Ângela Gomes Tomaz

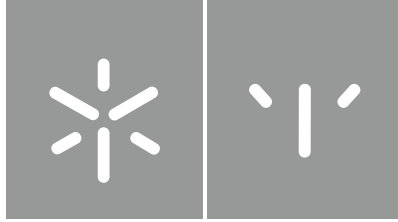**Are synonyms and translations similarly processed in the bilingual mind?**

junho de 2020

Universidade do Minho
Escola de Psicologia

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**Are synonyms and translations similarly
processed in the bilingual mind?**

Dissertação de Mestrado
Mestrado Integrado em Psicologia

Trabalho efetuado sob a orientação da
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Professora Doutora Ana Paula Soares
Professora Doutora Séverine Casalis

junho de 2020

DECLARAÇÃO

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Braga, June 4th, 2020

Ângela Gomes Tomaz

Serão os sinónimos e as traduções processados de forma semelhante na mente bilingue?

RESUMO

De acordo com o modelo Multilink (Dijkstra et al., 2018), as palavras de primeira (L1) e segunda (L2) língua partilham um armazenamento comum e o seu acesso é não-seletivo. Desta forma, a apresentação de uma palavra-alvo ativa, em paralelo, candidatos léxicos de ambas as línguas que partilham sobreposição ortográfica, fonológica e semântica com o alvo. O grau de ativação de palavras depende da forma, sobreposição ortográfica e semântica, bem como do seu nível de ativação em repouso (i.e., palavras usadas com mais frequência, usualmente palavras de L1, têm um maior nível de ativação em repouso). Dado que as traduções e sinónimos partilham significado, podem ser vistas como representações léxicas qualitativamente semelhantes e, portanto, sujeitas a um processamento similar se os níveis de frequência forem comparáveis. O presente estudo objetivou testar as assunções do modelo Multilink (Dijkstra et al., 2018) relativamente à representação e processamento dos sinónimos e traduções recorrendo a uma tarefa de decisão lexical com *priming* mascarado (TDL). Vinte e dois bilingues proficientes de Português Europeu e Inglês foram recrutados para a tarefa. Na TDL, palavras-alvo Inglesas eram precedidas pelo seu sinónimo ou por uma palavra Inglesa de controlo não relacionada. Após um mês, as palavras-alvo eram precedidas pela sua tradução em Português Europeu ou por uma palavra Portuguesa de controlo não relacionada. A ordem de apresentação dos *primes* foi contra balanceada. Os resultados não mostraram quaisquer efeitos significativos de *priming* para sinónimo ou traduções.

Palavras-chave: bilingues; decisão lexical; processamento de sinónimos, processamento de traduções

Are synonyms and translations similarly processed in the bilingual mind?

ABSTRACT

According to the Multilink model (Dijkstra et al., 2018), words from the first (L1) and second (L2) language share a common store and their access is non-selective. Thus, the presentation of a target-word activates in parallel lexical candidates from both languages that share with it orthographic, phonological, and semantic overlap. The degree of words' activation not only depends on the form and semantic overlap but also on their resting level of activation (i.e., words that are more used, usually L1 words, have a higher resting level of activation). Since translations and synonyms share meaning, they are seen as qualitatively similar lexical representations and so might be subject to a similar processing if their frequency levels are matched. The aim of the present study was to test the tenets of the Multilink model regarding the representation and processing of synonyms and translations by using a masked priming lexical decision task (LDT). Twenty-two unbalanced highly proficient bilinguals of European Portuguese and English were recruited for the task. In the LDT, English target words could be preceded either by synonyms or their corresponding unrelated English control prime words. One month later, the target words were preceded by their non-cognate European Portuguese translations or their corresponding unrelated European Portuguese control prime words. The order of the presentation was counterbalanced. Results showed no significant priming effects for synonyms nor translations.

Keywords: synonyms processing; translation equivalents processing; bilinguals; lexical decision

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

RHM - Revised Hierarchical Model

BIA - Bilingual Interactive Activation

BIA+ - Bilingual Interactive Activation+

L1 - First Language

L2 - Second Language

RLA – Resting Level of Activation

HF – High-Frequency

LF – Low-Frequency

EP - European Portuguese

EN - English

LHQ - Language History Questionnaire

M - Mean

SD – Standard Deviation

P-PAL - Procura-PALavras

NLD - Normalized Levenshtein Distance

LDT – Lexical Decision Task

RT -Reaction Time

ms - Milliseconds

ER – Error Rate

LIST OF FIGURES

Figure 1. Example of a trial in the translation (above) and synonym (below) experimental session.

LIST OF TABLES

Table 1. Mean Reaction Times (RTs) in milliseconds and percentage Error Rates (ERs) for each priming condition

Are synonyms and translations similarly processed in the bilingual mind?

Introduction

In bilingualism, one of the questions that has attracted great attention concerns the organization and processing of the two languages in the bilingual mind. Several models have been proposed to explain it, such as the Revised Hierarchical Model (RHM; Kroll & Stewart, 1994), and the Bilingual Interactive Activation Model (BIA; Dijkstra & van Heuven, 1998; van Heuven, Dijkstra, & Grainger, 1998), and its successors, the BIA+ Model (Dijkstra & van Heuven, 2002) and, more recently, the Multilink Model (Dijkstra et al., 2018).

The Multilink Model (Dijkstra et al., 2018) was developed to unify what is known about bilingual visual word recognition (BIA+, Dijkstra & van Heuven, 2002) and production (RHM, Kroll & Stewart, 1994). Multilink (Dijkstra et al., 2018) claims that the first (L1) and second language (L2) are stored in a common system. Also, it defends a parallel non-selective access to the lexicon (i.e., lexical candidates from both languages are activated during the recognition of a given input). The level of word's activation depends not only on form and meaning overlap across languages but also on their resting levels of activation (RLA) depending on their frequency of use in both languages. The RLA also depends on the level of L2 proficiency and on the frequency of language use associated with that level of proficiency. Specifically, the model holds that, when a written word is presented (e.g., "face"), it would activate in parallel all the orthographic representations that share form within (e.g., "fame") and between languages (e.g., "*faca*" [knife, in English]). The level of candidate activation would hence be modulated by the level of orthographic similarity, as well as by their RLAs. These representations then activate the semantic, phonological, and language membership information. The candidate which more quickly exceeds a certain recognition threshold is selected as the word previously presented as input (Dijkstra et al., 2018). Afterwards, an output (i.e., behavior) a subject should follow is generated according to the task at hand, for example, in a lexical decision task, the output may be to click on the previously established letter 'M' because the string of letters presented was a pseudoword.

