

Facial Expressions A study of Eyebrow Movement During Conversation

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المستخلص

تقترح بعض الدراسات ان هنالك علاقة بين عملية تحريك الحاجب والمظاهر المختلفة للرسائل اللفظية، ولكن المعرفة بهذه الرابطة لاتزال محدودة جداً. ان أي محاولة لتكوين وتوصيف العلاقة بين حركة الحاجب والاشارة اللغوية سيسهل فهم تصرف الاتصال البشري المتعدد النماذج. حيث سيكون من الممكن تطوير فعالية وقابلية عوامل المحادثة المتحركة للحاسوب في انظمة الاتصال المتعددة النماذج. يمكن للحاجبان ان يتقلا مختلف المشاعر - المواقف، المزاجيات، الشك، وفي بعض الاحيان عدم الرضا. حيث تعمل هذه سوية مع بقية تعابير الوجه لغرض توصيل الرسالة. يقدم هذا البحث خلفية لغوية بالاضافة الى تقديم نوع الموضوع الذي يربط حركات الجسم بالرسالة اللفظية. كما يلفت النظر الى حركات الحاجب في فصل منفصل. حيث اظهر هذا الفصل الدراسات القليلة المتوفرة التي بينت كيف ان تحريك الحاجب له علاقة لغوية مهمة بالاتصال ولكن المعلومات عن هذا النوع من السلوك في المحادثة محدودة جداً. كما اهتم هذا البحث بدراسة حركة الجسم وعلاقته بالقناة الشفوية. اخيراً، قد عرض البحث المناقشة والنتائج.

Abstract

Some studies have suggested a relationship between eyebrow movement and different aspects of the verbal message, but the knowledge about this link is still very limited. If there is an attempt of establishing and characterizing a relation between eyebrow movements and the linguistic signal it can better understand human multimodal communication behavior. It is possible to improve the credibility and efficiency of computer animated conversational agents in multimodal communication systems.

Eyebrows can communicate a full range of emotion - attitude, sense of humor, skepticism, and sometimes disbelief. They work with the rest of your facial expressions to communicate a message.

This research presents some linguistic background before presenting the kind of subject that has related body movements to the verbal message. Special attention to eyebrow movements in a separate section will show how the few studies available suggest that eyebrow movements may have an important linguistic role in communication but there has been very limited knowledge about this behavior in conversation. There is also a study of body motion in relation to verbal channel. Finally, a general discussion and conclusions are introduced.

Introduction

Like many of the subtleties of human communication, the use of the face is something we believe we understand but cannot yet describe. Human facial

movements have attracted a great deal of research, but the information we have about the use of the face in multimodal communication is still very limited. Research on facial movements has been largely dominated by the study of the expression of emotion. By contrast, and leaving aside movements that are necessary for the articulation of speech, studies on facial movements in connection with spoken language have been scarce. The difficulty in carrying out this type of research may explain to some extent the apparent neglect in the literature.

Observations have, however, been made which suggest possible conversational functions of eyebrow movements in particular, and in recent years a few studies have taken an empirical approach to this issue. Many results do not appear robust and more research is needed, especially in the temporal coordination of facial movements with the linguistic signal.

The sketchy nature of the evidence for coordination is particularly surprising because other body movements have been shown to have a non-random relation with the speech they accompany. For instance, hand gestures, head movements, body shifts, and gaze seem to integrate with language to deliver a message. If this is the case, then the intuition that eyebrow movements are also related to the speaker's message is probably well founded.

In this research, the researcher investigates the relationship between the linguistic signal and eyebrow movements in dialogue. In particular, the researcher is interested in when these movements appear in relation to speech, and ultimately in *why* they happen at all. If it is possible to describe the use of facial movements in dialogue, embodied conversational agents in multimodal communication systems will not be hampered by strikingly poor coordination between the verbal and the visual channel. One of the aims of this research is to provide some information that may improve this coordination in the design of such systems.

Chapter One: Functions of Body Movement and Linguistics Signals

Section 1.1 Conversation and Facial Expressions

A conversation is communication between multiple people. It is a social skill that is not difficult for most individuals. Conversations are the ideal form of communication in some respects, since they allow people with different views on a topic to learn from each other. A speech, on the other hand, is an oral presentation by one person directed at a group.

For a successful conversation, the partners must achieve a workable balance of contributions. A successful conversation includes mutually interesting connections between the speakers or things that the speakers know. For this to

happen, those engaging in conversation must find a topic to which they both can relate in some sense. Those engaging in conversation naturally tend to relate the other speaker's statements to themselves. They may insert aspects of their lives into their replies, relate to the other person's opinions or points of conversation.

