A Japanese University welcomed in Cambridge

TOHOKU-CAMBRIDGE FORUM

An International Workshop on Language, Brain and Cognition: Linguistic Science at Interdisciplinary Crossroads

Workshop Handbook

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Venue: University of Cambridge, Cambridge, UK

Sponsored by:

Tohoku University in collaboration with University of Cambridge, and The Tohoku University 21st Century COE Program in Humanities

Speakers:

Ina Bornkessel, Max Planck Institute for Neuroscience, Leipzig: *Neurotypology: Towards a cross-linguistic framework for language comprehension*

Hiroto Hoshi, SOAS, University of London: *Functional categories, structure building and theta marking*

Naho Ikuta, Jungho Kim, and Masatoshi Koizumi, The COE Program in Humanities, Tohoku University: *Brain activities related to the processing of Japanese canonical and scrambled sentences*

Sotaro Kita, Dept. of Experimental Psychology, University of Bristol: *Thinking-for-speaking in motion event descriptions as revealed by speech-accompanying gestures*

Kichun Nam, Dept., of Psychology, Korea University, and Sunbeom Pyun, College of Medicine, University of Ulsan: *Behavioral neuropsychological assessment and brain activation in an acquired dyslexia: An fMRI study*

Prashant Pardeshi, Kaoru Horie and Shigeru Sato, The COE Program in Humanities, Tohoku University: *Where grammar and socio-cultural cognition meet: A case of ego (speaker) as a goal*

Ian Roberts, Dept. of linguistics, University of Cambridge: *Parametric Comparison: Can we measure the syntactic distance between languages?*

Yuko Sassa, Hyeonjeong Jeong, Hideyuki Okamoto, Ryuta Kawashima, The COE Program in Humanities, Tohoku University: *Functional organization of the human inferior frontal cortex involved in language processing*

Organizing Committee:

Masatoshi Koizumi, Prashant Pardeshi, Kaoru Horie and Shigeru Sato, The COE Program in Humanities, Tohoku University

Ian Roberts, Dept. of linguistics, University of Cambridge

Time Schedule

09:00-09:30	Registration	
09:30-09:40	Opening/Welcome	
09:40-10:40	**Plenary Talk 1**	Ian Roberts, Cambridge
10:40-11:10	Presentation 1	Hoshi, London
11:10-11:40	Presentation 2	Ikuta et al., Tohoku
11:40-13:00	Lunch	
13:00-14:00	**Plenary Talk 2**	Sotaro Kita, Bristol
14:00-14:30	Presentation 3	Prashant et al., Tohoku
14:30-15:00	Coffee	
15:00-15:40	Presentation 4	Ina Bornkessel, Max Planck
15:40-16:20	Presentation 5	Nam et al., Korea
16:20-17:00	Presentation 6	Sassa et al., Tohoku
17:00-17:30	Discussion	

Neurotypology: Towards a cross-linguistic framework for language comprehension

Ina Bornkessel

Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig

Despite the undisputed diversity of human languages, most major models of language comprehension continue to base their fundamental processing assumptions on data from English. However, recent neurophysiological findings indicate that – even in closely related languages such as German – the strategies employed in real-time comprehension may differ significantly from those observable for English (e.g. Schlesewsky & Bornkessel, *in press*). For example, whereas argument interpretation in English relies heavily on positional information, German makes use of both a positional and a morphological strategy. Which of the two is chosen in a given sentence crucially depends on the morphological informativeness (i.e. degree of ambiguity) of the arguments. Importantly, the two strategies are *not* equivalent with regard to interpretative efficiency such that only the morphological strategy leads to a maximisation of on-line interpretation.

On the basis of these observations from German, we have developed a model of argument comprehension (the "Argument Dependency Model", ADM) that makes explicit the assumption of two alternative processing pathways (positional and morphological) for initial argument interpretation (Bornkessel, 2002; Schlesewsky & Bornkessel, *in press*). Crucially, the model assumes that other factors such as plausibility or discourse context do *not* play a role in this initial phase of interpretation, even in languages where morphological and positional factors appear to underdetermine argument interpretation from a surface (timeinsensitive) perspective. Rather, the initial establishment of an argument hierarchy takes place on the basis of a language-specific, relative weighting of the two processing pathways.