According to the tenets of the Multilink model (Dijkstra et al., 2018), there is a remarkable difference between the RLA of L1 words and L2 words. Since L1 words are generally used more on a daily basis than L2 words, they have higher RLAs and, consequently, they are recognized faster, at least by unbalanced proficient bilinguals. If this is so, it is plausible to think that there are no qualitative differences between words that share meaning within languages, such as synonyms (e.g., car-vehicle), and words that share meaning across languages, such as non-cognate translations (e.g., house-*casa*, in

English and European Portuguese, respectively), when their frequency of use are comparable. Translations that share form besides meaning (i.e., cognate words such as paper and *papel*) would be, of course, differentially processed because of their overlap in form (see Comesaña et al., 2015 for an overview on the differential processing of cognate and non-cognate words).

However, available empirical evidence on the processing of translations and synonym words, albeit scarce, point to cognitive differences (e.g., Altarriba & Soltano, 1996; Au & Glusman,1990; Kanwisher & Potter, 1990; Kolers & Gonzalez, 1980; Levy, Di Persio, & Hollingshead, 1992; MacKay & Bowman,1969; Macleod, 1976; Nelson, 1971; Paivio, Clark, & Lambert, 1988; Wen & van Heuven, 2017; Witzel, 2019).

For instance, in regarding language acquisition, a phenomenon of mutual exclusivity (i.e., the resistance to giving different labels to the same object) has been found to be greater for synonyms than for translations (Au & Glusman, 1990).

In memory research, translations lead to greater word recall than synonyms (e.g., Kolers & Gonzalez, 1980; see also Macleod, 1976 and Nelson, 1971) and are characterized by higher intrusion rates in free recall tasks comparatively to synonyms (e.g., Paivio, Clark & Lambert, 1988). In addition, the repetition blindness effect (i.e., inability to retrieve a repeated word in a rapid serial visual presentation task) seems to be higher for synonyms (e.g., Kanwisher & Potter, 1990) than for non-cognate translations (e.g., Altarriba & Soltano, 1996). Additionally, faster reading times has been found for translated sentences (MacKay & Bowman,1969) than for synonym substituted sentences (Levy, Di Persio, & Hollingshead, 1992).

Overall, these findings seem to indicate an advantage in processing for translations in comparison to synonyms.

On Psycholinguistics, there are no studies in which the processing of non-cognate translations and synonyms has been examined directly. There are, however, several masked primed lexical decision studies with only non-cognate translations which have consistently found masked priming effects (i.e., shorter reaction times when the target word in L2 is preceded by a non-cognate translation prime in L1 than when it is preceded by an unrelated prime word in L1; Chen, Zhou, Gao & Dunlap, 2014; Gollan, Forster & Frost, 1997; Jiang, 1999; Jiang & Forster, 2001; Nakayama, Sears, Hino & Lupker, 2013; Voga & Grainger, 2007). Indeed, Wen and van Heuven's (2017) meta-analysis showed significant priming effects for L1-L2 translation priming (i.e., effect size of .86). The same pattern has also been

found in the inverse direction (i.e., L2-L1) though at a smaller extent (i.e., effect size of .31; Wen & van Heuven, 2017). According to the postulates of the Multilink (Dijkstra et al., 2018), the two lexical representations send activation to the shared meaning representation, and then they receive feedback activation from meaning, which explains why masked priming effects with non-cognate words emerge. These masked priming effects with non-cognates are evidence for a non-selective lexical access as defended by Multilink (Dijkstra et al., 2018).

On the other hand, studies conducted with monolinguals have explored the access to the bilingual lexicon via the production (e.g., Ibrahim, Cowell & Varley, 2017) or recognition of synonyms to a given target (e.g., Witzel, 2019). According to Multilink (Dijkstra et al., 2018), L1 words have a higher RLA due to their higher frequency of use, comparatively to L2 words. As such, these studies manipulate synonym frequency in order to emulate the two translation directions (i.e., L1-L2 and L2-L1) in unbalanced bilinguals (Ibrahim, Cowell & Varley, 2017; Witzel, 2019).

Ibrahim, Cowell and Varley (2017) created a within language "translation" task in which monolinguals native speakers of British English had to produce a synonym for high-frequency or low-frequency words. Since the sample is only comprised of monolinguals, any differences in producing synonyms could not be explained by the existence of multiple lexicons, but rather general processing principles such as word frequency. In this task, high-frequency (HF) synonyms were produced faster than low-frequency synonyms (LF). In this way, the asymmetry found can better be explained as resulting from differences of resting states inherent to words of distinct frequency. Extrapolating to the bilingual case, different RLA between L1 and L2 words, as well as the frequency of L2 usage that modulates those RLA, may account for the differences in the processing of L1 and L2 words. This is also consistent with the Multilink model (Dijkstra, et al., 2018).

In the same vein, Witzel (2019), carried out two masked priming lexical decision experiments with synonyms in an effort to test whether synonyms and translations are similarly represented and processed. Participants, monolinguals native speakers of English, were presented with a row of hash marks for 500 ms, followed by a prime word in lowercase letters for 50 ms. The target word was presented last in uppercase letters at the center of the computer screen for 500 ms and the participants had to decide if the string of letters presented was an English word or a nonword. In both experiments, ninety-six pairs of synonyms were used in which one member always had a higher frequency than the other (e.g., pain [HF]-ache [LF]). In the first experiment, the author examined the existence of masked priming when a high-frequency synonym primed a low-frequency target (HF-LF)

and when a low-frequency synonym primed a high-frequency target (LF-HF), emulating L1-L2 and L2-L1 translation directions in unbalanced bilinguals. Both high- and low-frequency words of each synonym pair could be a target, so each word was presented twice to the participant in the same session - once as target and another as prime. Each target was preceded either by an identity prime and an unrelated condition (i.e., pain-PAIN and moon-PAIN, respectively), or by a synonym prime and an unrelated condition (i.e., ache-PAIN and tire-PAIN, respectively). Related primes were matched in word length and word frequency to the target. Also, unrelated words were matched in word length and word frequency to the related primes. Results showed no priming in either of the synonym conditions (HF-LF and LF-HF). However, as each word was presented twice, the difference regarding the resting level of activation of HF and LF words could have been minimized explaining the absence of priming effects with synonyms.