Conversation is indispensable for the successful accomplishment of almost all activities between people, especially the coordination of work, the formation of friendship and learning.

Facial expressions are an important channel of nonverbal communication. Many animal species display facial expressions, but expressions are highly developed particularly in the primates, and perhaps most of all, in humans. Even though the human species has acquired the powerful capabilities of a verbal language, the role of facial expressions in person-to-person interactions remains substantial. Messages of the face that provide commentary and illustration about verbal communications were significant in themselves.

The study of human facial expressions has many aspects, from computer simulation and analysis to understanding its role in art, nonverbal communication, and the emotional process. Many questions about facial expressions remain unanswered and some areas were relatively unexplored.

Psychological studies of facial movements had traditionally been directed towards the expression of emotion. A link between emotional states and facial expressions was already discussed by Darwin. Previous to his publication *The Expression of the Emotions in Man and Animals* (Darwin, 1872:84), this link had already been suggested by Bell (1844:19) and Duchenne de Boulogne (1862:76). Darwin claimed that facial expressions of emotion were innate, universal, and a product of evolution, and were not exclusive to the human race. He described some expressions of "states of the mind", such as "surprise", and also tried to explain why we produce them

From the 1960s onwards the study of facial expression returned to the arena of psychological research and was legitimized by several events as explained by Rosenberg (1997:79). In 1962, Tomkins published a theory of affect in which the face played a central role as a site of emotion. His ideas were consistent with Darwin's, and together with McCarter he reported a study (Tomkins and McCarter, 1964:96) in which observers consistently identified facial expressions as indicative of certain emotions. Ekman and Izard's cross cultural work on facial expressions of emotion in literate and preliterate cultures (e.g. Ekman and Friesen, 1971:117; Izard, 1971:84) presented evidence for the universality of the recognition of facial expressions of emotion. Subsequent work

by them and their followers strengthened the face-emotion link, which has dominated the study of facial expression in psychology until thus far.

Other emotions are subcategories or combinations of these. Facial expressions of emotion are considered involuntary but can also be voluntarily managed by what has been called "display rules", that determine what type of emotion is appropriate to a particular situation in a particular culture. One of the main ideas defended by psychologists in this program, the universality of facial expressions of emotion (e.g. Ekman, 1997:71) was criticized by Russell and Fern'andez-Dols, who argued that there was insufficient evidence for identical expression-emotion pairs across cultures. They even questioned the link between emotion and the face, since the assumption that facial expressions are caused by emotions has not been tested (1997:69).

Section 1.2 Synchrony of Gesture, Facial Movements, and Speech

Facial expression, eye gaze and hand gestures did not only do their communicative work within single utterances, but also had interspeaker effects. The presence or absence of confirmatory feedback by one conversational participant, via gaze or head movement, for example, affected the behavior of the other. A conversation consisted of the exchange of meaningful utterances and of behavior. One person punctuated and reinforced his/her speech by head nods, smiles, and hand gestures; the other person can smile back, vocalize, or shift gaze to show participation in the conversation.

Synchrony implies that changes occurring in speech and in body movements should appear at the same time. For example, when a word began to be articulated, eye blinks, hand movement, head turning, and brow movement could occur and finish at the end of the word. Synchrony occurs at all levels of speech: the phonemic segment, word, phrase or long utterance. Different facial motions were characteristic of these different groups (Condon and Osgton, 1971:57). Some of them were more adapted to the phoneme level, like an eye blink, while others acted at the word level, like a frown. In the example "Do you have a blank check?", a movement of eyebrow started and ended on the accented syllables "check", while a blink started and ended on the pause marking the end of the utterance. Facial expression of emphasis could match the emphasized segment, showing synchronization at this level (a sequence of head nods can punctuate the emphasis).

Moreover, some movements reflected encoding-decoding difficulties and therefore coincided with hesitations and pauses inside clauses. Many hesitation pauses were produced at the beginning of speech and correlate with avoidance of gaze (the head of the speaker turns away from the listener) as if to help the speaker to concentrate on what she is going to say. Gestures occurred in

synchrony with their semantically parallel linguistic units, although in cases of hesitations, pauses or syntactically complex speech, it was the gesture which appears first (David Mc Neill, 1992:67).

