Language in our hands

The role of the body in language, cognition and communication

INAUGURELE REDE DOOR PROF. DR. A. H. ÖZYÜREK

Radboud Universiteit Nijmegen

INAUGURELE REDE
PROF. DR. A. H. ÖZYÜREK

Even though most studies of language have focused on speech channel and/or viewed language as an amodal abstract system, there is growing evidence on the role our bodily actions/ perceptions play in language and communication. In this context, Özyürek discusses what our meaningful visible bodily actions reveal about our language capacity. Conducting cross-linguistic, behavioral, and neurobiological resarch, she shows that cospeech gestures reflect the imagistic, iconic aspects of events talked about and at the same time interact with language production and comprehension processes. Sign languages can also be characterized having an abstract system of linguistic categories as well as using iconicity in several aspects of the language structure and in its processing. Studying language multimodally reveals how grounded language is in our visible bodily actions and opens up new lines of research to study language in its situated, natural face-to-face context.

Aslı Özyürek, born in Ankara, Turkey, received her Ph.D. in Psychology and Linguistics at the University of Chicago (2000). After conducting postdoctoral fellowships in Max Planck Institute for Psycholinguistics (MPI) and the Donders Institute in the Netherlands, she was awarded an NWO VIDI (2006) grant and the prestigious European Research Council Starting grant (2010). Her research is affiliated with Center for Language Studies, MPI, and Donders Center for Brain, Cognition and Behavior at Radboud University. She has published over 55 articles, including those in *Science, PNAS, Cognition* etc.

Radboud Universiteit Nijmegen

LANGUAGE IN OUR HANDS: THE ROLE OF THE BODY IN LANGUAGE, COGNITION AND COMMUNICATION

Language in our hands: The role of the body in language, cognition and communication

door prof. dr. A. H. Özyürek

4

Meneer de rector magnificus, zeer geachte toehoorders,
Vanwege de aanwezigheid van een aantal buitenlandse gasten, en omdat ik nog geen perfecte spreker van het Nederlands ben, zal ik mijn voordracht in het Engels houden.

Ladies and Gentlemen,
My chair in the Department of Linguistics is entitled 'Gesture, Language and Cognition'. Probably some of you are thinking why the way we move our hands has anything to do with linguistics. Indeed, when I first submitted my thesis to *Journal of Memory and Language* – one of the leading journals in language studies – the editor noted: 'This is a rather interesting study, but what does this have to do with language?' Eventually my paper was published in this journal and today we see many papers published on this topic in many leading language journals and books (e.g. see Evans, 2009). So what has changed between then and now? Has there been a shift in the way we define what language is? In my lecture I would like to take you through some recent historical developments in philosophy, linguistics, psychology, and cognitive neuroscience that have made gesture or multimodal communication an emerging field of study and important part of language sciences. I will give you an overview of my research in this context.

SPLIT BETWEEN LANGUAGE AND THE BODY

Historically the western philosophical tradition has made a distinction between our mind and our body. One of the most well-known proponents of this view was Descartes with his Cartesian Dualism. According to Descartes, in his own words: 'The thinking thing that is 'me' is really distinct from the body and can exist without it.' (Descartes (1641) *Meditations* in Adam & Tannery (1964-76), pg. 78)

This philosophical distinction influenced other fields of science in the 20th century, such as psychology and linguistics. It has led to views about the nature of our language faculty as also being separated from our bodily actions and sensory experiences. This assumption can be found in theories of many leading linguists, such as in Saussure (1916), Hockett (1960), Chomsky (1965) and Fodor (1983) concerning what constitutes language and its borders within general cognition and communication.

For example, distinctions between 'langue' and 'parole' by Saussure (1916) and 'competence' and 'performance' made by Chomsky (1965) have isolated language as an abstract system, separate from its user and use in context. The split between mind and body also can be detected in the definition of a sign, one of the building blocks of language. According to Saussure (1916), a sign has an arbitrary relation to its referent. That is, there is no iconic or motivated relationship between for example the sign 'tree' and the referent (for example the visual features of a tree). Furthermore, discrete and categorical encoding of our holistic and analog experiences into meaningful or meaningless units that can be combined (as in phonology and syntax) has been also considered a unique feature of our language faculty (also known as 'duality of patterning'

in Hockett (1960)). Finally, language, according to Fodor (1983), is viewed as an isolated cognitive module that can process information apart from other cognitive systems such as sensory-motor experiences. So to summarize, in these views abstract, arbitrary, discrete, categorical and modular have been taken as defining characteristics of language with the exclusion of situated, iconic, analogue, holistic and interfacing aspects of it.

LANGUAGE IN BODY/BODY IN LANGUAGE

In the beginning of 1960s, however, an alternative philosophical view developed against the distinction of mind from the body. This can be seen in the works of Wittgenstein (1953), Marleau-Ponty (1962), Heidegger (1968), and recently in the work of Gallagher (2005). These philosophers argue instead that language as a mental faculty is grounded in and cannot be seen as separate from our situated and bodily experiences. Note that in these philosophical traditions the body has been viewed both as an individual and a social entity interacting with the world.

These philosophical views have given rise to a new field in the psychology of language (called embodied, embedded, grounded or situated language), where researchers have begun to show how our sensory-motor experiences interact with our processing of language (see Robbins & Aydede, 2009 for an interdisciplinary overview).

For example, in a simple experiment Zwaan and Yaxley (2004) gave subjects word pairs: the first one as prime and the second one as target (e.g. 'clock' followed by 'pie' or 'clock' followed by 'cheek') and asked them to respond saying whether these two words are related to each other or not. Since a 'clock' is as semantically unrelated to the 'pie' as 'cheek' is, one could have expected subjects to say no to both pairs, taking a similar amount of time. However, they found that pairs such as 'pie' and 'clock' take longer to respone. This is due to the fact that pairs such as 'pie' and 'clock' shared similar visual features, in this case roundness. Due to this extra processing the subjects took longer to respond, showing that the perceptual features of objects interfere with semantic processing of words.