This is the reason why Witzel (2019) decided to carry out the second experiment in which only high-frequency words were used as primes and low-frequency words were used as targets (HF-LF). Again, no signs of masked priming effects with synonyms were found, replicating the results of the first experiment (note that this condition [HF-LF] emulated the forward translation [L1-L2] condition used in previous experiments with bilinguals as L1 words usually have higher RLA than L2 words). In the end, the only priming effects found were on the identity conditions in the first (priming for HF and LF targets) and second experiment (priming for LF targets). The author discusses how L1-L2 translation priming effects could behave more like the repetition priming. Additionally, the author proposes that the semantic synonym priming (even though not significant) could behave similarly to L2-L1 translation priming given that the effect sizes found for the semantic conditions were similar to those found for L2-L1 translation priming in Wen and van Heuven's meta-analysis (2017). Additionally, the author claims that 50 ms of prime duration could not suffice to impact the semantic processing of the target. Indeed, some semantic priming studies have not found a priming effect with 50 ms of prime duration (e.g., de Wit & Kinoshita, 2015; Sánchez-Casas, Ferré, Demestre, García-Chico, & García-Albea, 2012) while others, using longer prime durations have found effects for synonyms (e.g., 67 ms of prime duration: Perea & Gotor, 1997; 83 ms: Perea & Rosa, 2002). However, since non-cognate translations and synonyms are very similar in meaning and translation priming effects have been previously found with 50 ms of prime duration (e.g., Jiang, 1999), it would be expected the existence of synonym priming according to the tenets of the Multilink model (Dijkstra et al., 2018). In this way, it would have been expected the existence of priming effects in Witzel's (2019) study.

The present study aims to directly compare the processing of synonyms and translations. At present, to our knowledge, studies that directly compare the processing of synonyms and translations with a homogenous sample of participants in what regards language proficiency are inexistent. In the present research, we examined whether or not there are differences between the processing of L1-L2 translations and L2-L2 synonyms using a masked priming lexical decision task as in previous studies (e.g., Chen, et al., 2014; Witzel, 2019) and with a homogeneous sample of unbalanced high proficiency European Portuguese (EP) - English bilinguals. The same target could be preceded by synonym or unrelated English word (e.g., kidnap - ABDUCTION and embody - ABDUCTION, respectively) and by an L1 word translation or unrelated European Portuguese word (e.g., *rapto* - ABDUCTION and *fatia* - ABDUCTION, respectively). The frequency of L2 synonym primes was higher than that of L2 targets. This allowed us to simulate the typical divergences in frequency between L1-L2 translations and consequently to directly compare the effect of priming for L1-L2 translations and L2-L2 synonyms. In this way, any observed differences between the processing of synonyms and translations would be in contradiction to the Multilink tenets (Dijkstra, et al., 2018) given that the frequency values were matched across conditions and the targets are always the same. Conversely, if the tenets of the Multilink are contradicted and there is a differential processing for synonyms and translations, we would expect larger masked priming effects for L1-L2 translations than for high-to-low frequency L2-L2 synonyms. If this is so, it would provide further evidence for the qualitative differences between translation equivalents and synonyms. However, it should be noted that there are more studies showing L1-L2 translation priming with 50 ms of prime duration (Gollan, et al., 1997; Jiang, 1999; Jiang & Forster, 2001; Voga & Grainger, 2007; Nakayama, et al., 2013; Chen, et al., 2014) than studies with synonyms (indeed, there is no study using a 50 ms prime duration that has showed priming effects; Sánchez-Casas, et al., 2012; de Wit & Kinoshita, 2015; Witzel, 2019).

If indeed there are qualitative differences between translations and synonyms, they would need to be considered in the models above mentioned. Namely, the RLA function proposed by the Multilink model (Dijkstra et al., 2018) might need to be adjusted because the model purports a similar RLA for L1 and L2 words for proficient bilinguals which might not be the case if differences between synonyms and translations are found. Additionally, a difference in processing between synonyms and translation equivalents might be indicative of different connections between these types of words. The results will inform the Multilink model (Dijkstra et al., 2018) about the precise representation of synonyms and translations.

General Method

Ethics Statement

The experiment complied with the ethical standards of the Declaration of Helsinki and was conducted with the approval (CEICSH 082/2019) of the Ethics Committee for Human Research of the University of Minho (Braga, Portugal). Written consent was obtained from all the participants.

Participants

Twenty-two high proficient European Portuguese-English bilinguals (18 females) were recruited from the University of Minho, Portugal. All were university students with ages between 18 and 34 years old (M = 22, SD = 4) and only one was left-handed. All participants received course credits for their participation.

According to the results of the Language History Questionnaire (LHQ; Li, Sepanski, & Zhao, 2006; Li, Zhang, Yu, & Zhao, 2019) which has a split-half reliability coefficient for the quantitative variables of .85, participants showed high levels on reading (M = 6.3, SD = 0.7), writing (M = 5.8, SD = 0.7), speaking (M = 5.5, SD = 1.0), and listening skills (M = 5.9, SD = 0.9) in English, on a 7-point Likert scale (from 1 = very poor to 7 = native-like). In addition, LHQ encompasses more specific questions about the language environment and language use. This allows us to characterize our participants as high proficient bilinguals. On average, the participants reported spending 25% (SD = 15%) of their daily life speaking English. Additionally, participants reported a mean age of acquisition of the spoken English language of 8 years old (SD = 2.5) with reading and writing acquisition roughly at the same time (M = 7.9, SD = 2.0). On average, the sample has dedicated a total of 10 years (SD = 2.1) to the learning of the English language.

Furthermore, Casalis, Commissaire, and Duncan (2015) created a lexical test and a spelling test that allows further evaluation of L2 proficiency. In this study, the Portuguese version was used. In the lexical test, participants must translate one hundred and fifty words from L1 (European Portuguese) to L2 (English) with increasing levels of difficulty (beginner, intermediate, and advanced) according to item frequency (M = 522, SD = 743; M = 72, SD = 96 and M = 24, SD = 36, respectively). The maximum score for each level of difficulty is fifty. The participants' average score for the beginner, intermediate, and advanced translation task was 48 (SD = 2), 37 (SD = 9) and 23 (SD = 8) words correctly translated, respectively. In the spelling test participants must choose the correct spelling of

twenty words, each with two possible candidates. On average, participants chose the correct spelling of 18 ($SD = 1$) words.