David Mc Neill (1992:75) stated that the most local level, individual gestures and words were synchronized in time so that the 'stroke' (most energetic part of the gesture) occurred either with or just before the phonologically most prominent syllable of the accompanying speech segment. At the most global level, we found that the hands of the speaker came to rest at the end of a speaking turn, before the next speaker began his/ her turn. At the intermediate level, the phenomenon of co-articulation of gestural units was found, whereby gestures were performed rapidly, or their production was stretched out over time, so as to synchronize with preceding and following gestures, and the speech these gestures accompany. An example of gestural co-articulation was the relationship between the two gestures in the phrase "get the check MADE OUT TO YOU for fifty dollars and then I can WITHDRAW fifty dollars for you". During the phrase 'made out to you', the right hand sketches a writing gesture in front of the speaker. However, rather than carrying this gesture all the way to completion (either both hands coming to rest at the end of this gesture, or maintaining the location of the hands in space), the hand dropped slightly and then pulled back towards the speaker to perform the 'withdraw' gesture.

Thus, the occurrence of the phrase 'made out to you', with its accompanying gesture, affected the occurrence of the gesture that accompanied "withdraw". action produced by one or a group of related muscles. Kalra et al., (1991:43) show that the multi-layer approach allows independent control at each level of the system. At the lowest level (geometric level), geometry of the face can be modified using free form deformation techniques. At the highest level, facial animation can be computed from an input utterance.

Section 1.3 Communicating Signals through Facial Movements

Researchers have considered functions of facial movements beyond the expression of emotion. In the following subsections the social function of certain facial movements will be introduced.

Subsection 1.3.1 Social Functions of Human Behaviour

As we have seen in the previous sections, the notion that facial expressions are involuntary indicators of underlying emotions, has been challenged from different sides. One source of criticism is human ethology. For instance, after working within the tradition of the face-emotion link for many years, Fridlund (1997:89) later proposed an alternative explanation for facial

expression: the behavioural ecology view (e.g. *ibid*:89). Within this view facial displays are not expressions of discrete emotions, involuntarily produced and sometimes modified by display rules. Instead, they are social signals, "messages which influence others' behavior because vigilance for and comprehension of signals co-evolved with the signals themselves" (*ibid*:104). These signals signify our intentions in a given social interaction and are only interpretable within that context. Similarly, a "fear face" in the former, would be a sign of "readiness to submit or escape" in the latter, and so on. The behavioural ecology view therefore, emphasizes the social function of facial displays. And this "sociality" applies even in situations when there is no "interactant" present, because "people are always implicitly social even when schematically alone".

Eibl-Eibesfeldt (1979:46) has also studied facial and other body movements as social signals and as part of human communicative behavior not necessarily linked to emotion. He was interested in the social functions of human behavior across cultures and pointed out that expressive behaviour has a communicative function, and can be interpreted by an onlooker even if a message is not intended.

When someone shivers, for instance, "he does not necessarily intend to communicate 'I am cold' or 'afraid', but the perceiver of the behavior may recognize the mood of the sender and either learn to attach significance to it or phylogenetically adapt to it" (*ibid*:11).

Eibl-Eibesfeldt paid particular attention to what he called the "eyebrow flash" (Grammer et al., 1988:59): a very quick movement of the eyebrows, which in his recordings were maximally raised for approximately 16 of a second. He first observed this movement in different cultures in situations of greeting, especially over a distance, in which people would also smile and nod.

Later, he observed it in several other situations, such as flirting, approving, seeking confirmation, thanking, and emphasizing a statement (calling for attention). He concluded that in these situations "the basic common denominator is a 'yes' to social contact and that the eyebrow flash is used either for requesting such a contact or for approving a request for contact" (*ibid*:300).

Looking at other contexts in which eyebrow movement occurred, Eibl-Eibesfeldt (1979:166) observed that people often raise and hold their eyebrows up for a while when they are surprised or, in conversation, when asking a question. He explained that in both cases people attend and open their eyes to perceive better and their eyebrows are raised in connection with the opening of the eyes. He hypothesized that "the eyebrow lift of surprise - originally part of the opening of the eye - was the starting point for the ritualization of several 'attention' signals" (*ibid*:301). He grouped some of these into "friendly attention signals" represented by the eyebrow flash, which can be accompanied by

nodding and smiling. As can be seen in Figure 1.1, emphasizing a statement was included into the contact and approval seeking eyebrow flash, whereas eyebrow movement when asking questions was considered a different attention signal.