In another experiment Richardson and Spivey (2000) showed subjects different sentences while focusing their eyes on different parts of the screen such as left or right. Later subjects were asked questions about one of the sentences they had heard earlier. Subjects' eye movements, as they are listening to the question, were fixated on the empty square where their eye gaze originally fixated while they were listening to the original sentences related to the question. This experiment shows that our sensory- motor experiences originally coupled with language in one context are evoked as we hear similar linguistic information in another context. Research in these areas in the last few years has accumulated a lot of evidence showing similar effects as well as neural correlates of these effects showing links between semantic processing of words and sensory–motor areas of the brain (see Willems & Cassasanto (2011) for a recent review).

However, recent investigations on embodied language, have focused almost exclusively in comprehension of spoken/written language and, I would like to argue, have been inadequate in looking at how language is situated in relation to the body in its real face-to face context. In face-to-face use, language is always executed as bodily action such as in speech (through articulatory gestures of the mouth and the larynx) and in gestures (of the hand) accompanying speech or in sign languages that use mainly body (face, eye gaze, torso and hands) for linguistic expressions. I will summarize my own and others' research that has accumulated in the recent years with regard to how in these two domains of communication – namely in spoken and in signed languages – language and bodily representations are linked, in terms of both how language is processed as well as in its structure. First I will start with spoken language and use of gestures.

THE ROLE OF COSPEECH GESTURES IN LANGUAGE PRODUCTION

As we speak, we almost always use hand gestures, i.e. meaningful visible actions, which accompany our speech (McNeill, 1992; 2005; Kendon, 2004). These are used by people of all ages (starting from 9 months), cultures and contexts. Speakers use gestures even when they are blind (Iverson & Goldin-Meadow, 1998), on the phone (Bavelas et al., 2007) or even talking to themselves (Chu & Kita, 2008). What is important about these hand movements for our understanding of language is that their representations are coordinated with the meaning of the speech they temporally accompany, and they are designed for communication with the addressee, as speech is, thus reflecting the speaker's communicative effort (e.g. Clark, 1996; Özyürek, 2002a; Kendon 2004).

Recent research on these meaningful and communicative hand movements by Kendon (2004) and McNeill (1992; 2005) and others in the last decade has shown that speakers use gestures in semiotically diverse ways as well as for different functions during communication. While some of these gestures are conventionalized and can replace speech (i.e. they are called emblems), the others show variation across speakers, are less conventionalized, and depend on the accompanying speech for their meaning (i.e. these are called 'gesticulation'). For example, while most people living in Western cultures would know that a V hand (Figure 1a) means victory even in the absence of speech, it would be quite difficult to unambiguously know what the idiosyncratic gestures of Barack Obama (left) or David Letterman (right) (Figure 1b) mean in the absence of speech context.

Figure 1: Examples of (a) a conventional emblem gesture meaning victory; (b) idiosyncratic gesticulations depending on speech context for their meaning

Here I will focus on a subset of the gesticulations, namely iconic or representational gestures (McNeill, 1992; Kita, 2000), and I will argue that they are linked to the language system. Iconic gestures bear some type of visual resemblance to the objects and events they refer to. Unlike language, they represent events in a holistic and analog way rather than in an abstract, categorical, arbitrary fashion. To give you some examples of iconic gestures I would like to take you to a small butcher's shop on a noisy street in Sicily. In this video this butcher is explaining how he makes sausage every day. I assume most of you do not know Italian, but try to focus on his hand movements and try to see if you detect any gestures that you might find meaningful. Note that in this recording we have not asked the speaker to use gestures specifically. In this clip as you might have noticed without even knowing the language, the speaker has represented a big bowl with an iconic gesture, as if his hands are holding a bowl, as well as the act of mixing the ingredients with a rotating movement of the hand. So the question is whether such gestures interact with the language production system or are generated independently (i.e. solely and directly from spatial/motoric imagery) and executed in parallel with language production.

In order to find out whether iconic gestures interact with the linguistic formulation of a message, my colleague Dr. Sotaro Kita and I asked speakers of different languages, Japanese, Turkish and English to talk about the same motion event (Kita & Özyürek, 2003; Özyürek et al, 2005; 2008). Crucially these languages differed with regard to how elements of a motion event are encoded linguistically. We wanted to see whether these differences in linguistic formulation would influence the representations in gestures. If gestures are generated directly and solely from imagery one would *not* expect them to

differ with differences in linguistic encoding and look the same across speakers of different languages. However, this is not what we found.

In one analysis we focused on descriptions of one event from a Sylvester and Tweety cartoon, which in English would be described differently than in Japanese and Turkish. This event included an arc trajectory of Sylvester's attempt to swing with a rope to try to get Tweety. English can easily express this arc movement with the verb 'swing' but Turkish and Japanese do not have such a verb in their lexicon and instead use other change of location verbs like 'go across' or ' jump to the other side' that, crucially, do not readily encode arc shape of the trajectory.

Gestures that accompanied these expressions also reflected these differences. While English speakers were more likely to use an arc gesture to depict the event, Turkish and Japanese speakers were more likely to use straight gestures than English speakers showing that semantic encoding of the event in the particular language influenced gestural representations.

In another analysis we looked at whether differences in syntactic encoding across languages also influence gesture production. For this we looked at speech and gesture descriptions of an intransitive motion event where manner and path occurred simultaneously (i.e. Sylvester *rolls with a ball in his stomach while going down the street*).

To express Sylvester's rolling with the ball and going down the street, English speakers use one verbal clause – a manner verb like 'roll' and a preposition 'down' (e.g. he rolls down the street). However, Turkish and Japanese speakers need to use two verbal clauses one for rolling and one for going down (e.g. Turkish: *yuvarlanarak caddeden aşağı indi-* while rolling, (he) went down the street). If we assume that one clause corresponds to a unit of production (Levelt, 1989), then we expect English speakers to use one gesture for both manner and path (i.e. since both elements can be encoded in one verbal clause) but Turkish and Japanese speakers to use one gesture for manner and another one for path due to encoding of each element in separate verbal clauses.