In this paper, I will present neurophysiological data from several further languages (Russian, Finnish) that support the basic architecture of the ADM. In addition, the findings from these languages point towards further important extensions to the model, for example with regard to the role of verb-object positioning. Finally, I will discuss neuroimaging findings from German and English to address the question of whether the positional and morphological pathways may be associated with distinct neural substrates.

References

Bornkessel, I. (2002). *The Argument Dependency Model: A Neurocognitive Approach to Incremental Interpretation*. Leipzig: MPI Series in Cognitive Neuroscience, 28.

Schlesewsky, M., & Bornkessel, I. (*in press*). On incremental interpretation:

Degrees of meaning accessed during sentence comprehension. *Lingua.*

Functional Categories, Structure Building and Theta Marking

Hiroto Hoshi

SOAS, University of London

In this paper, we attempt to provide an insight into the nature of functional categories, structure building and theta marking. Through an investigation into the nature of morphology and syntax, we claim that both structure building and theta marking are, in principle, completely free, and that functional categories have significant impacts upon how structure is built up and how a predicate assigns theta roles to its arguments in the course of the computation (cf. Hale and Keyser 1993, Chomsky 1995, 1999, 2000, among others). Specifically, developing the proposals in Hoshi (2001, 2002a-c), we set forth (1a-c) and (2a-b), and defend them here.

(1) a. Theta marking is, in principle, completely free.
b. A functional category constitutes a barrier for theta marking.
c. Functional categories such as Case and T in Japanese do not block theta marking.

(2) a. Structure building is, in principle, completely free.
b. A functional category is an obligatory licenser of a "phrasal/XP" domain, and a domain where there is no functional category is a "nonphrasal/X^0" domain.

To the extent that the proposed analyses based on (2a-b) are correct, they provide substantial empirical evidence for Chomsky's (1994, 1995) "bare" phrase structure theory, which claims (3).

(3) Categorial labels such as XP and X^0 should be eliminated from C_{HL} entirely.

This is so, because (2a-b) imply that the distribution of "phrasal" domains and that of "nonphrasal" domains are strictly determined by the presence or absence of a functional category in a given configuration in the course of the computation, but crucially, NOT by their categorical labels, XP and X^0 (cf. Fabb 1984, Sells 1996, H. Tada, p.c. 2001, N. Hornstein, p.c. 2002, J. Abe, p.c. 2003).

If (1a-c) are indeed correct, they provide strong arguments against Chomsky's (1995, among others) "configurational" theta theory, because (1a-c) clearly indicate that there is no fixed structural position for each argument (cf. Bošković 1994, Saito and Hoshi 1994/2000, 1998, Bošković and Takahashi 1998, Hornstein 1999, Lasnik 1999, Saito 2001, among others). Significantly, as Kuroda (2003) points out, proposals such as (1a-c) therefore imply below:

(4) LF provides only INSTRUCTIONS for the conceptual-intentional (C-I) system and the C-I system CALCULATES the meaning of each linguistic expression based on those INSTRUCTIONS.

Consequently, "[t]he interface C-I, i.e., LF, is not necessarily structurally in conformity with the RATIONAL analysis of meaning" (Kuroda 2003, p. 477. Emphasis provided by small capitals supplied by HH) (cf. Jackendoff 1997, 1998, Yumoto 2001, among others). Given the theoretically important conclusion in (4) together with recent INHERENT Case theories for Japanese, we speculate on the nature of the free word order phenomenon and "surprising constituents" in Japanese at the end of this paper (cf. Hale 1980, Farmer 1984, Saito 1985, 1989, 1992, 2003, Kuroda 1986/88, Fukui 1986, Gunji 1987, 1988, Yatabe 1993, Koizumi 1995, 2000, Takano 1996, Miyagawa 1997, 2001, Bošković and Takahashi 1998, Saito and Fukui 1998, Fukui and Takano 1998, Takano 2002, Abe 2003/2004, Fukui and Sakai 2003, Fukushima 2003, Kempson 2003, among others).

