised with their verbal counterpart (as the followers of the excitatory hypothesis claim) or precede it, most often occurring in the pauses before the verbal equivalent (as the supporters of the inhibitory hypothesis suggest) is in fact the source of a major controversy between proponents of both frameworks. Different results between the opponents may be explained exactly by the methodological differences mentioned above: for example, the focus of both groups on different phases of gestures (for details, see discussion in Nobe 2000), or even problems with the very definition of a gesture, or a gesture component to be compared with speech. The very fact that the experimental analyses have begun to be designed in such a way so as to confirm or disconfirm the existing theories (for example, the inhibitory or excitatory hypotheses) will introduce rigidity and systematisation into the future data.

4.1.4. Functional interdependency of gestures and speech: communicative and cognitive functions of gestures

The above conclusion that the basic issues concerning the gesture-speech relationship are still unsolved is probably the most true when the issue of functions of gestures in relation to speech is considered. Proponents of both the inhibitory and excitatory hypotheses recognise the cognitive and communicative functions of gestures in relation to speech. Still, the exact explanations for the two functions differ even between followers of the same framework.

One of the main arguments put forward in support of the cognitive function is that during conversations on the phone the occurrence of some gestures

(representational gestures, to be precise) remains at the same level, even though they cannot be seen by the interlocutor, that is, their communicativeness can be at least questioned. Two lines of explanation are offered for the cognitive function of gestures. According to the Image Activation Hypothesis represented by Freedman (1977) and de Ruiter (1995), representational gestures reinforce the connection between a concept and its lexical equivalent, especially in the case of spatial features which, after their conceptualisation at the first stage of the process, are said to be activated by means of gestures and then linguistically encoded at the speech formulation stage. Another approach, the Lexical Retrieval Hypothesis, stresses the function of gestures at the level of the linguistic encoding, emphasising in this way the role of gestures in lexical retrieval. This view is supported both by the excitatory theory adherents (e.g. cf. Krauss et al. 1996) and the followers of the inhibitory theory (cf. Butterworth et al.1989). They argue that representational gestures help a speaker retrieve lemmas (the morphosyntactic specifications of words to be delivered) by cross-modal priming. Yet another alternative approach, the Information Packaging Hypothesis, proposed by Kita (2000), anticipates the function of gestures at the very beginning of the processes of speaking, that is, at the stage of thought formulation. According to this theory, with the help of representational gestures, spatio-motoric information is organised in appropriate 'packages', which later 'unpack' in a form of a linguistic representation (Kita 2000: 163).

Gestures are also believed to perform the communicative function (cf. Kendon 1982). This function, however, raises many arguments. The authors (cf. Krauss et al. 2001) who support the word retrieval function of gestures (in other words, the cognitive function) usually attempt to undermine the communicative role of gestures. One argument for this non-communicative view is the fact that people gesticulate when talking on the phone, that is, display gesturing non-accessible for the listener. In response, the supporters of the opposite, 'communicative' view argue (de Ruiter 2000: 291) for their intended communicativeness, admitting that their effectiveness is another issue and does not have to necessary go with them. It is claimed (ibid.) that gestures may not have the same communicative efficacy under all circumstances, however there are still communicative devices from the speaker's point of view.

Despite these difficulties and controversies, experimental analyses of gesture distribution in relation to speech are increasing in number, since as McNeill (1981: 206) wrote '(...) combined with the speech channel, gestures give a rich basis, beyond the basis usually considered in linguistic investigations, for interpreting language activities'. These studies may lead to the reformulation of, for example, speech production models into which non-verbal behaviour will have to be incorporated. So far, as has been demonstrated above, a number of

attempts have been made to incorporate gestures at the conceptualisation and formulation stages.

4.2. Towards a psycholinguistic understanding of eye-behaviour

The second line of experimental analyses which has turned out a fruitful means for the verification of the hypothesis of the computational link between verbal and non-verbal behaviours has focused on eye-behaviour.

As has been already remarked, one of the first investigations carried out in the line relating eye-behaviour to linguistic units concentrated on the regulatory function of gaze in conversation (cf. Duncan 1975; Kendon 1967). In Kendon's study (1967), however, a first attempt was made to relate the study of eye-behaviour not only to speech, but also to the actual processes of speech production. Two functions, cognitive and monitoring, were distinguished.