This is exactly what we found. Most of the time English speakers used one gesture, but Turkish and Japanese speakers were more likely to use separate gestures for manner and path (See Figure 2). This finding shows that, also at the level of syntactic encoding, there are interactions between language and gesture.

(a) English: *he [rolls down the street]*

(b) Japanese: *koo [nanka kaiten-shi-nagara booru-mitai-ni] [korogari-ochi-te-t-te]*
Trans: Like somehow as he rotates like ball, (he/she) descends rolling
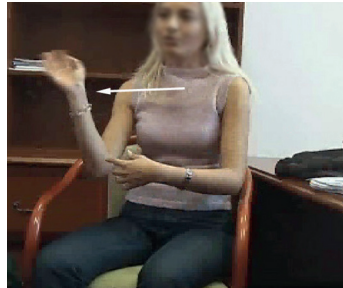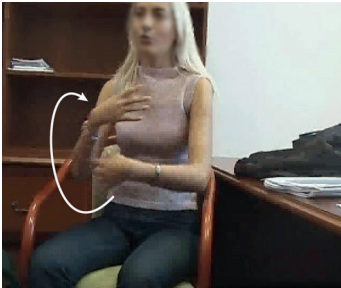
(c) Turkish: *[yuvarlana yuvarlana] [gidiyor]*
Trans: rolling, rolling   (he) goes

Figure 2: Differences between English, Turkish and Japanese speakers' gestures depicting simultaneous manner and path of a motion event paralleling differences in syntactic encoding (brackets and bold indicate where the stroke of the gestures overlap with the speech segment)

If language and gesture interact, do we also see these interactions in bilingual speakers? Do the same speakers speaking different languages gesture differently? We asked Turkish speakers who speak advanced English (L2) to describe the same cartoon event in Turkish and in English. As we expected, as speakers switched language, and crucially when Turkish speakers could encode the events as English speakers do (i.e. in one verbal clause), there was also a switch in gesture. That is, while speakers used separate gestures for manner and path in Turkish in their L1, they used one gesture for both when they spoke English in their L2 (Özyürek, 2002b). These cross-linguistic results overall show that gestures are not merely an independent action system but interact with the language production system in an online fashion.

But how deep are the interactions between language and gesture? Do our gestures also reflect the characteristics of our language – even if we do not use them with language? To answer this question in collaboration with Prof. Susan Goldin-Meadow we asked speakers of four different languages with different word orders (English, Turkish, Spanish, and Chinese) to depict simple events such as a boy drinking water, a girl opening a box, etc. by using only gestures, i.e. pantomime (Goldin-Meadow et al, 2008). The central question here was whether subjects' order of gestures depicting event elements reflects the word order in their language or are independently ordered.

The word order of the spoken languages used to depict the scenes was consistent with the preferred word order; Spanish: Subject (s) Verb (v) Object (o), English: svo, Turkish: sov, and Chinese: svo/sov. However, when we look at the order of the event elements in pantomime, it is consistently in the order of Agent, Patient and Action, which could correspond to a Subject-Object-Verb order in language. These results show that when gestures are used without speech they do not reflect the linguistic preferences when encoding information. Yet, when they are used *with* speech, then they *do* interact with our language system, as I have previously shown. Thus co-speech gestures are unique in their link to the language system and belong to a different system of communicative actions than those that are used without language.

THE ROLE OF COSPEECH GESTURE IN LANGUAGE COMPREHENSION

What about comprehension of co-speech gestures? If gesture and speech are interacting systems, then we expect interactions to occur not only during language production but also during language comprehension. We tackled this question with my colleague Dr. Spencer Kelly.

To investigate this we used a paradigm where subjects viewed speech and gesture pairs either as congruent or incongruent in terms of semantic content to see whether incongruent gestures disrupted speech comprehension. Even though incongruent gestures do not always occur in spontaneous speech, when it does happen addressees detect them very fast, as we see in this movie taken from a David Letterman late night show. In this film the former president of usa, George Bush said the following in a

speech, 'The left hand now knows what the right hand is doing.' This by itself is a fine idiom, but what the former president simultaneously did with his hands was inexplicable: He gestured first with his right hand (saying left) and then with his left hand (saying right). This multimodal 'Bushism' raises some simple but interesting questions. Does a message with incongruent speech and gesture disrupt comprehension for listeners? Alternatively would a message with congruent speech and gesture enhance understanding?

To answer these questions, we presented subjects with action movies that served as primes followed by speech and gesture targets (see Figure 3 below). In these targets speech always matched what is depicted in the movie but the relation of accompanying gesture to speech changed under different conditions. Sometimes the gestures were congruent with the speech. In other cases the gesture was incongruent with the speech. Sometimes the incongruence was weak (i.e. SPEECH: chop/GESTURE: cut) or stronger as in (i.e. SPEECH: chop/GESTURE: twist). We asked subjects to press a button if speech depicted the action prime they had seen before – namely the chopping action. Note that gestures were not relevant to perform the task accurately. Nevertheless we expected incongruent gestures to influence speech comprehension.
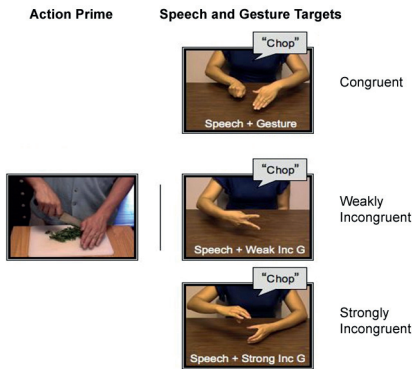

Figure 3: Examples from stimuli with action prime and speech /gesture targets in different semantic relationships with each other (Kelly, Özyürek, Maris, 2010)

The error rates showed that subjects were most correct if gesture and speech were congruent. They made more errors, however, when the level of semantic incongruence between the two modalities increased. Strong congruencies disrupted speech comprehension more than the weak ones. Thus in processing speech, subjects cannot help but process the information from gestures (even if they don't need to) and this influences their comprehension of the speech itself. My colleague Dr. Spencer Kelly has further found that these possible interactions between speech and gesture can be helpful in

teaching new words to learners of new languages (Kelly et al, 2009) and thus have broad implications for education and teaching.

