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The role of meaning and form similarity in translation recognition in highly proficient balanced bilinguals: A behavioral and ERP study

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ABSTRACT

Previous behavioral findings showed that pairs of words that are highly related in meaning across two languages and pairs in which the second word is related in lexical form to the correct translation of the first one produce interference effects when highly proficient balanced bilinguals perform a translation recognition task (Ferré, Sánchez-Casas, & Guasch, 2006; Moldovan, Sánchez-Casas, Demestre, & Ferré, 2012). In contrast, interference effects were not observed when the two words were less related in meaning. The lack of interference with less related words could be explained by the fact that the level of activation of the corresponding semantic representations is too low so as to produce interference at the time the translation decision has to be made. Moreover, behavioral measures might be not sensitive enough to capture the activation of such representations. In the present study, highly proficient balanced Catalan–Spanish bilinguals performed a translation recognition task in which a short stimulus onset asynchrony (SOA, i.e., 250 ms) was used and event related potentials (ERPs) were recorded. There were three critical conditions: pairs of words highly related in meaning, pairs of words less related in meaning, and pairs in which the second word was similar in lexical form to the correct translation of the first word. Behavioral results showed interference effects in all conditions. ERPs revealed modulations of the N400 for the two semantic conditions, and modulations of the LPC for the form condition. These results reveal that when short SOAs and sensitive measures are used, interference effects with words less related in meaning are obtained as well. In addition, these findings suggest that meaning is accessed before the translation equivalent becomes available, that is, highly proficient balanced bilinguals can directly access the conceptual system from both of their languages.

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1. Introduction

One of the central issues in the psycholinguistic study of bilingualism has been how lexical forms are mapped to meaning. A common way to explore this issue has been to examine form and meaning relationships between words. Words can be more or less similar in meaning and in (orthographic or phonological) form, both within and between languages. The present work

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focuses on the role of cross-language meaning and form similarity on translation. Our aim was to examine the time course of meaning activation across languages during the translation process in highly proficient and balanced Catalan–Spanish bilinguals.

Two influential models of bilingual memory are relevant for the purposes of the present study. These are the Distributed Representational Model (DRM, De Groot, 1992a, 1992b) and the Revised Hierarchical Model (RHM, Kroll & Stewart, 1994). Both models assume that meaning and form information are represented in two separate but interconnected levels: A lexical level that represents words' orthographic and phonological information and a semantic-conceptual level that represents words' meaning. The models differ in that the DRM mainly deals with the nature of semantic representations whereas the RHM is more focused on the access to the meaning of second language (L2) words and the modulation of this process by L2 proficiency. The two models are complementary in that taken together they offer a wider picture of how meaning is represented and accessed from words in the two languages. In what follows, we will first address the assumptions of the DRM concerning the representation of meaning, and meaning similarity, between two concepts. Then, we will explain how meaning is accessed in highly proficient bilinguals according to the RHM. In doing so, we will introduce the role that translation equivalents in the first language (L1) might play during this process.

The DRM proposes that words in the two languages of a bilingual are represented at the lexical level by two nodes, one for each language. These lexical representations are then connected to a language-independent set of nodes at the semantic level, where each node represents a semantic feature. When there is a complete meaning overlap between two words, such as in many translation equivalents (e.g., the Catalan–Spanish pair *ruc–burro* [donkey]), the nodes representing their meaning would be the same. Likewise, words that are related in meaning but do not have a complete overlap would share part of (but not all) the features at the semantic level. The more similarity between the meaning of two words, the more nodes shared by their representations. Thus, pairs that are highly related in meaning across the two languages (e.g., the Catalan–Spanish pair *ruc–caballo* [donkey–horse]) would have in common (and activate) more nodes than pairs less related in meaning (e.g., the Catalan–Spanish pair *ruc–oso* [donkey–bear]). Taking the above into account, it would be reasonable to expect that the degree of semantic similarity between words in the two languages modulates meaning access in bilinguals.

A common approach to examine how bilinguals access the meaning of L2 words has been the use of the translation recognition task (De Groot, 1992b). In this task, participants are presented with a first word in one language followed by a second word in another language and they have to decide whether the second word is the correct translation of the first one. To perform this task, participants need to access the meaning of the first word and then compare it with the meaning of the second word. In the present study, we relied on a variant of the task that has been previously used to identify participants' sensitivity to meaning and form similarity to the correct translation of L2 words (e.g., Ferré, Sánchez-Casas, & Guasch, 2006; Guasch, Sánchez-Casas, Ferré, & García-Albea, 2008; Sunderman & Kroll, 2006; Talamas, Kroll, & Dufour, 1999). In this version of the task, the critical pairs are those in which the two words are not translation equivalents, but are related in some way. These pairs are expected to produce longer reaction times (RTs) and more errors than unrelated pairs (i.e., an interference effect). Focusing on words that are similar in meaning, interference would be produced because their representations share semantic features. Thus, processing the first word would activate part of the features representing the second word, and, as a consequence, it would be harder for participants to answer that the latter is not the translation of the former than when the two words are unrelated. Furthermore, since the DRM assumes that the number of features shared by two words depends on their similarity in meaning, one would expect that pairs of words whose meanings are highly related (e.g. *ruc–caballo*; henceforth S1) would produce stronger interference effects than pairs that are less related in meaning (e.g. *ruc–oso*; henceforth S2).

The effects of the degree of semantic similarity between pairs of words have already been examined in two translation recognition studies conducted in our laboratory with highly proficient and balanced Catalan–Spanish bilinguals (Ferré et al., 2006; Guasch et al., 2008). The results of these studies showed that semantic interference was restricted to the S1 condition. Moldovan, Sánchez-Casas, Demestre, and Ferré (2012) proposed that a possible reason for the null results with S2 pairs might be the low level of activation of the units at the semantic level (i.e., the *low level activation account*). According to the DRM, when two semantically related words are presented closely in time, the more semantic nodes shared between them, the more activated would be the features of the second word. Thus, in the translation recognition task, when the Catalan word *ruc* is presented, the level of activation would be higher for *caballo* (S1) than for *oso* (S2). Moldovan et al. (2012) also suggested that the activation of S2 words, apart from being low, would be short-living. Thus, by the time the translation decision has to be made, the activation of these words might have decreased and be too low to compete with the correct translation. This proposal could account for the absence of interference effects in S2 pairs with long stimulus onset asynchronies (SOAs, the time interval from the onset of the first word to the onset of the second word), such as the 500 ms SOA used by Ferré et al. (2006) and the 750 ms SOA used by Guasch et al. (2008). Data supporting this account were reported by Moldovan et al. (2012), who found a nearly significant interference effect (20 ms) in the S2 condition when the SOA was shorter (250 ms). This promising evidence was obtained with behavioral measures. As the activation of S2 words may be low and decreases very quickly, RTs might not be sensitive enough to reveal a clear interference effect. Moldovan et al. (2012) suggested that a good measure to capture the activation of S2 words would be the recording of event-related brain potentials (ERPs), given its high temporal resolution. In particular, the most suitable ERP component to index such effects is the N400, whose amplitude has been shown to be modulated by the semantic relationship between pairs of words (e.g., Brown, Hagoort, & Chwilla, 2000).

Guo, Misra, Tam, and Kroll (2012) conducted the only bilingual ERP study to date that has examined the effect of semantic similarity in the translation recognition task, by testing proficient unbalanced Chinese (L1)-English (L2) bilinguals. In the

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