“Today, in our world of global markets and accelerating, cross-cultural exchanges, we all live in one another’s world, a world of collisions and confrontations that emerge not only from struggles for power but from blurred images of one another.” Weiss, 1992, p. 6.

“Because some negotiation processes are also culture specific, negotiating with someone from another culture requires understanding the other party’s communication and interaction norms.” Adair & Brett, 2005, p. 46.

Introduction

With an ever-more globalized world, understanding cultural differences and how these cultural differences get played out in organizational processes is becoming increasingly important. Large scale research has established the basic dimensions on which cultures can be differentiated (e.g., Gelfand et al., 2007; Hampden-Turner & Trompenaars, 1993; Hofstede, 1980). However, applying these broad dimensions to actual individual behavior has not been as fruitful, since these broad dimensions tend to cloak innumerable individual differences. It is precisely at the level of micro-interactions, however, where cross-cultural differences play out. For example, in negotiation and conflict management situations, understanding cultural patterns and tendencies is critical to whether a negotiation will accomplish the goals of the involved parties (Tinsley, 1998; Gelfand & Dyer, 2000; Adair & Brett, 2005).

Some of these cultural patterns have been identified, and usefully applied to negotiation situations (e.g., Gelfand & Dyer, 2000), however researchers hasten to point out that cultural patterns do not explain all of the variation found (Tinsley, 2001). Suggesting that German negotiators, for example, are higher in power distance than Americans, has not helped much to explain differences in actual negotiation styles. What is needed is a more fine-grained approach that examines differences below the level of behavioral norms. Drawing on the recent social neuroscience approaches (e.g., Cacioppo & Berston, 1992; Cacioppo et al., 2007), we argue that these differing negotiating styles may not only be related to differing cultural norms, but to differences in underlying language processing strategies in the brain (see Nisbett et al. 2001). Discovering these processing strategies at the level of cerebral activity may help us to understand more completely the basis of differences in negotiation and conflict management style.

Current research has focused on how different cultures address their perceptions and frames of the negotiation
process (i.e., Tinsley, 1998; 2001). The assumption is that cognitive processing is identical across people, but that cultures add a layer of behavioral norms creating differences in the understanding of negotiation and conflict management processes and practices. The metaphor is the computer: “Brain equals hardware, inferential rules and data processing procedures equal the universal software, and output equals belief and behavior, which can, of course, be radically different given the different inputs possible for different individuals and groups” (Nisbett et al. 2001, p. 291). Hall and Hall (1990, pp. 3-4) also refer to culture as a “computer program,” comparing it to “a giant, extraordinarily complex subtle computer.” Hofstede (1980) calls culture “the collective programming of the mind.” Using this metaphor, the brain is considered a black box in which, it is assumed, cognitive processing at the level of neuroscience is largely universal, or etic. In this article, we argue that in fact, cultural difference may influence neuropsychological processes (see Kotik-Friedgut, 2006). If this is the case, we would expect that individuals from different cultures will exhibit different neuropsychological tendencies, and that these tendencies have implications for negotiation and conflict management processes.

While one could study a number of languages, this research focuses on differences between native English-speaking Americans and native German-speaking Germans. The reason for comparing English and German is because of major syntactical differences that exist between the two languages. English is an action language that usually follows a subject-verb-predicate structure. German syntax, on the other hand, is more intricate and complex. German syntax includes separable prefix verbs, auxiliary verbs in relation to infinitives, and the placement of verbs in dependent clauses. This syntax, which frequently requires waiting until the end of the sentence for the verbal information necessary for comprehension, would lead one to hypothesize that cognitive processes would be affected and result in a more deliberative cognitive style. An auditory listening comprehension task was used to investigate the following hypothesis.

Hypothesis: Due to syntactical differences, native German-speaking individuals will develop a more deliberative cognitive style than native English-speaking individuals, resulting in a longer comprehension reaction time.

While there have been many studies of language using brain imaging techniques, fewer studies have investigated how language at the level of sentences is comprehended. In research using brain imaging techniques to study language comprehension, Hald et al. (2006) specifically used EEG to study theta and gamma responses to semantic violations in online sentence processing. EEG was used to compare subjects’ brain activity when listening to systematically congruent sentences and when listening to systematically incongruent sentences. One difference occurred when subjects were
listening to systematically congruent sentences. In this situation, the subjects had increased gamma activity in the frontal areas. This gamma activity, referring to brain wave oscillations around 40 Hz, did not occur when subjects were listening to systematically incongruent sentences. This finding proposes that activity in the gamma frequency range is part of the neural pattern of activity that occurs during normal language processing (Hald et al., 2006), suggesting that gamma activity could reflect time of comprehension.