And finally we asked how our brain processes information coming from both channels. Does our brain use similar or different areas to process language and gesture? This first investigation on brain's comprehension of co-speech gesture was conducted with two experts on neurocognition: Dr. Roel Willems and Prof. Peter Hagoort.

We presented subjects with sentences that included words or gestures that were hard to semantically integrate (i.e. mismatching) into a sentence context (see Experimental Conditions in Table 1) and compared them to regular sentences where both speech and gesture were easy to integrate (see Control Condition in Table 1). In this way we could see how the brain integrates information coming from language – compared to that coming from gestures – into a sentence context.

CONTROL CONDITION
(1)   He slips on the roof and [rolls down]
                 G: ROLL DOWN
EXPERIMENTAL CONDITIONS *(speech or gesture (in bold) mismatching to previous*
                       sentence context)
(2)   He slips on the roof and **[writes]** a note (speech mismatch only)
                 G: ROLL DOWN
(3)   He slips on the roof and [rolls down]
                 G: WRITE *(gesture mismatch only)*

Table 1: Examples from stimuli used in fMRI experiment to detect areas sensitive to speech and gesture integration to a previous sentence context. In each sentence gestures and speech in brackets were simultaneously presented (Willems, Özyürek, Hagoort, 2007).

When linguistic information was hard to integrate into a previous context (as in 2 in Table 1), this evoked more processing in the left superior temporal cortex (left STS) and left inferior frontal cortex (BA 45-44), as we can see in the red colored areas in Figure 4 compared to the control condition. These were the areas that are expected to be involved in semantic integration of words into a sentence context as found in previous research (Hagoort et al, 2004). Increased difficulty of semantic integration of gestures into the sentence context on the other hand activated the left motor cortex (BA 6) and the parietal cortex (left inferior parietal), which are known to be involved in action proces-sing, but crucially also the left inferior frontal cortex (BA 45) as well, as we see in yellow in Figure 4. Thus, in addition to the distinct areas of processing there was an overlap in areas that were sensitive both to semantic integration from gesture and language,

specifically in area BA 45 (see Figure 4). This provides further evidence for the fact that linguistic and action-related aspects of meaning are not completely separable and share a common neural substrate.
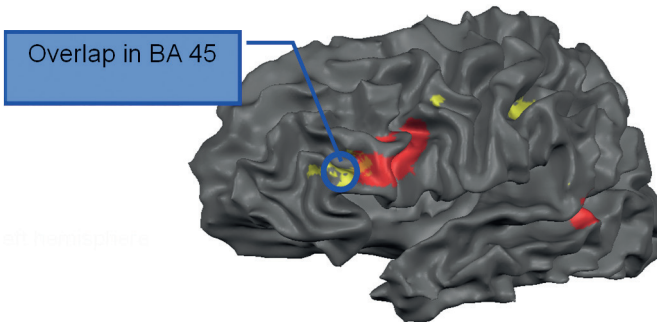

Figure 4: Activations in the left hemisphere that are sensitive to difficulty in integrating words (red) versus gestures (yellow) to a previous sentence context (both compared to a baseline of activations sensitive to language-gesture pairs that are easy to integrate) (Willems, Özyürek, Hagoort, 2007)

THE ROLE OF THE BODY IN SIGN LANGUAGE

Now I would like to turn to another domain of human communication, namely sign language, where linguistic expressions are directly expressed and perceived as visible actions and show how the modality through which sign languages are conveyed and perceived reveals further interactions between sensory-motor experiences and language.

Sign languages arise in deaf communities when individual deaf people get a chance to be together in an institution like a school (Senghas, Kita, & Özyürek, 2004) or if they are concentrated in a village community (Sandler, Meir Padden, Aronoff, 2005). The oldest sign languages we know of in the world are only around 200 years old.

Since the 1960s sign languages have also been seen as abstract systems. They have been shown to share many of the same design features with spoken languages, such as signs that have arbitrary relationships to referents, discrete, and categorical units that are combinable and thus having phonology and syntax, as we have seen in the fascinating works of Stokoe (1960), Klima & Bellugi (1979) and others. There is also evidence for signed and spoken language to a large extent sharing a common neural substrate (Poizner, Klima & Bellugi, 1987). Sign languages from different countries also differ from each other at many levels, as we see in spoken languages (Perniss, Pfau, & Steinbach, 2007).

Early on these findings led to idea that the visual-spatial articulators used in sign languages do not reveal modality effects in such a way that would influence sign

language structure and processing as different from spoken languages – both defined merely as 'abstract' systems. However, recently these views have begun to be challenged at least for some domains of signed languages, as I will show below and also with regard to assumptions about exact overlapping neural correlates between areas processing signed and spoken languages in the brain (MacSweeney et. al., 2002). Recently, my own and other people's research on different sign languages around the world has shown that sign language structures contain not only abstract, arbitrary and discrete features but also modality-specific structures such as iconic/motivated forms, which take advantage of affordances of the visual-spatial modality. Here I will demonstrate evidence that both features (arbitrary, discrete, and categorical) as well as iconic and analog forms characterize sign language structures and its processing. I begin with the first.

In an earlier study we investigated the robustness of the discrete and categorical encoding of information in an emerging sign language; that is when deaf children are never exposed to a sign language but need to create a new communication system among themselves. To answer this question, my colleague Dr. Sotaro Kita and I were lucky to collaborate with Dr. Annie Senghas, who has been working in a deaf community in Nicaragua. There we could observe the early stages of a new sign language emerging.