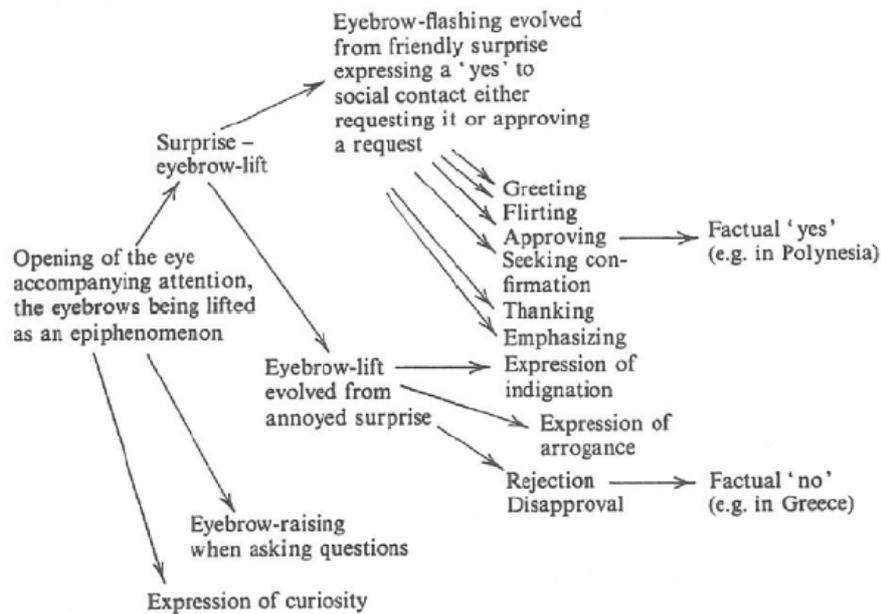


Fig. 1.1

Assessing the possible function of brow movement in its facial context, Grammer et al.(1988:78) pointed out it could stress the meaning of other social signals, mostly positive signals like smiling. And it could also be combined with “single verbal utterances” to mark their meaning for the interlocutor. Thus, they interpreted the eyebrow flash as a universal “social marking-tool” and concluded that it might have received this function through its prominent position in the face guaranteeing its visibility.

The possible social functions of eyebrow movement will not be addressed in the analysis of the current research. However, it is interesting to notice the reported temporal properties of the brow movement in the study above, such as the tendency for a fast onset. According to Grammer et al, this represents a marked change in the behavioral flow which is necessary for a particular behavior to become a stimulus interpretable by a perceiver. Another interesting and relevant finding is the fact that brow movement was longer at the start of interactions.

Section 1.3.2 The Social Communicative Functions of Facial Movements

The social communicative functions of facial movements have also been emphasized by psychologists Bavelas and Chovil (1997:334). They described facial displays, a term they prefer to facial expressions, as "active, symbolic, components of integrated messages (including words, intonations, and gestures)". They believe that "although they often depict emotional reactions by self or other, they are not emotional expressions; they signify rather than reveal". Since most facial displays occur in social interaction, these authors emphasize that they must be studied in conversation, in order to explore their communicative functions and their meaning in context.

Some researchers criticized the involuntary expression of emotional states as an explanation for facial behaviour. They proposed an alternative explanation that assigns social communicative functions to these movements. Within this approach, a relation between facial activity and the verbal message has been suggested. This is the relation that will be investigated in the current research, for eyebrow movement, but only from a linguistic perspective, leaving aside possible social functions.

Chapter Two: Linguistic Background for Functions that have been Associated with Body Movement and Eyebrow Movement

Section 2.1. Background

The purpose of this chapter is to introduce some linguistic background for functions that have been associated with body movement and eyebrow movement in particular. I will deal with discourse structure and utterance function, intonational prominence, and information structure. These will play a central role in the current analysis. The presentation here will be from a purely linguistic point of view. Body movement will be discussed later.

Subsection 2.1.1 Utterance Function and Discourse Structure

When we start a conversation we do not produce isolated utterances at random. Our utterances are linked to other utterances, and in this way they convey meaning and allow communication. Thus, some utterances form groups that combine into larger groups to make up the structure of the conversation.. Several schemes have been proposed. One criterion that has been used to analyse discourse structure is the utterance purpose. That is, utterances can be connected according to the speaker's purpose in producing them. In a computational approach to conversational analysis, Power (1974: 19) studied conversation in terms of the underlying goal of utterances. He proposed the notion of "conversational procedures" using a computer model of conversation.. Developing Power's model, Houghton proposed four "interaction frames" used

to accomplish simple goals in a similar robot simulation: getting attention, providing information, requesting information, and accomplishing an action.

Subsection 2.1.2 The Functions of Social Dialogue

The purpose of small talk is primarily to build rapport and trust among the interlocutors, provide time for them to “size each other up”, establish an interactional style, and to allow them to establish their reputations (Dunbar, 1996:67). Although small talk is most noticeable at the margins of conversational encounters, it can be used at various points in the interaction to continue to build rapport and trust (Cheepen, 1988:89), and in real estate sales, a good agent will continue to focus on building rapport throughout the relationship.