Brain activities related to the processing of Japanese canonical and scrambled sentences

Naho Ikuta, Jungho Kim, and Masatoshi Koizumi

The COE Program in Humanities, Tohoku University

Scrambling (or word order alternation) in "free word order languages" such as Japanese and German has generated a considerable literature in theoretical linguistics and psycholinguistics (Karimi ed., 2003). However, few imaging studies have been performed of the processing of non-canonical (or scrambled) word order (Friederici et al., 2003). Using functional magnetic resonance imaging (fMRI), we investigated the effects of scrambling on brain activation by directly comparing the brain regions involved in the processing of Japanese transitive sentences with canonical (Subject-Object-Verb) and scrambled (OSV) word order.
In this study, we performed the following two experiments on canonical and scrambled sentences. In the first experiment, we examined brain activation involved in the processing of the whole sentence. In the next experiment, we examined the changes of activated regions as the sentence unfolded.

Experiment 1:

In Canonical and Scrambled conditions, grammatical sentences with canonical and non-canonical (scrambled) order were visually presented at the center of a screen phrase by phrase. In either condition, half of the sentences were semantically plausible, and the others were semantically anomalous. Participants were instructed to judge whether or not the sentences they just read made sense by pressing one of the two buttons ('Yes' and 'No') with their right hands.
In the Canonical and Scrambled conditions (each compared with the Rest condition), similar regions were significantly activated, including Broca's, Wernicke's, premotor and visual areas. This suggests that most cognitive processes involved in the comprehension of scrambled sentences are also responsible for the comprehension of canonical sentences. When these conditions were directly compared (Scrambled minus Canonical), we found activated areas in the left dorsal prefrontal cortex and the left inferior frontal gyrus, which have been claimed to be selectively involved in syntactic processing (Hashimoto and Sakai, 2002).

Experiment 2:

Each SOV and OSV sentence was divided into the subject, the object and the transitive verb. They were presented one by one at regular intervals as visual stimuli. Words were also presented one by one at the same intervals as sentences. These words consisted of nouns that were the same nouns as those in subjects and objects and transitive verbs that were the same as transitive verbs in sentences. These words functioned as the control tasks. The participants read the presented sentences and words silently.

Subject of SOV sentences activated the same region as object of OSV sentences (left lingual gyrus). Object of SOV sentences activated the same region as subject of OSV sentences (left inferior frontal gyrus). SOV sentences and OSV sentences were different in regions activated when transitive verb was presented (SOV-left inferior temporal gyrus, OSV-left putamen and right middle frontal gyrus).

Therefore, the activated region common to the two experiments was left inferior frontal gyrus, including Broca’s area. This region was activated when reading the middle of a sentence in the experiment 2.

Based on the results of these experiments, we suggest that left inferior frontal gyrus is crucially involved in the processing of scrambled sentences. This finding is consistent with the observation that Broca's aphasics have difficulty comprehending scrambled sentences (Hagiwara and Caplan, 1990).

Thinking-for-speaking in motion event descriptions as revealed by speech-accompanying gestures

