Research Networking Programmes

Short Visit Grant ☒ or Exchange Visit Grant ☐

(please tick the relevant box)

Scientific Report

The scientific report (WORD or PDF file – maximum of eight A4 pages) should be submitted online within one month of the event. It will be published on the ESF website.

Proposal Title: Lexical Access in Bilinguals: Cognate Processing during Visual Word Recognition in L1 and L2.

Application Reference N°: 7022

1) Purpose of the visit

The main aim of this visit was to carry out a collaborative research (between the University of Toulouse and the University of Colorado) seeking to investigate lexical access in bilinguals, as the focus of my doctoral thesis is the understanding of processes involved in the visual word recognition of morphologically complex words in monolinguals and bilinguals. Interdisciplinary comparative experiments between these populations are needed, and the Institute of Cognitive Science of Colorado is an ideal place to do so. Not only Prof. Kim is an expert in neural correlates of language processing, but also there is a large population of English-Spanish proficient bilinguals and English monolinguals in the area.

The expectation was to design an electrophysiological experiment that would first of all replicate previous findings, specifically the cognate facilitation effect in the N400 component (less negative brain activity for words sharing form and meaning across languages when compared to controls). Also, and more importantly, it was one of our main interest to test the existence of a cumulative effect of lexical frequency across languages for cognate words. Finally, as recent evidence has suggested, it would be interesting to look at neural components reflecting possible morphological processes in early stages of reading. In order to run such experiment; it will be necessary to learn how to work with the software used to present the stimuli, record and analyze the data obtained. In this case, an intensive training in electroencephalogram (EEG) recording and Event-Related Potential (ERP) techniques is necessary.

2) Description of the work carried out during the visit

During the time spent in Prof. Kim's lab, we designed a research project using scalp-recorded event-related potentials (ERPs) to compare cognitive and neural mechanisms involved in the visual word recognition of cognates. In the process of it, there were meetings organized for extensive discussion from different theoretical views, as well as the creation of the stimuli, the optimal way to search and screen for specific participants profile, get to know the software and equipment that would be use, and lastly running pilot subjects to ensure the well functioning of it all.

Readings on the general theme of language processing, morphology and visual word recognition in bilinguals were reviewed on different lab meetings. Relevant empirical and theoretical papers were assessed, and current perspectives were presented for discussion. One of the main topic presented was the cognate facilitation effect. Cognates are words that across languages share form and meaning, and have long been used in research to explore lexical access and representation in bilinguals. According to the supra-lexical model proposed by Giraudo & Grainger (2001), word form representations from the same morphological family are interconnected via a higher level of abstract morphemic representations. It has been suggested that morphology transcends language and that morphemes can be the unit of transition across them. In a bilingual mind, cognates can be thought of as supra-lexical morphological representations that are modality and language independent. Intuitively, a cummulative cognate frequency effect (sum of the cognate frequencies across languages) can be expected in bilinguals (but not in monolinguals).

Some relevant studies that have assessed neural correlates of visual word recognition of isolated words in bilinguals, like the ones done by Midgley, Holcomb & Grainger (2011), Peeters, Dijkstra & Grainger (2013) and Mulder, Schreuder & Dijkstra (2013). Even though some aspects of their methodology varies (as they all use cognate words as stimuli but different language; task or participants language proficiency level), the main findings showed a facilitation effect for bilinguals when processing cognate words. This effect consists of a smaller (or more positive) amplitude in the N400 component when comparing cognates and non cognates. The material in the mentioned experiments consisted of identical and near identical cognates in English-French or English-Dutch (ex. table-TABLE victim-VICTIME; message-MESSAGE; hotel-HOTEL). In the present study we aimed to test previous claims using English and Spanish bilinguals.

The participants were students at the University of Colorado (Boulder) that voluntarily participated in the study for about 3 hours in exchange of 25 dollars. The participants could be either Spanish/English bilinguals or English monolinguals. The requirements for the bilinguals were to have English as L2 classes more than 5 years and lived at least for a year in an English speaking country. Monolinguals reported to have no knowledge of Spanish (or any romance language) and had never lived in a Spanish speaking country. Besides of the self reported proficiency questionnaire, an objective measure of language was used (online language proficiency test exam). All the participants were right handed and had normal or normal to corrected visual acuity with no history of neurological disorders.