Small talk has received sporadic treatment in the linguistics literature, starting with the seminal work of Malinowski who defined “phatic communion” as “a type of speech in which ties of union are created by a mere exchange of words”. Small talk is the language used in free, aimless social intercourse, which occurs when people are relaxing or when they are accompanying “some manual work by gossip quite unconnected with what they are doing” (Malinowski, 1923:123). Jacobson (1960:96) also included a “phatic function” in his well-known conduit model of communication, that function being focused on the regulation of the conduit itself (as opposed to the message, sender, or receiver) (Ibid:96). More recent work has further characterized small talk by describing the contexts in which it occurs, topics typically used, and even grammars which define its surface form in certain domains (Cheepen, 1988:57). In addition, degree of “phaticity” has been proposed as a persistent goal which governs the degree of politeness in all utterances a speaker makes, including task-oriented ones.

Subsection 2.1.3 Intonational Prominence

Research on intonation has long been characterised by a number of unresolved basic issues and fundamental differences of approach. For many years, these precluded the emergence of any widely accepted framework for the description of intonational phenomena, or even any general agreement on what the interesting phenomena are. Since the mid 1970s, however, several lines of research have converged on a set of broadly shared assumptions and methods, and studies on a variety of languages are now yielding new discoveries expressed in comparable terms. This emerging viewpoint is the subject of this subsection.

The meaning of utterances are taken from words, word order, and how words are said. Body movement, particularly brow movement, is thought to be associated with the phonological prominence of words. In a linguistic message

not all words have the same weight. Some words stick out and are more "prominent" than others. This does not happen at random, it is part of the linguistic meaning. For instance, imagine a conversation where someone has just mentioned a person named Layla who is unknown to the interlocutor. When asked "who is Layla?", this someone answers "she is a Iraqi teacher". Now, with the phrase "Iraqi teacher" he can mean one thing if he makes "Iraqi" prominent (Layla comes from Iraq and is a teacher) and something else if he makes "teacher" prominent (Layla teaches Iraqi). This illustrates how different prominence patterns can convey different meanings on the same string of words. Ultimately, prominence is a perceptual phenomenon always determined in relative terms from a relation between weak and strong elements in an utterance, but how exactly it is realized phonetically is not a simple issue. It is associated to suprasegmental features of the linguistic signal, that is, fundamental frequency, intensity, and duration, and therefore intonation, which is described by Ladd (1996:25) as the use of these "suprasegmental phonetic features to convey 'post lexical' or sentence-level pragmatic meanings in a linguistically structured way". In English, major sentence-level prominence is associated with the occurrence of a pitch accent on the prominent word.

Pitrelli et al., (1994:142) state that the definition of pitch accent is not always clear, but there is very good agreement (80.6%) on the identification of presence/absence of pitch accents by listeners. A pitch accent can be defined as "a local feature of a pitch contour - usually but not invariably a pitch change, and often involving a local maximum or minimum - which signals that the syllable with which it is associated is prominent in the utterance" (Ladd, 1996:46). Pitch accents are elements of intonational contours, which are often analysed in terms of two distinctive levels: High and Low.

Stress is also related to prominence and can be interpreted as "acoustic salience" that can be cued by the presence of a pitch accent but also by increased intensity and duration. Stress is one of the most difficult concepts to define in intonation, because it is "a complex perceptual amalgam only indirectly relatable to psychophysical and physical dimensions" (Ladd, 1996: 6). In English, stressed syllables are often accompanied by pitch accents and some studies have used both terms interchangeably (different approaches to intonation have even used them in opposite ways).

Subsection 2.1.4 Information Structure and Discourse Structure

Information structure is construed broadly here as comprising structural and semantic properties of utterances relating to the discourse status of their content, the actual and attributed attentional states of the discourse participants, and the participants' prior and changing attitudes (knowledge, beliefs, intentions,

expectations, etc.). This broad view of information structure is meant to subsume notions like focus, presupposition, given vs. new, theme vs. rheme and the various dichotomies such as topic vs. comment or focus, ground or background vs. focus etc.

While discourse structure is more difficult to define, there is at least agreement that coherent discourse (multi-sentence conversation or monologic text) is more than a sequence of propositions, just as sentences are more than sequences of words. In discourse, both explicit and implicit devices signify links between sentences, between groups of sentences, and between elements within sentences, and in turn, carry additional elements of discourse semantics. Understanding information structure in light of discourse structure and vice versa is not only justified on theoretical grounds: Experience with applications such as translating telephony and interactive query-answering makes it painfully clear that a theory relating information structure and discourse structure is essential for accurate Natural Language Processing.