Moreover, the LexTALE (Lemhöfer, & Broersma, 2012) is a vocabulary test that consists of 60 items (40 words and 20 nonwords) and allowed us to assess the participants' English vocabulary size. The items have a mean of 7.3 letters and the words have a mean frequency per million of 6.4. The words belong to different syntactic classes with 15 nouns, 12 adjectives, 1 verb, 2 verb participles, 2 adverbs, and 8 being both a verb and a noun. The nonwords are pronounceable and were created by changing the number of letters in an existing English word or by the recombination of morphemes. This test shows a reliability coefficient that ranges from .81 to .68. The average score of a large group of Dutch and Korean advanced learners of English was 70.7%. The participants' mean score was 75.51% ($SD = 7.70\%$) which confirms our participants' L2 proficiency.

Stimuli

Ninety English targets words were selected from previous studies on synonyms and translation equivalents studies (e.g., Ibrahim et al., 2017; Finkbeiner, Forster, Nicol, & Nakamura, 2004; Locker, Simpson, & Yates, 2003; Fraga, Padrón, Perea, & Comesaña, 2017; Basnight-Brown, & Altarriba, 2007), as well as from the WordReference English Synonyms dictionary (2019) and the Infopedia dictionary of the Portuguese language (Porto Editora, 2019). Each target word was associated both to its EP translation equivalent (e.g., *rapto* - ABDUCTION) and to its synonym in English (e.g., *kidnap* - ABDUCTION), which functioned as prime words. Target words present a lexical frequency (log10) that was always lower than the frequency of the primes (synonym and translation equivalent) as a measure of control to avoid any advantage of the translations over the synonyms due to the fact that L1 words usually have a higher frequency of use comparatively to L2 words. The lexical frequency (log10) was chosen over the classical lexical frequency per million to facilitate the stimuli control across languages.

The number of letters, lexical frequency (log10), number of orthographic neighbors, mean of the bigram log10 frequency (taken from N-Watch for the English words; Davis, 2005; as well as from P-PAL for the EP words; Soares et al., 2018) and the Normalized Levenshtein Distance (NLD), measure of orthographic overlap, between primes and targets (NIM; Guasch, Boada, Ferré, & Sánchez-Casas, 2013) were controlled for. Unrelated EP and English prime words were also matched to translations and synonyms primes, respectively, on the above-mentioned psycholinguistics' variables. For example, for the triplet *ABDUCTION* (target) – *rapto* (EP translation) – *kidnap* (EN synonym), *fatia* was matched

with *rapto* and *embody* was matched with *kidnap*. A one-way ANOVA showed no significant statistical differences between the primes according to the number of letters, $F(3,355) = 1.514$, $p = .211$, lexical frequency (log10), $F(3,356) = .779$, $p = .506$, number of orthographic neighbors, $F(3,356) = 1.710$, $p = .165$, mean of the bigram log10 frequency, $F(3,356) = .942$, $p = .420$], and the Normalized Levenshtein Distance (NLD) between primes and targets, $F(3,356) = 1.645$, $p = .179$.

Due to the nature of the lexical decision task, 90 target pseudowords were created using the Wuggy software (Keuleers & Brysbaert, 2010) from the targets of other previously excluded triplets (target, synonym, and translation) with the same characteristics as the ones used in the experimental set. For each synonym and translation of those triplets, another unrelated English and EP prime words were also selected, following the method used for the experimental stimuli control reported above.

The stimuli were organized in four lists such that in two lists each target word was preceded by its synonym or unrelated English prime and in the other two lists the target was preceded by its translation and EP unrelated prime.

Procedure

All participants signed the informed consent form. Subsequently, they were tested individually in soundproof booths at the Human Cognition Lab (School of Psychology, University of Minho). The experiment had two experimental sessions one month apart, each with a masked priming lexical decision task (LDT). The order of the sessions was counterbalanced to control for order effects. In this way, if the participant first responded to the LDT in which the list had synonyms and English unrelated words as primes, the second time the subject would respond to the LDT with translations and European Portuguese words as primes, and vice-versa. In both sessions, participants performed the LDT in which a hash marks mask (############) was presented for 500 ms in the center of the screen. Afterwards, a lowercase prime was presented for, approximately, 50ms. Following the prime, an English target word or an English target pseudoword appeared on the screen in uppercase letters. Participants were asked to decide on whether the target constituted an English word or a nonword, as fast and as accurately as possible. The target word appeared on the screen for 2,500 ms or until the participants' response. According to the instructions presented on the computer screen at the beginning of the LDT, if the letter string was considered an English word, participants were instructed to click on the 'M' keyboard key, whereas if they considered that it was not an English word, they should press the 'Z' keyboard key.

In the end, participants also answered a word recognition/familiarity task to assure they were previously familiar with the stimuli. All experimental words (i.e., targets and primes) were presented as a list and the participants' task was to report which words they did not know.

Participants took approximately 50 minutes to complete all the procedure (including both LDT sessions). The experiment was run using the DMDX software (Forster & Forster, 2003). Figure 1 shows an example of a given trial for each experimental session.
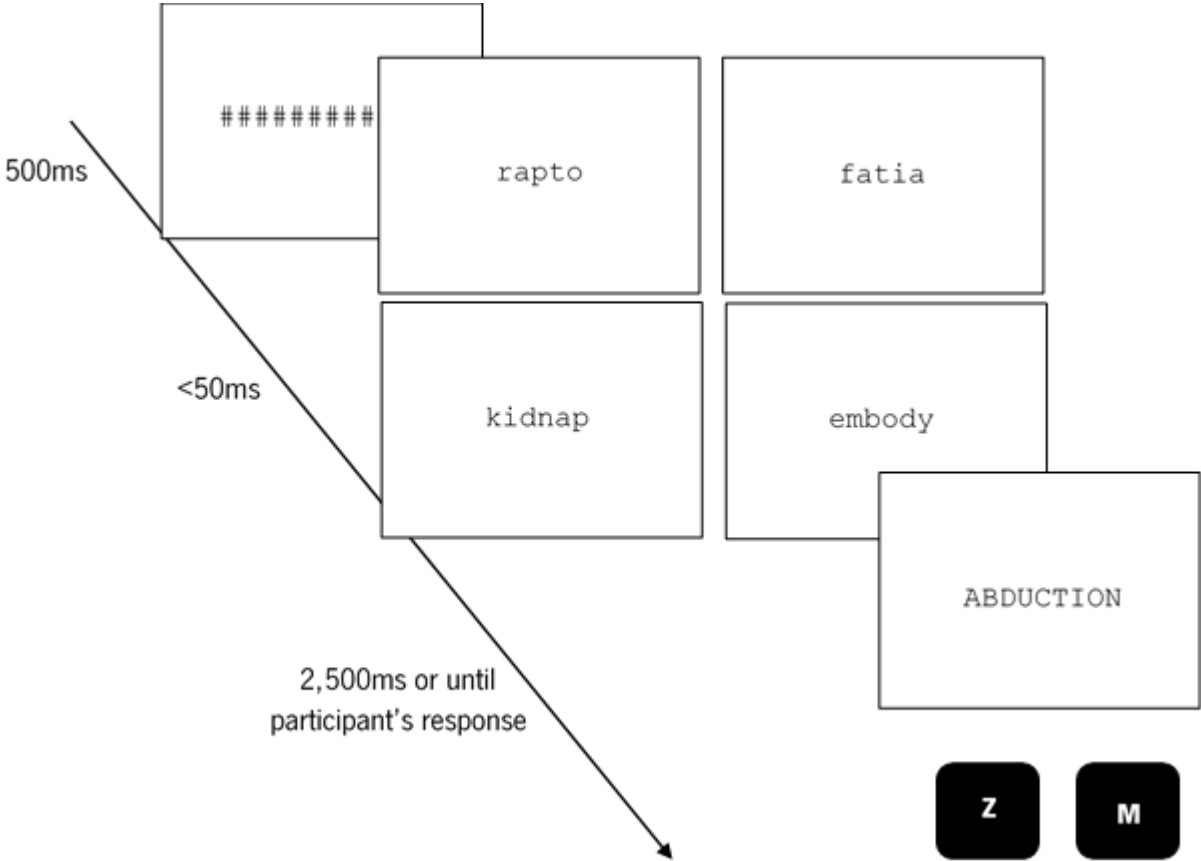