Sotaro Kita

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This talk concerns the relationship between speech and gestures that spontaneously accompany speech. The basic message of the talk is that spontaneous gestures can serve as a window into the spatial representations that speakers generate on-line at the moment of speaking. By observing such gestures, we can gain insight into how speakers organize spatial information in preparation for speaking, namely, the speaker's thinking-for-speaking. The talk will focus on how people express motion events with speech and gestures. I will discuss three studies that shed light on exactly how speech and gesture production processes are related to each other in such a way that gesture reflects the speaker's thinking-for-speaking, and how early in a child's development the relationship between the two processes is established. In these studies, spontaneous gestures were elicited by having adult and child participants narrate animated cartoons. The first study showed that adult speakers of Turkish, Japanese, and English gesturally expressed the same motion events differently and, furthermore, the gestural differences mirrored lexical and syntactic differences between the languages. The second study demonstrated that the linguistic effect on gesture was observed even within a single language. Syntactically different descriptions of Manner and Path in motion events were elicited from English speaking adults (e.g., In a event in which an entity rolls down a slope, rolling is the Manner and downward direction is the Path). Depending on how Manner and Path were syntactically related in a given utterance, gestural expression of Manner and Path varied in such a way that the linguistic and gestural representations have a similar structure. From these two studies, it is concluded that speech-accompanying gestures are generated from an interface representation between spatial cognition and speaking. The interface representation is an imagistic representation of an event that is adjusted on-line to be more compatible with demands of speech formulation processes. Finally, in the third study, we explored how early in a child's development such interface representations emerge. It was found that three year old English-speaking children exhibited the same gestural sensitivity to syntactic packaging of Manner and Path as adults (in the second study). Thus, it was concluded that children at the age of three can already adjust their imagistic representation of events for the purpose of speaking.

Behavioral neuropsychological assessment and brain activation in an acquired dyslexia: an fMRI study

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In our presentation, we will introduce the concept of dyslexia and specific reading difficulties of different types of dyslexics. And then two studies about Korean dyslexic will be presented. In study 1, psycholinguistic tests were used to specify the reading difficulties of a dyslexic, and the dyslexia type was defined as the deep dyslexia, based on the results of the psycholinguistic tests. In study 2, fMRI technique was used to examine the activation pattern of the dyslexic during doing psycholinguistic test. We found that the deep dyslexic read prints by using the right frontal lobe rather the left parietal and inferior temporal lobes.

Where grammar and socio-cultural cognition meet: A case of ego (speaker) as a goal

Prashant Pardeshi, Kaoru Horie and Shigeru Sato

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In the field of Japanese linguistics, a sentence is conceived to have a two-tier structure viz. “proposition” and “modality.” At the level of proposition are the grammatical categories such as voice, aspect, negation and tense while those at the level of modality include markers of deontic and epistemic modality. In this research paradigm, it is tacitly assumed that at the level of proposition, *ipso facto*, there is no room for cross-linguistic variation since it is the “objective” description—modality being the forte of “subjective” description allowing variation across languages. This view accords with the findings of typological studies such as as Bybee (1985) and Bybee et.a.l. (1994).

In this paper we will argue that languages *do* vary even at the so-called level of proposition through a typological study of events involving first person as a patient/recipient/goal. Our analysis is couched in the Speech Act Participant (SAP) based framework proposed in Shibatani (2003) which offers a principled and unified account of passive, inverse (transmission events), verbs of ‘giving’ (transaction events) and benefactive event involving first person as a goal of action, motion, transaction and benefit respectively (see data from Japanese on page 2).

Keeping the semantic denominator constant—speaker (or those in his in-group) being the patient/recipient/goal of an action, motion, transaction or benefit—the cross-linguistic study of the events under discussion nicely unravel subtle differences across languages. Our claim that languages do exhibit variation at the level of proposition is based on the primary data from languages from East Asia (Japanese, Korean, Chinese, Mongolian), South East Asia (Thai. Vietnamese, Cambodian), South Asia (Marathi, Hindi, Nepali) and Europe (English, German).

We claim that the cross-linguistic variation under investigation is not random but rather well motivated and is dictated by the notion of interpersonal characteristic of a language or the notion of “subjectivity” that a language entertains. The higher the degree of subjectivity the greater are the chances of using the marked expressions like passive, inverse, lexical inverse and benefactive. We argue further that the variation in question is not an isolated fact but has an overall repercussion on the grammar of the language as a whole—the higher the degree of interpersonal characteristic of a language, the wider and profound are the ramifications of such SAP related phenomenon pointing at the necessity of non-linguistic (cultural) facts to bear upon the linguistic description—a methodology akin to cognitive-functional linguistic approaches. Our findings nicely complement and echo with Uehara (manuscript) who nicely demonstrates through a cross-linguistic study that languages differ in respect of degree of “subjectivity” that

they impose upon their speakers.