4.2.1. Functional interdependency of eye-behaviour and speech: the cognitive function of eye-behaviour

In the study by Kendon (1967), it was noted that speakers tend to avert gaze, especially during the actual speech production. This function of gaze, or in fact, of gaze *aversion,* is known as cognitive, since it is believed to reflect directly the cognitive processing taking place during speech planning and production. Given speakers' limited processing capacity, changes in the speaker's gaze are said to reflect competition in the completion of two tasks: speech planning and visual monitoring of their interlocutor (cf. Argyle and Cook 1976). Various studies have confirmed the finding that gaze aversion facilitates speech planning. Gaze aversion has been especially noted during disfluent speech (cf. Beattie 1979) and in particular during filled pauses, which are symptomatic of difficulties in formulating speech (cf. Cegala et al. 1979), clause boundaries (cf. Goldman-Eisler 1968), beginnings of turns (cf. Kendon 1967), that is in general at places where cognitive planning is believed to take place.

It has also been observed recently that the cognitive function of gaze does not exclusively involve speech processing facilitation by means of gaze aversion while experiencing difficulties during encoding by a speaker. For example, during an object naming experiment (cf. Meyer 2000), it emerged that linguistic formulation benefits from directing visual attention to the referent object. This fact is not predicted by most theories of speech production and points to a direct connection between gaze and speech. In another 'object naming' experiment (cf. Meulen et al. 2001), it was discovered that gaze behaviour reflects the actual process of lexical access. When eye movements were registered during speech production while naming different objects, it emerged that patterns of viewing

these objects matched those of naming them, i.e., speakers looked longer at objects with partial rather than complete contours, and at objects with low rather than high frequency names. In other words, the timing of the speakers' eye movements evidently depended not only on how difficult the objects were to identify, but also on how difficult it was to retrieve their names, precisely as a serial stage model of lexical access in Levelt's model would predict.

4.2.2. Functional interdependency of eye-behaviour and speech: the monitoring function of eye-behaviour

The second function of eye-behaviour in relation to speech, i.e., the function of monitoring, decides about the interactive character of communication and enables the actual effective participation in conversation.

Several elements, operating by means of different input systems, constitute this process in terms of Levelt's model (see Footnote 7). By means of the auditory system (speech comprehension system) monitoring of, e.g., the type and topic of a discourse and also what is currently in focus proceeds. The same system, which has access to one's inner and overt speech, co-ordinates also so-called self-monitoring. The process of self-monitoring allows speakers to correct and improve on what they are saying.

Monitoring by means of gaze, that is, receiving feedback from the visual input system, is still different. First of all, it competes with the cognitive function of gaze. The major function of gaze in this sense is to provide the system with visible information concerning various aspects of the interaction status, i.e., observation of signs of comprehension, agreement, disagreement, the degree of listener attentiveness, etc., but also e.g., the listener's wish or attempt to take the floor. It has been found that speakers tend to look at their interlocutors at the end of turns (cf. Kendon 1967) and during fluent phases (cf. Beattie 1981), that is, at places where it would be highly beneficial to monitor the interlocutor in order to get feedback concerning comprehension of what has been produced by the speaker. A 'side effect' of monitoring is also elicitation of the so-called 'back – channel' responses (e.g. smiles, head nods) from the listener (cf. Duncan 1975; Duncan and Fiske 1985), i.e., information from the listener about their understanding and reaction. Within the interactionist perspective (cf. Clark and Schaefer 1987; Clark and Wilkes-Gibbs 1986) monitoring is an indispensable element of speech production as it provides information to the system about what is coming next, both from the speaker's turn perspective and discourse perspective. Speakers use such visible information as facial expressions and head nods to help themselves to formulate the content of the speech to come.

The cognitive and monitoring functions of gaze in relation to speech production processes work interchangeably in conversation. When the cognitive demands of speech planning are substantial, speakers avert gaze to reduce the visual information input, and when those demands are moderate, they redirect their gaze towards the listener, especially at points in the speech flow where feedback would be useful. Gaze distribution is therefore not random but it is associated with certain linguistic processes employed by a speaker. Moreover, the finding that the time speakers spend looking at an object appears to correspond closely to the time needed for visual and conceptual processing and name retrieval (in other words, the very fact that eye movements and speech production are systematically co-ordinated) suggests that eye monitoring can be fruitfully used in studies of speech production. Since a gaze shift seems to be a shift of attention, gaze observation can provide information helping to determine when different parts of a picture are processed, how the order and time spent on the processing of each object are related to the speaker's lexical and syntactic choices and in this way how the actual process from intention conceptualisation to its linguistic realisation in a form of speech output proceeds.

5. Towards a psycholinguistic understanding of non-verbal behaviour: future research

The understanding of the relationship between verbal and non-verbal behaviours, i.e., accounting for their computational link, as shown by the example of gestures and gaze, is still a long way from any definite conclusions and well-grounded theories.