Figure 1. Example of a trial in the translation (above) and synonym (below) experimental session.

Results

The experiment presents a 2x2x4 mixed factorial experimental design in which the Prime type (related, unrelated), Prime-target relation (translation, synonym), and the List (List 1, List 2, List 3, List 4) were manipulated in the analysis by subjects ($F1$). In both analyses, the dependent variables were the reaction times (RTs) in the lexical decision task and the percentage of errors. A mixed factorial ANOVA was performed based on the participant ($F1$) and item ($F2$) latency and accuracy data with Prime type (related, unrelated) and Prime-target relation (translation, synonym) as within-subjects' and

within-items' factors. The factor list (List 1, List 2, List 3, List 4 or List 1, List2) was a between-subjects and between-items' factor.

The familiarity task showed that participants did not know on average 19 (SD=12) words used in the experimental task.

All participants had an error rate of 15.6% or lower. No participants were excluded. Data from trials in which an error occurred was excluded from the RTs analyses (16.3%). Afterwards, data corresponding to unknown words from the familiarity task that weren't previously eliminated were also excluded from both the RTs and errors analysis (9.8%). Any reaction times (RTs) that were above or below 2.5 SDs of the mean for each participant in each experimental condition were also removed (16.8%). The mean RTs (in ms) and error rates in all conditions are presented in Table 1.

Table 1

Mean Reaction Times (RTs) in milliseconds and Error Rates (ERs) for each priming condition

Prime Type	Prime-Target Relation			
	Synonym		Translation	
	RT	ER	RT	ER
Related	718 (88)	.07 (.05)	714 (66)	.06 (.04)
Unrelated	714 (86)	.06 (.05)	715 (83)	.06 (.05)

Note. The standard deviation of the means is presented in parentheses.

The analysis of variance on the participants' and items' latency and accuracy data ($F1$ and $F2$) showed neither significant main effects nor interactions.

Discussion

The aim of this study was to directly compare the processing of synonyms and translations, in order to assert the existence of possible differences between the two types of words and, consequently, test the tenets of the Multilink model (Dijkstra et al., 2018). Results showed no priming effects either for synonyms or translations. The hypothesis that synonyms and translations are similarly processed was confirmed, however, not as anticipated (i.e., with the existence of priming effects for both synonyms and translations).

However, before reaching solid conclusions, it is important to consider some methodological frailties that might be impeding the capture of any priming effects, especially given that the translation

priming effect in the L1-L2 direction seems to be a robust effect (Wen & van Heuven, 2017). For instance, the sample size of twenty-two participants might be too small, due to the abrupt stop of the data collection caused by constraints of the COVID-19 pandemic, and consequently, may have decreased statistical power to the analyses. Particularly when compared to studies with similar methodological procedures that were able to capture priming effects. One such example is Jiang (1999) that also had 50ms of prime duration with 500ms of target presentation but had significantly more participants.

When it comes to the lexical decision task, on the one hand, we used a masking procedure (which minimizes the use of strategic processing), the same targets in both experimental sessions (i.e., when participants saw translations or synonyms as primes) and we took care to counterbalance the items so that they appear on both related and unrelated conditions. On the other hand, we allowed no time between the presentation of the prime and the target. In a way, it assures automatic processing and leaves no room for processing strategies by the participants (e.g., an expectancy strategy). However, varying stimulus-onset-asynchrony (SOA) has led to larger translation priming effects (Altarriba, 1992) and the existence of semantic priming effects (Perea & Gotor, 1997; Perea & Rosa, 2002). As such, the replication of this study with a larger SOA (but no more than 200 ms) and with 50ms of prime duration (e.g., Gollan et al., 1997 and Jiang, 2001), might reveal previously hidden priming effects without compromising automatic processing. The addition of an identity prime condition would have revealed if the lack of results was due to the methodological choices of the task or a genuine non-existence of priming effects for synonyms and translations. In this way, it would be helpful to add an identity condition in the future.

While the SOA and the reduced sample size are possibly the best candidates for explaining the lack of effects (similarly to Witzel's [2019] study), it is not the only one. The options regarding stimuli might play a part. Indeed, Jiang (1999) had no time period in-between the presentation of the primes and targets, along with a 50 ms prime, but still obtained priming effects. Aside from a bigger sample size as mentioned above, Jiang's (1999) study included high-frequency nouns while the stimuli in our study had a somewhat low lexical frequency, not only the targets (which always had a lower lexical frequency than the primes) but also the primes themselves (mean lexical frequency [log10]) was 1.651 and 1.632 for synonyms and translations, respectively).