In Nicaragua before 1970s all deaf children born to hearing parents would stay at home and not interact with each other. Hence no sign language emerged. In 1970s the Nicaraguan government established a vocational school for the deaf where they got together for the first time. In 1980 another cohort of deaf people, mostly children, joined the community and in 1990s the 3rd cohort of children arrived. All these cohorts coexisted and had interactions with each other in the school environment as a new language emerged (i.e. Nicaraguan Sign Language, NSL). By comparing these cohorts to each other one could see a new language emerging. Thus we collected data from these 3 deaf groups in Nicaragua. In addition to the deaf cohorts, we also observed the gestural patterns of hearing Spanish speakers surrounding the deaf community. We wanted to find out whether structures that we find in the new sign language could be perhaps copied from the hearing people's gestures.

We asked all groups to watch the same Sylvester and Tweety cartoon that we have used in our previous gesture studies and asked them to narrate the events that had simultaneous manner and path components such as in the rolling-down event (or Sylvester climbing up a pipe). We wanted to see whether manner and path would be depicted as one gesture, corresponding to a holistic representation (as in picture A in Figure 5) or in segmented and sequenced gestures represented in a sequence (as in picture B in Figure 5) as is typical of segmented, discrete features of linguistic structures.

In the graphs in Figure 5 we can see the preferences for holistic versus segmented, discrete expressions among the groups. It is very clear that the later cohorts are using the segmented and sequenced gestures for manner and path more frequently, whereas

the first cohort signers and Spanish speakers prefer the holistic expressions. Thus segmented structures are not simply copied but emerge as part of the conventional linguistic system in the deaf community. Discrete segmented organization of information is a robust feature of sign language, as it is for spoken languages. Note that the segmentation allows generalization and combinatorial possibilities that are not possible in the holistic expression.
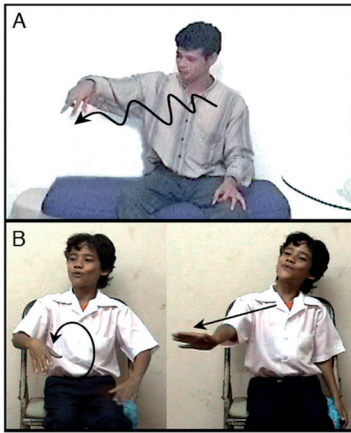

Figure 5. Examples of motion event expressions from participants' narratives and their distributions across the groups. Picture **(A)** Manner and path expressed simultaneously. In this example a Spanish-speaker describes a character rolling down a hill with a bowling ball on his belly; the gesture shown naturally accompanies his speech. Here manner (wiggling) and path (trajectory to the speaker's right) are expressed together in a single holistic movement. Picture **(B)** shows manner and path being expressed sequentially. In this example, a third-cohort signer describes the same rolling event in Nicaraguan Sign Language. Here manner (circling) and path (trajectory to the signer's right) are expressed using two separate signs, assembled into a sequence. Graph **(A)** shows the proportion of holistic expressions, while graph **(B)** shows the proportions of expressions with segmented and sequenced signs (from Senghas, Kita, & Özyürek, 2004).
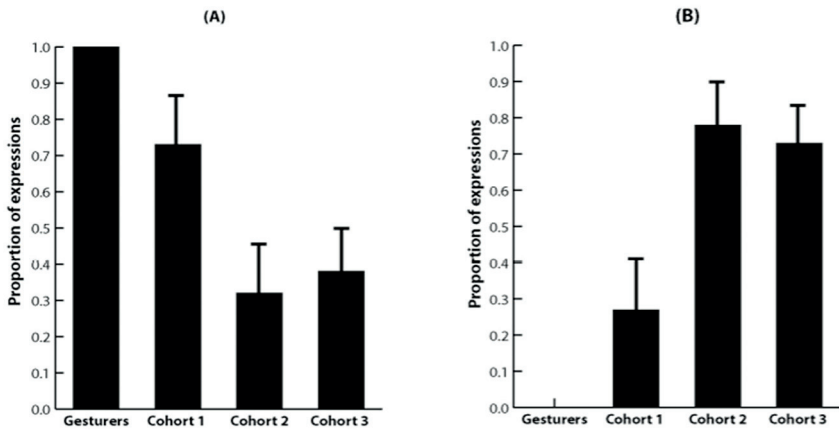
Even though we can see major design features of language such as discreteness and being categorical as robust phenomena in sign language, it is not the case that iconic representations do not play a role in sign languages. Recently it has been observed that modality, i.e. the fact that the body is involved as a main articulator in sign language (as opposed to vocal-auditory channel of spoken languages), plays a greater role in its structure than was previously thought. One of the affordances of the body as the main articulator is that it allows iconicity, that is, semiotic properties that convey representations that are more directly linked to the way we visually perceive and experience the world than speech does. Such effects of modality have been found at many levels in sign languages, together with abstract, discrete and categorical ones.

Let's first start with lexicon. In sign languages many individual signs are constructed out of meaningless phonological unities (Corina & Sandler, 1993). Signs can be minimally distinguished by hand configuration, place of articulation, movement, and orientation. The signs that you see in the upper row of Figure 6 (POOR vs. COLLEAGUE) are taken from German Sign Language (DGS) (Perniss, 2007) and they illustrate examples of minimal pairs. They are similar in terms of handshape, place of articulation but not orientation (up vs. down), which makes each of them a different sign. These signs do not seem to be iconic to their referents. However, many signs retain their iconicity as we see in the bottom row of signs in Figure 6 (MORNING and BICYCLE).
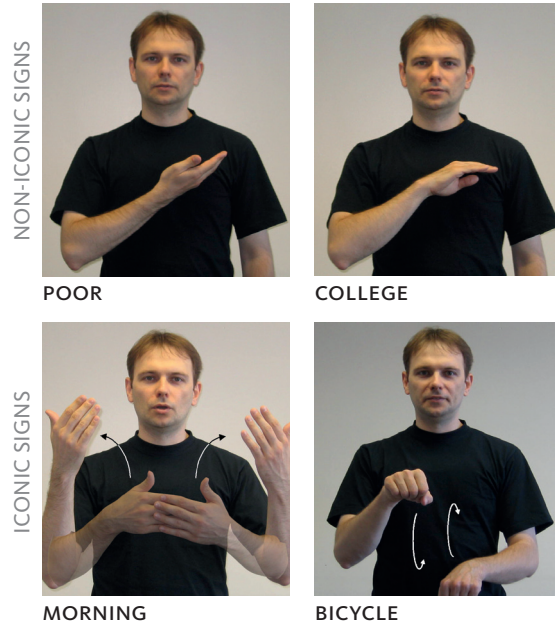