The words used as stimuli could be either English- Spanish identical cognates, or English only words. For the cognates, a total of 300 words with identical orthography in English and Spanish that have a semantic overlap (shared meaning across languages). As for the control words, a total of 300 only english words (non legal or low frequent letter

strings in Spanish) matched in length and frequency to cognate words. Cognate and control words frequency was taken from the Corpus of Contemporary American English (COCA; Mark, 2008) and the Español Palabras Corpus (EsPal; Duchon et al., 2013). All word frequencies were transformed to log10 freq log range was from .05 to 2.5. Español Palabras (EsPal) is a web interface to Spanish word frequency data and other word properties based on written and subtitle corpora, collection of written data from the Web, government sources, newspapers, and literature (Duchon et al., 2013). The Corpus of Contemporary American English (COCA) is the largest freely-available corpus of English, and the only large and balanced corpus of American English. The corpus contains more than 450 million words of text and is equally divided among spoken, fiction, popular magazines, newspapers, and academic texts. It includes 20 million words each year from 1990-2012. Because of its design, it is perhaps the only corpus of English that is suitable for looking at current, ongoing changes in the language (Mark, 2008). The COCA frequency measurement used was the average of written fiction, magazines and subtitles. When a word appeared listed in different parts of speech (noun, verb, etc.) all frequencies were added.

As the participants had to perform a Lexical Decision Task (LDT), a total of 600 pseudo-word letter strings (matched in length) were created from the cognate and control words by changing the first or last letters (maintaining affixes present in cognates and control english words). Only orthographically legal letter strings, matched in length and non-existent neither in COCA nor EsPaL. The pseudo words were created changing 1-4 letters of the existing English words, maintaining affixes (prefix or suffix) in line with English orthotactics (legal letter string pseudowords), homophones may have been used as pseudowords. It is best to keep the pseudowords as similar to the words as possible, in order to claim that existing differences in the processing of the words and pseudowords (in general, not just cognates) is due to morphological processing (or at a semantical level) as the orthography is as similar as possible (when just changing one or two letters) and it is just the arbitrariness of having a concept or not linked to the letter string.

In total the experiment consisted of 1200 trials that consisted of 300 English/Spanish identical cognates (ex; general), 300 English control words (ex; herself) and 600 English-like nonwords (ex; peleral). All words were presented in Courier font to ensure same width for every letter, size 33 (no more than four visual angles for the whole word). Words were presented in uppercase to avoid written accents differences for the Spanish form of the words.

Table 1. Stimuli properties: Words used matched in length and frequency.

	Lenght	Log Freq. English	Spanish
Cognates	6.87	1.2	1.24
Control	6.88	1.2	NA
Pseudowords	6.87	NA	NA

The procedure was the following: participants were seated in a comfortable chair in a dimly lit room in front of an LCD screen. The experimental session took around two and a half hours, including the initial setup and language proficiency tests. Each trial consisted of a fixation point (cross in the center of the computer screen), followed by a single word or pseudoword. The fixation prompt appeared on screen for 500 ms, followed by a 100 ms blank screen. The word was presented on screen for 500 ms, followed by an 400 ms blank screen, and finally a prompt indicating that the participant should judge whether the previously displayed stimulus was a word or a nonword ("Word/NonWord"). The target word was presented in white letters centered on a black

background monitor. Lexical and cognate status varied pseudo-randomly across trials (never repeating the same condition more than two times in a row). Response buttons were counterbalanced across participants.

Participants performed the LDT while continuous EEG was recorded from 64 sintered Ag/Ag-Cl electrodes embedded in an elastic cap (Neuroscan QuikCaps) arranged according to the extended 10–20 system. Vertical eye movements and blinks were monitored with two electrodes placed above and below the left eye, and horizontal eye-movements were monitored by electrodes placed at the outer canthi of each eye. EEG was also recorded over left and right mastoid sites. Impedances were maintained below 10 k Ω. EEG was referenced on-line to a vertex electrode and later re-referenced to linked mastoids.