Moreover, Altarriba and Basnight-Brown (2007) draw attention to other methodological issues of concern in studies on translation priming, such as the control of word length, which we only

controlled between primes but not between prime-target. Indeed, New, Ferrand, Pallier and Brysbaert (2006) have found a facilitatory word length effect for words with three to five letters but an inhibitory effect for eight to thirteen letter words in a lexical decision task. In this way, the reaction times and consequently, priming effects could have been influenced by this psycholinguistic variable.

Given the methodological considerations presented above and the lack of priming effects it is not possible to conclude that the tenets of the Multilink model (Dijkstra et al., 2018) are correct or, conversely, that need reviewing.

In order to be able to confirm the Multilink model (Dijkstra et al., 2018), there would need to exist priming for the related conditions (synonyms and translations) in comparison to the unrelated conditions. Semantic priming happens for two reasons: feature sharing or categorical membership (e.g., giraffe and dog) and context association (e.g., monkey and banana) (McNamara, 2005). Synonyms and translations share both. Although, the latter can be said to happen for synonyms to a lesser degree, since we do not usually use a synonym in the same context. However, when a speaker uses his L2 it is quite common to also recall his L1 word translation, not only at the beginning stages of L2 learning but also in more advanced stages of proficiency, for example, while in a tip-of-the-tongue (TOT) state (e.g., Ecke, 2009). Nevertheless, according to the Multilink model (Dijkstra et al., 2018), the level of a word's activation depends not only on form and meaning overlap across languages but also on their RLA, which is most similar in proficient bilinguals. If the results were to confirm the model's assumptions, both synonyms and translations would show a priming effect if we consider the participants' proficiency and similar RLA for L1 and L2 words. However, when also considering that translations have more context association than synonyms and that in turn affects their RLA, it would be more accurately expected the existence of larger priming effects for translations than for synonyms. In this case the difference in priming effects between translations and synonyms wouldn't be a matter of qualitative differences in processing between both types of words but a matter of degree. The replication of this study with a larger sample size and balanced bilinguals (whose proficiency in L1 and in L2 is comparable) would allow to ascertain this.

Concluding, in future studies the replication of the present experiment with a larger sample size, balanced bilinguals as well as with the manipulation of the SOA, stricter word length control between primes and targets and, if possible, higher lexical frequencies, could shed light on the question at hand and allow for more precise conclusions on the cognitive status of synonyms and translation equivalents.

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Comissão de Ética para a Investigação em Ciências Sociais e Humanas

Identificação do documento: CEICSH 082/2019

Relatores: Emanuel Pedro Viana Barbas Albuquerque e Marlene Alexandra Veloso Matos

Título do projeto: *Are synonyms and translations similarly processed in the bilingual mind?*

Equipa de Investigação: Ângela Gomes Tomaz, Mestrado Integrado em Psicologia, Escola de Psicologia, Universidade do Minho; Prof.ª Dr.ª Ana Paula Soares (Orientadora), Grupo de Investigação em Psicolinguística, CIPsi, Escola de Psicologia, Universidade do Minho; Prof.ª Dr.ª Montserrat Comesaña (Orientadora), Grupo de Investigação em Psicolinguística, CIPsi, Escola de Psicologia, Universidade do Minho, Prof.ª Dr.ª Séverine Casalis (Orientadora), Universidade Charles de Gaulle Lille 3, França

PARECER

A Comissão de Ética para a Investigação em Ciências Sociais e Humanas (CEICSH) analisou o processo relativo ao projeto de investigação acima identificado, intitulado *Are synonyms and translations similarly processed in the bilingual mind?*.

Os documentos apresentados revelam que o projeto obedece aos requisitos exigidos para as boas práticas na investigação com humanos, em conformidade com as normas nacionais e internacionais que regulam a investigação em Ciências Sociais e Humanas.

Face ao exposto, a Comissão de Ética para a Investigação em Ciências Sociais e Humanas (CEICSH) nada tem a opor à realização do projeto, emitindo o seu parecer favorável, que foi aprovado por unanimidade pelos seus membros.

Braga, 12 de dezembro de 2019.

O Presidente da CEICSH

Anexo: Formulário de identificação e caracterização do projeto

Formulário de identificação e caracterização do projeto

Identificação do projeto

Título do projeto	Are synonyms and translations similarly processed in the bilingual mind?		
Data prevista de início	Setembro de 2019	**Data prevista fim**	Outubro de 2020

Investigador principal e filiação	Ângela Gomes Tomaz, Mestrado Integrado em Psicologia, Universidade do Minho
Orientador(es) e filiação	Prof.ª Dr.ª Ana Paula Soares, Grupo de Investigação em Psicolinguística, CIPsi, Escola de Psicologia, Universidade do Minho Prof.ª Dr.ª Montserrat Comesaña, Grupo de Investigação em Psicolinguística, CIPsi, Escola de Psicologia, Universidade do Minho Prof.ª Dr.ª Séverine Casalis Universidade Charles de Gaulle Lille 3, França

Nota: No caso de projetos de mestrado ou doutoramento deve ser indicado o estudante como investigador principal e o nome do mestrado ou doutoramento

Instituição proponente	Escola de Psicologia, Universidade do Minho, Braga, Portugal
Instituição(ões) onde se realiza a investigação	Laboratório de Cognição Humana Escola de Psicologia Universidade do Minho Campus de Gualtar, 4710-057 Braga, Portugal

Entidades financiadoras	

Questões relativas ao envolvimento de investigadores exteriores	
Estão envolvidos no projeto, colegas de outra (s) Escola(s)/Instituição(ões)?	**S**
Se sim, este pedido de parecer cobre o seu envolvimento?	**S**

Qualificação dos investigadores

Ângela Gomes Tomaz é atual estudante do Mestrado Integrado em Psicologia da Universidade do Minho, tendo já realizado com sucesso os 3 anos de curso. Nesses anos, várias unidades curriculares abordavam métodos de investigação e estatística. Adicionalmente, duas unidades curriculares realizadas correspondem a "Psicologia da Linguagem" e "Laboratório de Linguagem".