We can say that information structure refers to the structure of a linguistic message into units of information with different relationships to previously presented information. A common distinction traditionally made in information structure is that between *new* and *given* information. This distinction was adopted and developed by Halliday (1967:63), following the Prague School that worked within the "functional sentence perspective". New/given information can be defined respectively as "information that the addressor believes is not known to the addressee" versus information "which the addressor believes is known to the addressee (either because it is physically present in the context or because it has already been mentioned in the discourse)" (Brown and Yule, 1983: 154). In the imaginary conversation above, an interlocutor asked "who is Layla?" after Layla had been mentioned by the main speaker. The first time "Layla" was mentioned would be an example of new information, whereas in the question "Who is Layla?", it would be given information. As Brown and Yule explained, Halliday believed that in English speakers marked the new/given distinction by means of intonation. Others studied information structure in terms of its syntactic form. In their presentation of different approaches, Brown and Yule concluded that although there are no rules for the specification of new/given information, there are some "regularities". For instance, new entities are usually introduced by indefinite referring expressions and intonational prominence.

If the linguistic form of a message does not always provide conclusive cues for its information structure, perhaps in face-to-face communication it is facial cues that we should attend to in order to understand how information status may

be expressed. This research investigates a potential role of eyebrow movement as information structure markers in face-to-face conversations.

Section 2.2 Studies on Body Motion in Relation to the Verbal Channel

In the previous sections, we saw how some researchers have proposed the study of facial movements in terms of their communicative functions, rather than the expression of emotion. Their emphasis was on social functions, but in this context facial behaviour has also been linked to the verbal message and researchers have emphasized the need to study it in interaction and in relation to language (e.g. Bavelas and Chovil, 1997:73). Other body movements have also been associated with the verbal message. This section presents studies on body motion in relation to the verbal channel. The purpose of this presentation is to show what kind of linguistic phenomena have been related to body movement and how this encourages and lends support to the study of eyebrow movement within the linguistic context.

Subsection 2.2.1 Linguistic Signal and the Structure of Body Movement

Birdwhistell(1970:72) emphasized the importance of studying non-verbal behaviour in its social context. Within this approach, he looked at the structure of body movement. He microanalysed filmed material and observed body motion as an important part of the communication process.

According to Birdwhistell, communication is a continuous process in which one or more channels of all sensory modalities are always in operation. He explained that communicative body motion occurs at the kinesthetic-visual channel and is studied by kinesics, of which he was a pioneer. He defined kinesics as "the systematic study of the communicational aspects of human body motion (Birdwhistell, 1952: 11, cited in Wiltshire, 1999:145).

Birdwhistell's treatment of motion owes much to structural linguistics. Thus, by analogy with phones, allophones, phonemes, and morphemes, in the audioacoustic channel, he proposed kines, allokines, kinemes, and kinemorphemes to describe the structure of body motion in the kinesthetic-visual channel. Kinemes are "building blocks with structural meaning" and as they are "combined into orderly structures of behavior in the interactive sequence they contribute to social meaning" (Birdwhistell, 1970: 99).

Condon(1970:64) investigated body motion in relation to speech. He observed and described a phenomenon he termed "synchrony" by which our body movements are synchronised with the speech segments we produce (self-synchrony) and even with the speech produced by another speaker when we are the listener (interactional synchrony). He described the flow of body movement as small waves (e.g. blinks and finger movements) within larger waves (e.g. arm

movement). The point at which movement changed in the small waves, coincided with changes in the large waves. And he observed a synchronization between this flow of movement and changes in speech. Thus he described a "rhythm hierarchy" in which movements were synchronised with different levels of the speech: the phone, syllable, word, phrase, half second, and second.

Condon(1979:64) made his observations by very close inspection of recordings on 16mm sound film. With the use of a time-motion analyzer, he could advance the film frame by frame or across a series of frames, and compare the observed movements with the accompanying speech by means of an oscilloscopic display (frame numbered). Using modern computer equipment, Wiltshire (1999:28) found examples of self-synchrony at the onset of speech units in her data, and she attributed earlier failures at replicating the phenomenon to a lack of understanding of Condon's theory and methodology. Condon's findings and methodology influenced Kendon, who, as we will see below, became a very important figure in the study of gesture. Kendon, like other researchers introduced below, studied the alignment of body motion and speech, but he analysed linguistic units larger than Condon's and looked at suprasegmental aspects such as prosodic structure.

Subsection 2.2.2 Body Movement and Prosodic Structure

Birdwhistell (1970:52) associated some movements with linguistic stress, such as head nods, eye blinks, and thorax thrusts, among others. In the field of gesture studies, gesture is usually defined as "spontaneous bodily movements that accompany speech. He associated this in his study of body motion. The most common body parts used are the hands, fingers, arms, head, face, eyes, eyebrows, and trunk".