Figure 6: Examples of lexical items from German Sign Language (DGS) that do not bear iconic relationships to their referents (upper row) and ones that do (lower row) (Perniss, 2007)

NON-ICONIC SIGNS

POOR

COLLEGE

ICONIC SIGNS

MORNING

BICYCLE

Recent research has also shown that such iconic features in signs facilitate word processing in sign languages compared to processing of spoken words (Vigliocco, Vinson, Woolfe, Dye, Woll, (2005); Ormel et al., (2009)). Thus in sign languages the iconicity is prevalent (i.e. due to affordances of the modality) as an index of the link between sensory-motor experiences and the word forms as well as the discrete, categorical features.

Another domain of sign language where iconicity plays a prominent role is in the expression of spatial relationships (Emmorey, 2002). For example to express relationships between multiple entities (e.g. plates next to each other) signers use handshapes that iconically resemble the referents they refer to (i.e. so-called classifier predicates) and place these handshapes in sign space in an analog way corresponding to the spatial relationships between the entities. In the example of German Sign Language (Figure 7a, below) which is a description of plates next to each other, one can see C-handshapes resembling the contours of the plates and the analog placement of the handshapes onto the sign space corresponding to those in the picture depicted. These features of sign languages, that is, the use of classifier predicates, and the analog mapping of space to space in spatial descriptions have been considered to be shared across sign languages of the world, i.e. making use of the visual affordances of the modality (Aronoff, Meir, Padden, Sandler, 2003)

However, in our recent work from Turkish Sign language (*Türk İşaret Dili, TİD*), we have discovered that Turkish signers do not necessarily use iconic expressions as German signers do (Özyürek, Zwitserlood, Perniss, 2010; Perniss, Özyürek, Zwitserlood, 2011). Instead Turkish signers can use a strategy where each finger refers to an object and not iconically similar to the referents; that is, they do not necessarily use classifier predicates to locate objects. Furthermore, note that in Figure 7 b the distance between the fingers do not correspond to the space among the entities in the scene depicted. Thus Turkish signers in doing so they simply focus on the fact that entities are side-by-side rather than on precisely where they are located. Turkish signers – compared to Germans – are more likely to be abstract, categorize and move away from iconic and
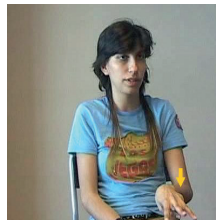

Figure 7: A German Sign Language user (left (a)) and Turkish Sign Language user (right (b)) signing to depict three plates next to each other on a table (Perniss, Özyürek, Zwitserlood, 2011).

analog representations of spatial relationships among the entities. This also shows that sign languages, even in spatial descriptions where we would expect most homogeneity across languages, can differ from each other driven by the categorical structuring of language-just as we see in the domain of spoken spatial language (Levinson &Wilkins, 2006)

Thus, both in lexical items and in spatial expressions, sign languages can use abstract, discrete and categorical features as well as iconic ones. These two tendencies co-exist in the structure of sign languages.

CONCLUSIONS: 'DOUBLE ESSENCES' OF LANGUAGE

I tried to show evidence both from my own research and others that if we investigate language in its face-to-face usage and multimodally, we see that both spoken and signed languages reveal interactions between an abstract, categorical and discrete system and sensory-motor experiences – in terms of both processing and structure. These provide further evidence partially for the embodied and situated views of language, yet from its situated and face-to-face uses. In spoken languages, iconic gestures (meaningful actions) interact with linguistic production and comprehension processes. Sign languages are composed of abstract, discrete and categorical features as well as iconic structures.

Thus when we look at language in its natural face-to-face uses we see what I will call here the 'double essences' of language (following a term used by McNeill, 2005). In language, the abstract is used in a situated way, and arbitrary and discrete features coexist with iconic , analogue and holistic ones. One can not separate these double features of language from one another or reduce one to the other, as they simply seem to be two sides of the same coin. Furthermore these different types of representations interact with each other during processing. When we study language development, evolutionary precursers, and neural underpinnings of language we need to take these double essences into account. Why then does language need these double essences; why can't we get away simply with the abstract, discrete, and modular system or alternatively with the purely embodied, iconic, and situated uses in language structure and processing-as have been claimed by some strong versions of embodied language theories (e.g., Glenberg & Kaschak, 2002; Barsalou, 2009)?

I believe that these double essences reflect (at least) two equally important needs of our communication system (Garrod et al., 2007; Perniss, Thompson, Vigliocco, 2010). First of all, languages need to provide generalizability of expression above the here-and-now of human experience which is provided by the abstract, arbitrary and the categorical structures. As such a conventional system among multiple users can be maintained in a community within which the language is socially shared and can be transmitted from one generation to the next (e.g., Christiansen & Kirby, 2003; Fay et al, 2010). But secondly there is also the need to link the abstract system to the here-and-

now of the communication every time it is used. Neither of these functions alone can achieve successful communication and thus languages, signed or spoken, young or old, keep the double essences.

Science of multimodal communication is still in its infancy. Thus I am interested in finding out further how exactly our mind/ brain processes the double essences of language in spoken and signed languages and cross-linguistically. Furthermore I would like to do this in more applied settings than have been studied so for. For example in social and situated contexts, in education and health sectors. Also in multilingual and cross-cultural communication contexts- for example concerning immigrants' use of multimodal means in the culture they live in. And finally I am interested in the dialectic interplay among the double essences as a driving factor during language development.