DATA FROM JAPANESE

(1) Watasi-wa sensoo-ni hantai sita node minna-ni
I-TOP war-to ppose did hence all-by
hihan s-are-ta.
criticize-PASS-PAST
'Since I opposed the war everyone criticized me.'

(2) boku-wa ame-ni fur-are-ta.
I-TOP rain-by fall-PASS-PAST
'I was adversely affected by the rain.'

(3) boku-wa Taro-ni nikki-o yom-are-ta.
I-TOP Taro-by diary-ACC read-PASS-PAST
'I was adversely affected by Taro reading my diary.'

(4) Ken-ga boku-ni denwa-o shi-te kita.
Ken-NOM I-DAT phone-ACC do-CONJ came
'Ken called me.'

(5) Ken-ga boku-ni hon-o kure-ta.
Ken-NOM I-DAT book-ACC give-PAST
'Ken gave me a book.'

(6) Ken-wa boku-o tasuke-te kure-ta.
Ken-TOP I-ACC help-CONJ give-PAST
'Ken helped me.'

SELECTED REFERENCES

DeLancey, S. 1981. "An Interpretation of split ergativity and related patterns". *Language* 57: 626-657.

Shibatani, M. 2003. "Directional Verbs in Japanese". In *Motion, Direction and Location in Languages*, Shay, S. (ed.), 259-286, Amsterdam: John Benjamins.

Thompson, C. 1994. "Passive and Inverse Constructions" In *Voice and Inversion*, T. Givon (ed), 47-63. Amsterdam: John Benjamins.

Uehara, S. (manuscript). "Typologizing linguistic subjectivity: A cognitive and cross-linguistic approach to grammaticalized deixis." Tohoku University.

Functional organization of the human inferior frontal cortex involved in language processing

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The classical model of language in the brain is based on the lesion studies that have reported functional roles of the affected brain region through observation of patient's symptom(s). For example, the left inferior frontal gyrus (LIFG) including Broca's has been believed to be involved only in language production. However, since number of cases in these lesion studies is relatively small, also the localization of lesions is somewhat uncertain, it is difficult to generate comprehensive models for language processing.

Recently, on the other hand, functional neuroimaging techniques enable us to identify non-invasively, the brain areas involved in the cognitive processes of interest of normal subjects. The previous functional neuroimaging studies have reported that a number of the brain areas in addition to Broca's area and Wernicke's area, are involved in language functions, and the results of these studies have made it possible to discuss the language systems in the brain precisely. Especially, it has been suggested that the LIFG area plays an important role in the syntactic processing, which forced to change the classical view for the functional role of this area.

In this workshop, we will introduce two functional magnetic resonance imaging (fMRI) studies, which can figure out the functional role of the LIFG in the different aspects of language processing.

In the first study, the brain activations during sentence comprehension in different languages by Korean native speakers were investigated. We used three different languages such as Korean, Japanese, and English, which were divided into two groups from typological differences in the basic word order, that is, English is different from Korean and Japanese. We found that the bilateral superior temporal cortex was activated in during the comprehension of Korean, English and Japanese. It is noteworthy that the LIFG including Broca's area was significantly activated only when the subjects were listening to English despite the fact that all the Korean subjects had learned English (L2) much longer than Japanese (L3). The results suggest that the brain activation patterns were different according to typological differences in the basic word order.

In the second study, the brain activations during hearing different types of grammatical violation sentences in Japanese by Japanese native speakers were investigated. We found different brain activations depending on each type of grammatical violation sentences. As a result, we found that syntactic processing in Japanese is related to not only the LIFG but also

to some specific regions such as the bilateral superior temporal gyrus. The magnitude of activation in the LIFG was different according to processing of different types of grammatical violation sentences. The results suggest that the brain network exists for different syntactic processing in the LIFG, although the pattern of activation is different in relation to the specific syntactic processes.