There are still more questions than finally settled problems. First, it is still unknown, whether the two modes of expression (verbal and non-verbal) function on the basis of modular processing, which proceeds in stages, or connectionist processing, during which spread activation along a set of excitatory or inhibitory connections takes place, not to mention the fact whether the particular mode of processing is common for the two.

Next, the exact interrelations at the neural level between the two channels of communication are unidentified. So far the evidence from neuroscience and cognitive psychology (research on picture description and visually guided reaching) shows that our cognitive processing involves interconnection of multiple systems and operations determined by a general cognitive architecture. The neurological evidence also suggests that non-verbal behaviour (eye- and other body parts movements) is controlled by the same mechanism that controls conceptualisation and expression of emotions. Neurons responsible for (1) 'sensory inputs (e.g. somaesthetic, proprioceptive, vestibular, auditory and

visual)', (2) 'movement information of the oculomotor system, head, limb, and the locomotor system', (3) 'the limbic system', are all placed in the posterior parietal cortex, which is believed to be involved in intention and affect expression (cf. Stein 1992 after Kita 2000: 183). This finding may have twofold implications. First, it can be assumed on its basis that, at least in some conditions, eye-gestures may for example fulfil the same function as gestures, that is, participate in the conceptual, pre-verbal organisation of the message. Secondly, and more importantly, this might be one of the few hints detected at the neurological level of the conceptualisation link between verbal and non-verbal behaviours (the part of the brain mentioned is responsible both for intentions generation and motor activities). Another such piece of evidence comes from the experiments in which it was found (cf. Feyereisen et al. 1991) that naming pictures of tools and imagining hand movements with these tools activate the same premotor area. Therefore, it might be the case that action words localised in motor areas are somehow related to the hand movements, and they together constitute the functional knowledge about the objects. The assumption that the cognitive architecture of human minds is based on representations of actions would also explain gestural activity during speaking. Consequently, on the basis of the above, also gesture participation in the processes of speech conceptualisation and next its generation could be inferred.

The above offers some insights into the next problem in grasping the nature of the relationship between verbal and non-verbal behaviours, that is, at which stage (if modular, sequential connections are assumed) of processing the link occurs, and consequently, what is the function of the non-verbal mode of expression in relation to speech. If at the stage of message generation, the function is crucial for mental processing; if at the stage of message formulation, the function of gestures may be perceived as a facilitating factor. For example, gesturing in certain ways, the neural nature of which still remains unknown, could facilitate retrieval of words, at least those located in sensorimotor regions of the brain. The function of non-verbal behaviour could also be inhibitory in relation to the cognitive processing, for example, gaze aversion while encountering cognitive difficulties reduces the sensory input entering the perceptual system.

All these issues constitute the core of the research problems of the psycholinguistic approach to non-verbal behaviour. Their further experimental examination may be closer to obtaining some conclusive results due to the technological progress in data processing. Since the analysis of non-verbal behaviour is very detailed, conducting it perceptually is very time-consuming. In addition, some analyses (e.g. stroke extraction from gestures) are impossible to accomplish without automated tools. These tools have been developed only recently as a result of interdisciplinary cooperation between engineers, computer scientists, linguists and psychologists.

6.   Conclusion

The present paper started with the citation of a popular saying which, in general, acknowledges the presence of non-verbal behaviour in the process of communication. Still, as it was remarked, for the adherents of the interdependent channels approach 'speaking with our bodies' means conveying different information than when speaking 'the language', whereas the followers of the interdependent channels approach assume functional relationship between the two modes of communication. Finally, according to the third understanding, a natural development of the second one, non-verbal behaviour should be perceived not only as functionally similar, but also computationally related to the verbal mode of expression. The aim of the paper was to present some preliminary justification for this claim.

In conclusion, it ought to be pointed out that none of the approaches described, especially the one presented in greatest detail, is or should be considered more correct than the others. The truth is that the first interpretation, assuming the functional distinctiveness of verbal and non-verbal behaviours, has for a long time dominated the field. It has been additionally publicised (and, very often, misinterpreted by a straightforward correlation of single cues displayed through non-verbal behaviour with various social aspects of communication) by, for example, the authors of the popular handbooks of 'effective non-verbal communication'. The present-day technological progress, in turn, directs researchers' attention to the mental processes underlying both verbal and non-verbal behaviours, which were completely inaccessible earlier. It seems that their analysis may reveal not only the nature of the relationship of non-verbal behaviour to speech, but also some general principles of human cognition.

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