A orientadora Montserrat Comesaña é investigadora principal no Grupo de Investigação em Psicolinguística (GIP) do Departamento de Psicologia Básica da Escola de Psicologia da Universidade do Minho, e professora do Programa de Doutoramento "Procesos Psicolóxicos e Comportamento Social" da Universidade de Santiago de Compostela. Está especializada no estudo da organização e funcionamento da memória bilingue conforme se pode atestar a partir do site: https://www.researchgate.net/profile/Montserrat_Comesana/research

A orientadora Séverine Casalis é investigadora e membro da UMR SCALAB, e professora de Psicologia Cognitiva – Psicolinguística na Universidade de Lille. Está especializada no estudo da aquisição e aprendizagem da linguagem como se pode atestar a partir do site: https://www.researchgate.net/profile/Severine_Casalis/research

Ana Paula Soares é coordenadora do Grupo de Investigação em Psicolinguística (GIP) inserido no Centro de Investigação em Psicologia (CIPsi), bem como professora auxiliar do departamento de Psicologia Básica da Universidade do Minho. Está especializada no estudo de aquisição e aprendizagem da linguagem como atestado a partir do site: https://www.researchgate.net/profile/Ana_Soares5

Caracterização do projeto e questões de carácter ético relativas à sua execução

Introdução justificativa do projeto e sumário dos seus objetivos

A representação e o processamento de palavras na mente bilingue é alvo de grande investigação. De acordo com o modelo computacional mais recente de reconhecimento de palavras (Multilink, Dijkstra et al., 2018), a língua nativa (L1) e a segunda língua (L2) partilham um armazenamento único e o acesso é não-seletivo, isto é, aquando a apresentação de uma palavra, os candidatos léxicos que partilham sobreposição ortográfica, fonológica e semântica, de ambas as línguas são ativados em paralelo. Atendendo aos postulados deste modelo, palavras sinónimas (e.g., coluna-pilar) e traduções não cognatas (e.g., casa e *house* em português e inglês, respetivamente) seriam qualitativamente semelhantes e, por isso, passíveis de igual processamento. Ainda, de acordo com o modelo, cada palavra tem um nível de ativação em

repouso (RLA) que depende de fatores tais como o nível de proficiência e a frequência de uso da língua. Assim, as traduções em L1 de uma palavra em L2 facilitariam mais o seu reconhecimento mais do que um sinónimo em L2, se as frequências não estiverem igualadas. Isto porque tipicamente as palavras de L1 têm maior frequência de uso e, portanto, maior RLA. Nesta ótica, bilingues proficientes que usam as duas línguas no seu dia-a-dia, não mostrariam diferenças no processamento de sinónimos e traduções dado que, *a priori*, as frequências de uso destas palavras e, consequentemente, os seus RLA seriam muito semelhantes. No entanto, evidência na área da memória não aponta no mesmo sentido e tem mostrado um efeito consistentemente vantajoso das traduções (por exemplo, Kolers & Gonzalez, 1980; Macleod, 1976; Kanwisher & Potter, 1990; Altarriba & Soltano, 1996; Francis, 2005). Mais especificamente na área da psicolinguística, têm sido encontrados efeitos de *priming* aquando uma palavra *target* na segunda língua é precedida por uma tradução na primeira língua (por exemplo, Wen & van Heuven, 2017;Nakayama, Ida, & Lupker, 2016; Gollan, Forster & Frost, 1997; Jiang, 1999; Jiang & Forster, 2001; Voga & Grainger, 2007; Nakayama, Sears, Hino & Lupker, 2013; Chen, Zhou, Gao & Dunlap, 2014), mas não efeitos de *priming* com sinónimos (Witzel, 2019). A investigação acerca do processamento de sinónimos é escassa. Ao nosso atual conhecimento, apenas Witzel (2019) conduziu um estudo de *priming* semântico com sinónimos em monolingues no sentido de extrapolar se existiriam diferenças entre o processamento de sinónimos e traduções em bilingues. Neste estudo, a autora não encontrou quaisquer efeitos de *priming* semântico. Assim sendo, até à data, ainda nenhum estudo comparou diretamente o processamento de sinónimos e traduções não-cognatas com bilingues.

Este é o objetivo do presente trabalho, isto é, investigar se o processamento de traduções é semelhante ao processamento de sinónimos em bilingues através de uma tarefa de decisão lexical com *priming* mascarado. Dada a literatura anterior, espera-se que as traduções sejam um melhor contexto para o reconhecimento da palavra-*target*. Ou seja, espera-se que a palavra *target* em L2 seja mais rapidamente reconhecida quando precedida pela tradução em L1 do que por um sinónimo em L2. Se existirem estas diferenças entre sinónimos e traduções não-cognatas, as mesmas teriam que ser consideradas no modelo previamente mencionado (Multilink; Dijkstra et al., 2018).

Participantes

Os participantes serão homens e mulheres caucasianos/as, bilingues proficientes (e.g., C1 ou C2) de Português Europeu-Inglês, sendo o Português Europeu a sua língua materna.
Tendo em consideração o tamanho da amostra e o tamanho do efeito encontrados na literatura, determinou-se que serão necessários cerca de 35 participantes.

Recrutamento e triagem

Os participantes serão recrutados na Universidade do Minho, podendo-se inscrever na experiência através da plataforma da Escola de Psicologia destinada a esse efeito, onde serão especificados os requisitos de domínio das línguas exigidas. Como a população do estudo serão bilingues de Português Europeu (nativos)- Inglês proficientes (e.g., C1 ou C2), potenciais participantes deverão reunir os seguintes critérios de inclusão: ter como língua nativa o Português Europeu, visão normal ou corrigida para o normal, alto nível de proficiência em Inglês.

Compensação e custos

Os participantes serão recompensados por creditação. Esta será realizada para alunos da Escola de Psicologia com recurso à plataforma de creditação por participação em experiências onde se podem listar como voluntários em experiências. Por compensação, podem obter até 2 pontos (0,1 ponto por cada 15 minutos de duração da experiência). Estes pontos poderão ser posteriormente atribuídos a unidades curriculares realizadas (máximo de 1 ponto por unidade curricular), sendo que não será possível utilizar os créditos para obter aprovação em unidades curriculares, ter acesso a exames de recurso ou melhorar classificações obtida em semestres passados.

Procedimento

Para explorar o processamento de sinónimos e traduções não-cognatas serão usadas duas tarefas de decisão lexical com priming mascarado. Irá recorrer-se ao software DMDX (Forster & Forster, 2003) instalado nos computadores fixos destinados a efeitos de recolha de dados. As tarefas serão realizadas individualmente nas cabines insonorizadas do Laboratório de Cognição Humana da Escola de Psicologia da Universidade do Minho. Cada participante terá duas sessões para a recolha de dados.