Gamma activity has been implicated as playing a key role in understanding the physiological process of binding in sensory perception (Crick & Koch, 1997; Llinas & Pare, 1996). 40Hz has appeared to be the most likely frequency range involved in indicating the point at which all signals used to process a given stimulus are integrated into one (Haig et al, 2000). A study of neurophysiological functioning of the brain during language processing could reveal more information on how humans comprehend auditory information. Based on the role of 40 Hz frequency in sensory binding, it would be reasonable to assume that 40 Hz is an indicator of the point at which the separate discrete signals caused by the onset of the language stimuli come together as a meaningful sentence. Thus, 40 Hz could be used not only as a measure of perceptual recognition but also as a measure of linguistic comprehension (McCarthy et al, 2002).

Having a stable marker for timing of comprehension would be particularly relevant when trying to study and compare different languages and their neuro-physiological similarities and differences. Looking at 40 Hz activity specifically, time-frequency representations of power changes in the gamma range can be used. These representations are referred to as wavelets and have been used for analyzing localized variations of power within a time series (Torrence & Compo, 1998). The fact that these representations use time and frequency makes them the analysis of choice for this study.

In the present study native English-speaking American subjects and native German-speaking German subjects listened to a series of sentences in their native language and clicked a mouse when they understood each sentence. EEG data were collected as subjects listened and responded. It was hypothesized that because of syntactical differences, native German-speaking Germans have developed a more deliberative cognitive style than native English-speaking Americans. This deliberative cognitive style in native German-speaking Germans would be reflected in a longer reaction time indicating comprehension as well as a later onset of 40Hz when compared to native English-speaking Americans on the simple sentences.

Method

Participants
A total of 11 native English speaking people and 10 native German speaking people participated in the study. The German subjects were local “au pairs” who had recently arrived from Germany (M = 7.68 months). All subjects were right handed college aged women (19-22 yrs) who were enrolled in classes at a university.

Materials

Presentation version 0.8 software was used to present a series of 86 sentences, which were a randomized combination of sentences having both simple and complex syntax. All sentences were originally written in English and were then translated by a native German-speaking German into German. Sentences with simple syntax were defined as following the structure of subject-verb-predicate. A variety of sentences with complex syntax was used to create an alternate set of sentences. Since only sentences using simple syntax could be equated for length and position of verb between the two language groups, only the reaction time recorded for the sentences with simple syntax (45 in total) were used in the analysis of the two language groups. A statistical analysis showed that any differences in length of simple sentence between the two languages were not significant ($t (44) =1.21 \ p<0.23$). The sentences on average lasted 2.67 seconds and were separated by a gap of 4 seconds.

Procedure

When subjects arrived, they filled out a questionnaire and signed a consent form. The questionnaire asked them to identify their name, age, handedness (if subjects were left handed they were not used in the study), where they were born, and where their parents were born. Subjects were then seated in a comfortable leather recliner, and the EEG setup was completed. They viewed instructions on a monitor directly in front of them, instructing them to remain as still as possible during the experiment and to click the mouse when they understood a sentence. In order to reduce eye movement, the subjects were also told to look towards the monitor, which had a simple fixation cross displayed in the center, during the presentation of the sentences. The lights were turned off and the experiment began. Presentation software recorded the experiment from beginning to end on a millisecond time scale, and each response made by a subject was recorded by the presentation system. Later analysis was done to determine the average length of time that transpired between when a sentence ended and when comprehension was reported. At the end of the experiment subjects received monetary compensation for participating, were debriefed on the nature of the experiment, and were thanked for their participation.

EEG recording and analysis

EEG data were collected using products by Bio Semi including a 64-channel ActiveTwo EEG/ERP acquisition
system that had an AD box with battery and a USB2 Receiver. The acquisition system was controlled by a Dell personal
computer with a Pentium 4 processor using the program Acti-View, which monitored and collected EEG signals. EEG
data were analyzed, segmented, and averaged using Brain Vision Analyzer version 1.0. The stimulus of the 86
sentences created through the presentation program contained markers indicating key events essential to the experiment.
These markers were translated into the Brain Vision Analyzer program and provided corresponding EEG data occurring
at the key events. These key events were the beginning of each sentence, the occurrence of each verb, the end of each
sentence, and the response click to each sentence. The markers included EEG data that occurred at some time before the
key event and at some time after the key event. For the markers indicating the beginning of a sentence and the occurrence
of a verb, EEG data were marked 100ms before the marker and 900ms after the marker. For the markers indicating the
end of a sentence and a response click, EEG data were marked 500ms before the marker and 500ms after the marker.
The EEG data collected for each marker, on each sentence, and for each subject were averaged to create a grand average
for that key event for each language group. This data collection method allowed for comparative analysis between groups
for each key event.