According to McNeill et al., (2001:211) and as suggested earlier by Kendon (1972), common discourse themes will produce gestures with recurring features. Therefore, gesture will give clues for discourse structure. Indeed, by comparing their annotations of the different channels, McNeill et al., observed that recurring gesture features revealed a discourse organisation that correlated (100%) with the hierarchical structure derived from Nakatani et al's discourse annotation system. Nakatani et al., (1995:83) presented a set of instructions to do discourse segmentation from text.

These instructions are based on the theory of discourse structure by Grosz and Sidner (1986:79) and were prepared for naive segmenters who have not studied discourse theory or discourse processing methods. Head movements have also been investigated in the context of speech though not as much as hand gestures. Condon (1970:85) reviewing previous research on

head movements observes that some head movements are connected to the discourse structure of an utterance. He carries out a microanalysis of two dyadic conversations between native speakers of American English (male-male, female-female).

The subjects were asked to talk about topics of their choice for approximately an hour. Two cameras recorded their upper body while a third camera captured their full bodies. A time code was generated on each tape to allow the coordination of the movements of one participant with those of the other. The analysis was carried out using a VCR machine with the muting device off to hear the sound as the film was advanced frame by frame. This

They concluded that posture shifts can signal *boundaries* of units. Their empirical findings were used to derive an algorithm for generating posture shifts in an animated embodied conversational agent (Cassell et al., 2000:25) with the aim of improving the naturalness of this conversation system.

Subsection 2.2.3 Body Movement and its Relation with Information Structure

Another behavior that has been studied in connection with information structure in speech is gaze. Cassell et al., (1999:79) explained that in his research gaze behavior was associated to turn-taking behaviour in conversation: the speaker *looks away* from the interlocutor to keep the floor and *looks at* the interlocutor to give up the floor .

Cassell et al. said that "turn-taking only partially accounts for the gaze behavior in discourse" and that "a better explanation for gaze behavior integrates turn-taking with the information structure of the propositional content of an utterance". As an explanation, they suggested that speakers looked toward hearers when new information or the key point of their contribution is being conveyed (at the beginning of the rheme) and this may

focus the attention of speaker and hearer on this key part of the utterance. And also that this is not entirely independent of turn behaviour, because speakers may be more likely to give up the turn once they have conveyed this important material of their contribution.

To summarize, studies have shown that some body movements are aligned with certain linguistic events indicating a connection between them.

In this alignment, the movement usually starts before the word or phrase with which it is associated. The link between the two modalities has also been studied in terms of prosodic structure, discourse structure, and information structure. Although not always based on a sound empirical approach, the

conclusions encourage further research, particularly into whether facial movements can be related to these linguistic phenomena.

In conclusion, some association was suggested here between verbal and nonverbal behaviours in conversation. The most important finding was that when speakers raised their eyebrows they always did so in close alignment with an accented syllable in their speech. It was speculated that eyebrow movement had prosodic functions, such as marking the start of certain prosodic units and emphasizing information.

Chapter Three: General discussions and Conclusions

Section 3.1 General Discussion

Eyebrow movement, like many human behaviours, is something we do mostly without conscious control of it. However, it is clearly not a random phenomenon and seems to be linked to other behaviours. For instance, the fact that we raise our eyebrows in a reaction of surprise indicates that eyebrow movement is related in some way to certain emotions. The fact that we also raise our eyebrows as we are talking and not necessarily feeling a particular emotion indicates a relation with communication and with speech. As we saw, the connection between facial expression and emotion has received a lot of attention. On the other hand, we still know comparably little about how eyebrow movement may relate to speech. Yet, we use spoken language as a communication tool in daily life very frequently, and on most occasions what we are communicating is not emotional states. Thus, there would be important advantages in a better understanding of how eyebrow movement may be related to verbal communication. One area in which this is specially true is the development of multimodal conversation systems in which visual information from the face can be part of the communication.

This research was motivated partly by an intuition that eyebrow movement is connected to the production of spoken messages. Two basic questions were asked: *when* do we raise our eyebrows in conversation? and *why*? These questions are not only interesting from a psycholinguistic and cognitive point of view but they could also be a key to efficient communication in multimodal conversation systems that make use of conversational animated agents. In order to investigate these questions, it is necessary to study spontaneous, but controlled, human behaviour in interactive communication.

Introspection suggests that we tend to raise our eyebrows more when we are engaged in conversation than when we, for instance, read to ourselves. This

suggests eyebrow movement is linked to *interactive* aspects of linguistic communication..

There are correlations between eyebrow movement and the linguistic message. The question ,here , is *why* we raise them. This is a more difficult question, especially because this area of research is still at a preliminary stage. On the grounds of the findings in this research, we can speculate that brow movement may have different communication roles associated to them. These roles could be summarized into two hypothetical functions: structuring and emphasizing.