Na primeira sessão, todos os participantes assinarão o consentimento informado antes de qualquer participação no estudo. Nesta primeira sessão e para avaliar o nível de proficiência de cada participante, será administrado um questionário de auto-relato (Language History Questionnaire; Li, Sepanski, & Zhao, 2006; Li, Zhang, Yu, & Zhao, 2019) de modo a obter informação acerca das competências linguísticas e aquisição das mesmas pelos participantes. Adicionalmente, realizarão um teste léxico de tradução no qual terão de traduzir 150 palavras de Português para Inglês e um teste de soletração que consiste na escolha da palavra corretamente soletrada entre duas palavras candidatas (Casalis, Commissaire, & Duncan, 2015). Ainda, realizarão um teste de vocabulário (LexTALE; Lemhöfer, & Broersma, 2012) para averiguar a extensão do léxico dos participantes na sua segunda língua. Posto estas tarefas, o participante realizará uma tarefa de decisão lexical com priming mascarado no software DMDX. Esta tarefa consiste na apresentação de uma máscara de símbolos cardinais (############) no centro do ecrã do computador por 500 milissegundos. Após a máscara, será apresentado um prime por 50 milissegundos seguido da palavra-alvo por 2500 milissegundos ou até que o participante efetua uma resposta. Os primes poderão ser um sinónimo, uma palavra em Inglês não-relacionada com a palavra-alvo, uma tradução ou uma palavra em Português Europeu não-relacionada com a palavra-alvo. O alvo que segue o prime será sempre uma palavra em Inglês ou uma pseudo-palavra (i.e., uma unidade de texto que se assemelha a uma palavra da língua, mas que não tem qualquer significado). Perante a apresentação deste alvo, e tal como as instruções indicam no início da tarefa, o participante terá de decidir se o conjunto de letras apresentado no ecrã constitui uma palavra inglesa ou não. Se constituir uma palavra, deverá clicar na Tecla 'M', se constituir uma pseudo-palavra, deverá clicar na tecla 'Z'. Esta sessão terá uma duração aproximada de 30 minutos.

Um mês após esta participação, o participante será testado novamente na mesma tarefa de decisão lexical. No entanto, se o participante respondeu previamente a uma tarefa que tinha como primes sinónimos e palavras inglesas não-relacionadas, neste segundo momento responderá à tarefa em que os primes serão traduções ou palavras portuguesas não-relacionadas,

e vice-versa. No final desta segunda sessão, os participantes irão ainda realizar uma tarefa de reconhecimento para que seja possível verificar que o mesmo conhecia, previamente à sua participação, as palavras utilizadas como estímulos no estudo. A segunda sessão tem uma duração aproximada de 25 minutos.

Assim, a duração total da participação será de 45 a 50 minutos, com um mês de intervalo entre as duas sessões de participação.

Não existirá qualquer gravação de vídeo e/ou áudio.

Benefícios, Riscos e Desconforto

Não se espera a existência de benefícios pela participação nesta investigação.

Não são conhecidos riscos físico, psicológicos, económicos e/ou sociais associados à participação nesta investigação e nas tarefas que a mesma inclui. No entanto, caso algum participante sinta qualquer desconforto durante a realização da sua participação na investigação, o mesmo poderá desistir a qualquer momento sem que isso envolva qualquer prejuízo para o mesmo ou para qualquer ajuda que necessite.

Confidencialidade

Quaisquer dados recolhidos serão tratados de forma completamente confidencial sem nunca identificar os participantes, sendo apenas usados para fins estatísticos. Qualquer divulgação de dados será para fins de investigação e com a anonimidade de todos os participantes garantida. A privacidade dos participantes será mantida através da criação de um código de participante (e.g., P01_L1), sem referir o seu nome ou qualquer dado que o possa identificar no momento da recolha de dados. Apenas informações sociodemográficas (e.g., idade) descaracterizadas bem como os códigos de participante serão mantidas no estudo. Quaisquer dados recolhidos serão guardados apenas com referência ao código inicialmente criado. Os dados serão guardados durante o período em que estiver a decorrer o projeto. Apenas as investigadoras terão acesso aos mesmos.

Conflito de interesses

Declara-se não existir qualquer conflito de interesses.

Consentimento Informado

A investigação envolve apenas voluntários saudáveis?	**S**
A investigação envolve grupos vulneráveis: crianças, menores, idosos ou outras pessoas com incapacidade temporária ou permanente?	**N**

O pedido de parecer inclui a declaração de consentimento informado, livre e esclarecido?	**S**

Aqui tem de escolher o formato de consentimento informado

[X] **Consentimento informado, livre e esclarecido para participação em investigação - de acordo com a Declaração de Helsínquia e a Convenção de Oviedo**

[ ] Consentimento informado não assinado - E.g. formulário para questionários preenchidos online. Deverá adicionar a informação incluída e o modo de os participantes concordarem em participar

[ ] Consentimento informado alterado - Um formulário de consentimento informado que omite informação requerida. E.g., se não indica o objetivo do estudo para evitar o viés na resposta dos participantes. Deve explicar o racional no procedimento e os processos de *debriefing*

[ ] Isenção de consentimento – quando não é obtido consentimento informado – esta opção pode ser apropriada para utilização de dados já disponíveis. Justifique

Anexe o formulário de consentimento informado e outro material informativo relevante quando adequado, ou justifique a isenção de consentimento

Assinatura do Investigador Responsável

……………………………………………………………………………

Documentação a anexar

[ ] cópia dos questionários ou formulários de recolha de dados a utilizar, se aplicável;

[X] modelo de consentimento informado e outro material informativo relevante;

[ ] modelo de declaração de compromisso para outros investigadores ou colaboradores na investigação, se aplicável, destinada a documentar o seu envolvimento nas garantias de confidencialidade dadas pelo investigador principal no processo apresentado;

[ ] cópia da notificação às autoridades nacionais ou internacionais competentes, juntamente com o parecer das mesmas, se emitido; (e.g., Direção Geral de Educação, no caso dos inquéritos em ambiente escolar)

[ ] informação sobre o enquadramento, apoio e viabilidade do projeto facultada pelo responsável pela unidade/subunidade orgânica onde se vai desenvolver o projeto;

[ ] *curriculum vitae* resumido de todos os investigadores.

[ ] Deverá ser seguido o Regulamento Geral de Proteção de Dados (RGPD), com entrada em vigor em 25 de Maio de 2018, - REGULAMENTO (UE) 2016/679 DO PARLAMENTO EUROPEU E DO CONSELHO, de 27 de abril de 2016, relativo à proteção das pessoas singulares no que diz respeito ao tratamento de dados pessoais e à livre circulação desses dados, que revoga a Diretiva 95/46/CE (Regulamento Geral sobre a Proteção de Dados).