3) Description of the main results obtained

During the stay we were able to discuss important current issues of language processing, as well as design a research experiment to clarify some previous findings. The stimuli for the experiment was created and 20 participants completed the experiment (ten monolinguals and ten bilinguals). Visual inspection of the results obtained so far showed a difference in the amplitude of the N400 component (Kutas & Federmeier, 2011; Luck, 2014) which follows the pattern of the previously described cognate facilitation effect for the bilingual participants, but as expected, this was not the case for the monolinguals. More participants are needed to carry out the corresponding statistical analyses. Overall, we aim to replicate the facilitation effect at the N400 component that has been previously described in a similar experiment using English - French (Midgley et al., 2011), but using English - Spanish stimuli. This important finding will help generalize the hypothesis that cognates are special words for bilinguals regardless of the language. The project is still a work in progress, as more data is needed from more participants in order to make stronger claims.

4) Future collaboration with host institution (if applicable)

As the research is a work in progress, more subjects will continue to participate until enough data has been obtained. Once the data for all the participants needed in both groups has been recorded, different statistical analyses will be carried out. First of all we will look at the stimuli properties and with a correlation analyses of the different frequency of the words (cognates or not) and the amplitude of the N400 (among all the participants) in order to explore if the frequency has a cumulative effect across languages. Secondly, participants characteristics can be looked at (specifically language proficiency) and see if there is any correlation with the cognate facilitation effect. Another important project to be done in the near future will be the online LDT using the same material but with no delay (as we included some delay for the ERP procedure used). This online task will allow us to obtain behavioral data of many participants and compare it with the behavioral data obtained in situ.

Depending on the results we find with the current English -Spanish ERP's and behavioral data experiment, we can also aim to carry out a similar experiment but with a more sophisticated procedure like the masked priming. This technique will allow us to examine neural correlates for reading processes with the advantage of an unconscious prime, where we will be able to explore cross-language effects in a direct way.

5) Projected publications / articles resulting or to result from the grant *(ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant)*

The experiment performed in the University of Colorado will be submitted for publication. We will also submit the results for presentation in future international congresses.

6) Other comments (if any)

The opportunity given to work with Prof. Kim and his laboratory has been a very enriching learning experience for which I am extremely thankful.

REFERENCES:

Davies, Mark. (2008-) The Corpus of Contemporary American English: 450 million words, 1990-present. Available online at http://corpus.byu.edu/coca/.

Duchon, A., Perea, M., Sebastián-Gallés, N., Martí, A., Carreiras, M. (2013) EsPal: One-stop Shopping for Spanish Word Properties. Behavior Research Methods, 45: 1246-1258. Available online at http://www.bcbl.eu/databases/espal/.

Giraudo, H., & Grainger, J. (2001). Priming complex words: Evidence for supra-lexical representation of morphology. Psychonomic Bulletin & Review, 8(1), 127-131.

Kutas, M., & Federmeier, K. D. (2011). Thirty years and counting: finding meaning in the N400 component of the event-related brain potential (ERP). Annual review of psychology, 62, 621-647.

Luck, S. J. (2014). An introduction to the event-related potential technique. MIT press.

Midgley, K.J., Holcomb, P.J., & Grainger, J. (2011). Effects of cognate status on word comprehension in second language learners: An ERP investigation. Journal of Cognitive Neuroscience, 23(7), 1634-1647.

Mulder, K., Dijkstra, T., Schreuder, R., & Baayen, H.R. (2014). Effects of primary and secondary morphological family size in monolingual and bilingual word processing. Journal of Memory and Language, 72, 59-84.

Peeters, D., Dijkstra, T., & Grainger, J. (2013). The representation and processing of identical cognates by late bilinguals: RT and ERP effects. Journal of Memory and Language, 68(4), 315-332.