The averaged and filtered data were transformed into wavelets to compute the gamma power change between 30
Hz and 50 Hz. A wavelet was created for the markers at the verb, 100ms pre-stimulus to 920ms post-stimulus; at the end
of sentence, 500ms pre-stimulus to 500ms post-stimulus; and at the response, 500ms pre-stimulus to 500ms post-
stimulus. This procedure was followed for each region of the brain.

Results

An independent two-tailed t-test was conducted comparing German speakers’ average comprehension response
time to English-speakers’ average comprehension response time. Means were calculated by determining the time that
transpired between when a sentence ended and when subjects responded indicating comprehension. English-speaking
subjects were significantly faster in their response time (M = 409.51ms SD = 341.68ms) than German-speaking subjects
(M = 726.39ms SD = 265.13ms) \( t(19) = 2.36, p < .029 \).

EEG data readings showed differences between the groups. While overall patterns between groups were similar
on all electrodes, there were differences in amplitude and frequency. Averages were broken down into groups according
to regions. An overall average was created for frontal electrodes (AFz, AF3, AF4, AF7, AF8, Fpz, Fp1, Fp2, Fz, F1,
F2, F3, F4, F5, F6, F7, F8, FCz, FC1, FC2, FC3, FC4, FC5, FC6, FC7, FC8, FT7, and FT8) and parietal electrodes
(Pz, P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, POz, PO3, PO4, PO7, and PO8).
In a visual inspection of the wavelets, differences were found in the overall frontal average wavelet. English-speakers had gamma activity ranging in intensity from -100 \( \mu \text{V} \) to 100 \( \mu \text{V} \) in steady band ranging from 36 Hz to 39 Hz in their frontal electrode average surrounding the marker of the verb. German-speakers had very little gamma activity surrounding the marker of the verb in their frontal electrode average. In contrast German-speakers had gamma activity ranging in intensity from -100 \( \mu \text{V} \) to 100 \( \mu \text{V} \) in a steady band ranging from 29 Hz to 33 Hz surrounding the end of the sentence marker in their frontal electrode average. When inspecting the parietal leads, no difference in pattern was found. Rather, both groups had similar gamma activity in all three markers.

**Discussion**

As indicated by the results, native English-speaking American participants differed from native German-speaking German participants in both comprehension reaction time and EEG measured response. Consistent with our hypothesis, native German-speaking German participants took significantly more time to indicate when they understood a sentence, than did native English-speaking American participants. This result is consistent with the ideas of Vygotsky (1986) and the theory that individuals from different cultures develop unique language processing strategies that affect behavior. A deliberative cognitive style used by Germans could account for this difference in comprehension reaction time.

The hypothesis was further supported by EEG 40 Hz wavelets that showed different patterns of activity in relation to time and brain region. As predicted, both native English-speaking American participants and native German-speaking German participants had 40 Hz activity while they listened and responded to sentences. However, a difference in timing of 40 Hz activity was found between the groups with native English-speaking American participants having on average 40 Hz activity earlier in each comprehension task than the native German-speaking German participants. In the frontal region, native English-speaking American participants had 40 Hz activity surrounding the verb whereas native German-speaking German participants had 40 Hz activity later surrounding the end of the sentence. In the parietal region, however, both groups had comparable 40 Hz activity surrounding the verb. This difference in the timing of 40 Hz is consistent with the idea of a more deliberative cognitive style, which was reflected in manual reaction time.

It is important to note limitations of the sample. All participants in the study were college-aged females due to the fact that only college-aged German-speaking women were available. It is recommended that the study be extended in order to include a more mixed group of participants including males and other age groups. In addition it is recommended that more studies focusing on language comprehension using EEG and 40 Hz be done in order to investigate further the relationship between physiology and cognitive functioning.
We argue that the lexicology and grammar of a language have a role beyond the traditional one of determining how speakers conceptualize the world around them. Language is acted upon by the internal framework of the brain. In order to understand the nature of conflict at the level of observed behavioral differences, we should also understand the micro-language processing strategies that may underlie these differences. This study demonstrates that social neuroscience may provide a new way of understanding micro-processes in cross-cultural negotiations and conflict resolution. Perhaps, just as researchers such as Hofstede have constructed ordinal scales to position behavioral tendencies of different cultures relative to one another, future research might attempt a similar ranking of brain language processing across cultures.

We argue that in order to understand the effect of differing cultures on negotiations and conflict management, we need to examine these interactions on a more micro level. The reason that much variance is left unexplained in extant research is that macro-level models are difficult to translate into specific interaction patterns in negotiations. We contend that individuals from differing cultures will differ, not just in their observable norms and behaviors (that have been studied previously), but also in their underlying neuropsychology—their ways of understanding and ascribing meaning to interactions (see Nisbett et al., 2001). In other words, while previous studies have primarily examined external behaviors that are indicative of culture, very little research has examined internal cognitive processes that may also reflect cultural differences.

References


Neuroscience Research, 11(4), 669-675.