On the basis of the results of our studies and these of previous investigations, we conclude that the LIFG seems to have a critical role in the processing of specific syntactic aspects.

Invitation to the Science of Language, Brain and Cognition

What is going on in a human brain when one is speaking or trying to comprehend what is being uttered? This fundamental question remained unanswered for many years. However, the last decade has witnessed immensely sophisticated non-invasive techniques for observing brain functions, i.e. functional Magnetic Resonance Imaging (fMRI), Positron Emission Tomography (PET), Magnetoencephalography (MEG) etc. These newly developed techniques have gradually been enabling us to recognize, visually, which part of our brain is working when we produce and comprehend utterances. The goals of our COE program in an Integrated Approach to Language, Brain, and Cognition, are twofold: (i) to enhance our accumulated knowledge and expertise in linguistic sciences by employing fMRI techniques, and, more importantly, (ii) to uncover the inner working mechanism of our brain, which has hitherto been treated as a "blackbox".

Inquiry into the relation between brain and language was initially dominated by studies of language disorder such as aphasia. Researchers examined patients with linguistic disability to determine its correlation with damage in a specific brain region. Our enhanced understanding of on-line functions of a lived brain greatly contribute to improvements in rehabilitation therapies for speech disorders. It can also help shed light on how we can prevent age-related speech disorders by training and keeping our brain in good shape, a matter of grave concern in this rapidly aging society.

This fMRI-driven integrated approach to language and brain also benefits foreign language education. Traditionally, linguists based their grammatical and semantic analyses and theories/models on "native speaker intuition". Recent fMRI techniques have presented us with interesting data suggesting that understanding of grammar and that of meaning are performed in different brain regions. A new interdisciplinary field of linguistic science as an experimental science has thus been emerging. If this field develops its full explanatory potentials in the future, it can reveal the differences between the working of a brain as one use one’s native tongue and that as one uses a foreign language, leading to the development of efficient foreign language learning methods much needed in this age of globalization.

Another venue of applying our research findings is implementation of brain mechanism in AI (artificial intelligence), i.e. a robot that can understand language. The day may soon come when welfare robots will be able to provide care and assistance to elderly people with physical disability by responding to their verbal cues.

Language is thus right at the heart of interdisciplinary crossroads where both humanistic sciences (linguistics, psychology) and natural sciences (medicine, information science) meet. Internationally, very few research organizations have attained such interdisciplinary collaboration in linguistic science as our COE. At our COE, a collaborative team of researchers in linguistic science from various subdisciplines at Tohoku University - Graduate School of International Cultural Studies, the New Industry Creation Hatchery Center, Graduate School of Information

Sciences, Graduate School of Engineering, Graduate School of Medicine, and Graduate School of Arts and Letters - closely work together to reveal "language in the brain".

Program Objectives

[1] Creation of a New Field of Research through Multi-dimensional Integrated Approaches to Language, Brain, and Cognition

With collaboration by an interdisciplinary team of researchers in linguistic science - linguistics at its core, joined by brain scientists, psychologists, information engineering scientists, we form a research and education center and aim to create a new field of research addressing the following issues: (i) How language is represented and organized in a human brain, (ii) How language is acquired, practiced, and lost, and (iii) How language can be acquired by a robot. We take language-related behavior to be uniquely human and aim to train junior researchers in linguistic science of the next generation in our research and education center synthesizing both humanistic and natural sciences.

[2] Synthesizing Humanistic and Natural Sciences for Enhanced Research Potentials in Linguistic Science

Our COE program has linguistics at its theoretical foundation and is crucially linked to brain imaging studies, natural language processing and cognitive psychology that provide experimental verification. Evaluating linguistic theories by brain functional imaging data and reconstructing more realistic linguistic theories are expected to provide vital research findings not attainable by respective disciplines of linguistic science alone. We are convinced that this research and education environment offered at our COE offers an ideal hatchery ground for the next generation of original researchers in linguistic science.

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