I believe that an approach to language in the way I layed out here (i,e. multimodal and situated in our bodily experiences) will bring us closer to our understanding of its workings in every day life and improve the communicative the needs of the society.

ACKNOWLEDGEMENTS

for logistically supporting my research in Turkey for many years and my colleagues there.

Even though students think that they learn form their advisors, only when you become an advisor you realize how much you learn from your students. I am grateful to all my previous and current students and postdocs in my team for their inspiring ideas that they share with me everyday!! For my current and future students in the faculty I will teach a vision of language that focuses on double essences of language that need to be studied in an interdisciplinary way. This can be only achieved by collaborations between different excellent institutions we have on campus such as CLS, Donders Institute and the MPI.

Of course everything is grounded in the family. I would like to thank my father, mother, and sister who have always been supportive of my ambitions, struggles and travels to far countries to lead a scientific career. Without their emotional support I could not have even begun and I am lucky that they can be here today with me .

Every scientist knows that science is not 9 to 5 work. A scientific career is very demanding in terms of emotional and intellectual commitment around the clock. I would like thank my husband Peter Hagoort for his support at many different levels; intellectually as a scientist, emotionally as a husband and caring for our daughter as a father .

Most importantly I would like to thank our daughter Lale for making life so cheerful and happy and for her patience in sharing me with a laptop. Finally I would like to thank all the national and international visitors from Sweden, Germany, England, US, and Turkey who have come here just for this event and needless to say the sign language interpreters for their hard work and deaf audience for being here today.

I will end my oratie with a quote from Herbert Mead on his early insights on language paralleling the view I have tried to outline here:

'But if we are going to broaden the concept of language...we can see that the so-called intent, the idea we are talking about, is one that is involved in the gesture ... we are using' (Mead, (1934-1962). Vol 1, pp. 14).

I dedicate this inaugral lecture to my parents Mustafa and Sünter Özyürek.

Dames and Heren, Ik heb gezegd.

REFERENCES

- Adam, C. & Tannery,P. 1964-76. (eds.) *Oeuvres de Descartes Revised.* Vol 5, pg. 78 Paris:Vrin/CNRS
- Aronoff, M, Meir, I., Padden, C. & Sandler, W. 2003. Classifier Constructions and Morphology in Two Sign Languages. In Emmorey, K. (Ed.) *Perspectives on Classifiers in Signed Languages*, Lawrence Erlbaum, NJ. pp. 53-84.
- Barsalou, L.W. 2009. Situating concepts. In Robbins, P. & Aydede, M. (eds) *The Cambridge Handbook of Situated Cognition.* CUP: Cambridge, pp.236-263
- Bavelas, J. B., Gerwing, J., Sutton, C., Prevost, D. 2008. Gesturing on the telephone: independent effect of dialogue and visibility. *Journal of Memory and Language*, 58, pp. 495 – 520.
- Chomsky, N. 1965. *Aspects of the Theory of Syntax.* MIT Press.
- Christiansen, M. & Kirby, S. 2003. *Language evolution.* Oxford University Press: Oxford
- Chu, M., & Kita, S. 2008. Spontaneous gestures during mental rotation tasks: Insights into the microdevelopment of the motor strategy. *Journal of Experimental Psychology: General,* 137, 706-723.
- Clark, H. 1996. *Using language.* CUP: Cambridge
- Corina, D. & Sandler, W. 1993. On the nature of phonological structure in sign language, *Phonology,* 10, 165-207
- Garrod S., Fay N., Lee J., Oberlander J. & MacLeod T. 2007. Foundations of representation: Where might graphical symbol systems come from? *Cognitive Science* (31) pp. 961-988
- Glenberg, A.M & Kaschak, M.P. 2002. Grounding language in action. *Psychonomic Bulletin & Review*, 9(3), 558-565.
- Emmorey, K. 1996. The confluence of space and language in signed language. In P. Bloom, M. A. Peterson, L. Nadel & M. Garrett (Eds.), *Language and Space.* Cambridge, MA: MIT Press.
- Emmorey, K. 2002. *Language, Cognition and the Brain.* Lawrence Erlbaum, NJ
- Evans, N. 2009. *Dying Words: Endangered languages and what they have to tell us.* Willey-Blackwell, Sussex, UK
- Fay N., Garrod S., & Swoboda N. 2010. The interactive evolution of human communicative systems *Cognitive Science* Vol.34 pp. 351-386
- Fodor, J.A. 1983. *The modularity of mind.* Cambridge. MA: MIT Press
- Gallagher, S. 2005. *How the body shapes the mind.* Oxford University Press: Oxford
- Goldin-Meadow, S., Chee So, W., Özyürek, A., & Mylander, C. 2008. The natural order of events: how speakers of different languages represent events nonverbally. *Proceedings of the National Academy of Sciences of the USA,* 105(27), 9163-9168.
- Hagoort, P. Hald, L., Bastiaansen, M., & Petersson, K-M. 2004. Integration of word meaning and world knowledge in language comprehension. *Science,* 304, 438-441
- Heidegger, M.1968. *Being and time* (J. Macquire & E. Robinson, Trans). Harber & Row: NY
- Hockett , C. F. 1960. Origins of Speech. *Scientific American,* 203, 88-96
- Iverson, J. M. & Goldin-Meadow, S. 1998.Why people gesture when they speak. *Nature,* 396, 228
- Kelly, S. D., McDevitt, T., & Esch, M. 2009. Brief training with co-speech gesture lends a hand to word learning in a foreign language. *Language and Cognitive Processes,* 24, 313-334.
- Kelly, S. D., Özyürek, A., & Maris, E. 2010. Two sides of the same coin: Speech and gesture mutually interact to enhance comprehension. *Psychological Science,* 21, 260-267.