First, it seems that by means of eyebrow movement, speakers can add a visual marker to the start of groups of utterances (i.e. transactions) and groups of words prosodically linked (e.g. by downstep). Both these groups represent coherent linguistic units in the structure of the conversation: discourse structure and prosodic structure. And by signalling the start of these units, the eyebrow movement may contribute to convey this structure and maintain the coherence. Second, apart from a structuring function in conversation, we can hyporesearch that eyebrow movement has an emphasizing function. This is supported by the fact that brow movement is aligned with pitch accents in the conversations under investigation.

Pitch accents can lend acoustic prominence to words that need to be emphasized. But some words may require greater emphasis. In these cases, a cue on a different channel of communication, such as body/ facial movement, may add an extra signal that reinforces that segment. In this case, brow movement and pitch accents would share the same linguistic goal. The pressure to satisfy this goal would sometimes give rise to co-variation of both behaviours. The emphasis hyporesearch is consistent with the fact that in the conversations of this corpus, instructions were accompanied by eyebrow movement more often than other type of utterances. As explained previously, in the task performed by the participants of these conversations, the instructions carried the information most importantly to the task's goal. The delivery of these instructions, therefore, would need to be very clear and this could be seen to warrant extra emphasis on certain bits of information.

Section 3.2.Conclusions

It is important to notice that reinforcing of instructions is not intrinsic to the type of utterance then, but is related to the important function that those utterances have in this type of conversation. Thus, in different contexts different types of utterance might be accompanied by eyebrow movement, where the brow movement would emphasize words within the utterance and at the same time, to a certain extent, they would serve to identify its function.

We have talked about eyebrow movement as *signaling* different linguistic phenomena. A question arises as to whether this is an intended signal addressed to the listener or if it is not intended and merely produced for the benefit of the speaker. There has been a long debate about this in the field of gesture studies. On one side of the debate, researchers believe that gesture has a communicative role and can add meaning to a linguistic message. On the other side, gestures are believed to aid speech production but to add little or no meaning to it.

The researcher believes that eyebrow movements may be explained with arguments on both sides. Some brow movements could be a by-product of the speaker's processing effort in organising and delivering her message. Other brow movements may be intended signals to attract the attention of the interlocutor to certain parts of the message. The former would perhaps agree most with the hypothesized structuring function of eyebrow movement, whereas the latter would be more on the line of the emphasis hypothesis.

We could further speculate that these two functions would be reflected on the magnitude of the eyebrow movement. That is, eyebrow movements that are a by-product of the speech production process might be smaller in magnitude, since they do not need to be perceived by an interlocutor, whereas brow movements that are directed as a signal to the listener would be larger and more easily perceived. However, there is no reason to believe that big physical gestures are intended for others and small ones are not, because intention is not directly connected to the physical display.

In fact, intention is a sticky issue, because it is not possible to determine intention by looking at behavior without manipulating it. In this research, intention was not studied and the investigation focused only on the produced behavior.

Some manipulations could be used in future experiments to address the issue of intention, for instance by manipulating the visual access between participants. Experiments could be done to test whether eyebrow movement on the part of the speaker would also decrease when there is no visual availability between participants. If it did not decrease we might infer that eyebrow movements were not intended signals. However it may be the case that the behaviors on the verbal and visual channels are so strongly connected in the speaker that when their interlocutor cannot see them they will continue to use eyebrow movements even if this was primarily an intended signal.

In any case, it is important to mention that the eyebrow raise might be interpreted by the interlocutor, who, due to its correlation with the linguistic signal has learnt to interpret it as a signal even if originally it was not an 'intended'

signal. For this reason, I think that brow movements do have some communicative value.

One of the contributions of this research, is the presentation of a methodology for the collection and analysis of audiovisual data in human-human interaction, specifically eyebrow movement in conversation. The difficulty in studying this kind of data puts high demands on the method employed.

For instance, when observing facial behavior informally, it is difficult to identify and isolate an individual behavior such as eyebrow movement. When we see and hear a human face engaged in conversation, we perceive a whole set of behaviors, some involving facial movements such as those of the lips and jaw, head, eyes, and eyebrows. And each of these seems to serve different purposes.

But because we are used to perceive all this as a whole, it is difficult to isolate a single behavior such as eyebrow movement in order to study its possible functions. Therefore, it is important to use a rigorous method of analysis which allows us to observe the behaviors as they occur naturally but also to separate them and qualify them individually before describing them together. The methodology, in this research, proved successful at identifying some relationships, in this way, between visual and auditory signals.

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