- Kendon, A. 2004. *Gesture. Visible action as utterance.* Cambridge University Press, Cambridge.
- Kita, S. 2000. How representational gestures help speaking. In D. McNeill (ed.) *Language and gesture* (pp.162-185). CUP: Cambridge
- Kita, S., & Özyürek, A. 2003. What does cross-linguistic variation in semantic coordination of speech and gesture reveal? Evidence for an interface representation of spatial thinking and speaking. *Journal of Memory and Language,* 48(1), 16-32.
- Klima, E. & Bellugi, U.1979. *The signs of language.* Cambridge: MA: Harvard University
- Levelt, W.J.M. 1989. *Speaking: From intention to articulation.* Cambridge, MA: MIT Press
- Levinson, S. & Wilkins, D. 2006. *Grammers of space: Explorations in cognitive diversity,* Cambridge University Press: Cambridge
- MacSweeney, M. F., Woll, B., Campbell, R., Calvert, G. A., McGuire, P. K., David, A. S., Simmons, A., Brammer, M. J. 2002. Neural correlates of British sign language comprehension: spatial processing demands of topographic language. *Journal of Cognitive Neuroscience* 14(7), 1064-1075
- Marleau-Ponty, M. 1962. *Phenomenology of perception* (C. Smith, Trans). London: Routledge & Kegan Paul
- Mead, H. 1934-1962. *Mind, self and society: from the standpoint of a social behaviorist.* Vol 1. C.M. Morris (trans and eds)., University of Chicago Press: Chicago
- McNeill D. 1992. *Hand and mind: What gestures reveal about language and thought.* University of Chicago Press, Chicago.
- McNeill D. 2005. *Gesture and thought.* University of Chicago Press: Chicago
- Ormel, E., Knoors, H., Hermans, D. & Verhoeven, L. 2009. The role of sign phonology and iconicity during sign processing: the case of deaf children. *Journal of Deaf Studies and Deaf Education,* 14: 436-448.
- Özyürek, A. 2002a. Do speakers design their co-speech gestures for their addressees? The effects of addressee location on representational gestures. *Journal of Memory and Language,* 46. pp. 688 – 704.
- Özyürek, A. 2002b. Speech-gesture relationship across languages and second language-learners: Implications for spatial thinking and speaking. In B. Skarebela, S. Fish, & A. H. Do (eds). *Proceedings of the 26th Annual Boston University Conference on Language Development* (pp. 500-509). Cascadilla Press: Somerville, MA
- Özyürek, A., Kita, S., Allen, S., Furman, R., & Brown, A. 2005. How does linguistic framing of events influence co-speech gestures? Insights from crosslinguistic variations and similarities. *Gesture,* 5(1/2), 219-240
- Özyürek, A., Kita, S., Allen, S., Brown, A., Furman, R., & Ishizuka, T. 2008. Development of cross-linguistic variation in speech and gesture: motion events in English and Turkish. *Developmental Psychology,* 44(4), 1040-1054.
- Özyürek, A., Zwitserlood, I., & Perniss, P. M. 2010. Locative expressions in signed languages: A view from Turkish Sign Language (TID). *Linguistics,* 48(5), 1111-1145.
- Perniss, P. 2007. *Space and Iconicity in German Sign Language (DGS)*. PhD Thesis, Nijmegen: MPI Series in Psycholinguistics.
- Perniss P, Pfau R, Steinbach M . 2007.Can't you see the difference? Sources of variation in sign language structure. In Perniss P, Pfau R, Steinbach M (eds). *Visible Variation: Cross-Linguistic Studies on Sign Language Structure,* (pp 1–34). Mouton: Berlin
- Perniss, P., Thompson, R., Vigliocco, G. 2010. Iconicity as a general property of language: Evidence from signed and spoken languages. *Frontiers in Psychology,* doi: 10,3389/fpsyg.2010.00227

- Perniss, P. M., Zwitserlood, I., & Özyürek, A. 2011. Does space structure spatial language? Linguistic encoding of space in sign languages. In L. Carlson, C. Holscher, & T. Shipley (Eds.), *Proceedings of the 33rd Annual Meeting of the Cognitive Science Society* (pp. 1595-1600). Austin, TX: Cognitive Science Society
- Poizner,H, Klima, E. & Bellugi, U. 1987. *What the hands reveal about the brain.* Cambridge: MIT Press
- Richardson, D. and Spivey. M. 2000. Representation, space and Hollywood Squares: Looking at things that are not there anymore. *Cognition, 76*, 269-95
- Robbins, P. & Aydede, M. 2009. *The Cambridge Handbook of Situated Cognition.* Cambridge University Press: Cambridge
- Saussure, F. [1916]1959. *Course in general linguistics* (W. Baskins. transl)Reprint. NY: Philosophical Library
- Sandler W, Meir I, Padden C, Aronoff M. 2005. The emergence of grammar: Systematic structure in a new language. *Proc Natl Acad Sci USA* 102:2661–2665.
- Senghas, A., Kita, S., & Özyürek, A. 2004. Children creating core properties of language: Evidence from an emerging sign language in Nicaragua. *Science, 305*(5691), 1779-1782.
- Stokoe, W. C. 1960. *Sign Language Structure. An outline of the visual communication systems of the American Deaf.* Silver Spring, MD: Linstok Press.
- Vigliocco, G., Vinson,D., Woolfe,T., Dye, M., Woll, B. 2005. Words, signs and imagery: when the language makes a difference. *Proceedings of the Royal Society,* B. 272, 1859-1863
- Willems, R. M., Özyürek, A., & Hagoort, P. 2007. When language meets action: The neural integration of gesture and speech. *Cerebral Cortex, 17*(10), 2322-2333.
- Willems, R. & Cassasanto. D. 2011. Flexibility in embodied language understanding. Frontiers in Psychology; doi: 10.3389/fpsyg.2011.00116
- Wittgenstein, L. 1953. *Philosophical Investigations* (G.E.M. Anscombe, Trans). Oxford, UK: Blackwell
- Zwaan, R. and Yaxley. R.H. 2004. Lateralization of object shape information in semantic processing *Cognition, 94*, 53-43