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INTERSECTION OF SETS AND INTER-UNDERSTANDING BETWEEN PORTUGUESE AND SPANISH[a]

Intersección de conjuntos e intercomprensión entre portugués y español

Artículo de investigación científica y tecnológica
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Abstract

This paper describes a study about inter-understanding between Portuguese and Spanish. Based on Peano's work, the study resorts to the logical relation of intersection between sets and applies it to words in Portuguese and Spanish meaning the same. The material is the abstract of a psychology paper. Each of the words in that text, which is written in Portuguese, is compared to its corresponding Spanish word by means of the relation of intersection. This is made by considering the letters in the words to be elements in sets. The results show the potential that this methodology can have to provide percentages of inter-understanding between the two languages (and between any pair of languages).

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Keywords

Inter-understanding; Peano; Portuguese; Relation of intersection; Romance languages; Spanish.

Resumen

Este artículo describe un estudio acerca de la intercomprensión entre el portugués y el español. Basándose en el trabajo de Peano en 1904, el estudio recurre a la relación lógica de intersección entre conjuntos y lo aplica a palabras en portugués y en español con el mismo significado. El material de análisis es el resumen de un artículo de psicología. Cada una de las palabras en ese texto, que está escrito en portugués, se compara con su palabra correspondiente en español por medio de la relación de intersección. Esto se hace considerando que las letras en las palabras son elementos en conjuntos. Los resultados muestran el potencial que esta metodología puede tener para establecer porcentajes de intercomprensión entre los dos idiomas (y entre cualquier par de idiomas).

Palabras clave

Español; Intercomprensión; Lenguas románicas; Peano; Portugués; Relación de intersección.

Introduction

At present, there are many works about linguistic inter-understanding (e.g., Bertelli, 2016; Chávez Solís & Erazo Muñoz, 2014; Decandio & Dolz, 2015). As it is well known, that concept refers to the understanding of a language by a person that does not speak it. However, that very person's mother tongue is, to an extent, akin to that language.

On the other hand, there are also several studies on the similarities and differences between Portuguese and Spanish (e.g., Almeida Filho, 1995; Aparecida Duarte, 2005; Ceolin; 2003; Vázquez Diéguez, 2011). This issue is important; the proximity between these two languages has caused a great interest in the field of inter-understanding. In fact, the relations between Portuguese and Spanish are subject matters in many works about inter-understanding among romance languages (e.g., Bonvino et al., 2015).

The present paper tries to move forward in these directions. Nevertheless, it describes a study resorting to a methodology based on formal logic. When Peano (1903) proposed *latino sine flexione*, he carried out an analysis of the levels of similarity of several languages. Those languages were English, French, German, Spanish, Italian, Russian, Greek, and Sanskrit. A very relevant point is that his methodology was developed from the logical relation of intersection of sets (Peano, 1904). That was made in the study presented below. Nonetheless, the relation of intersection was used in this new study just to determine levels of similarity between Portuguese and Spanish. That allowed providing predictions about percentages of potential inter-understanding among these two languages.

There are already works indicating possible predictions regarding inter-understanding between Portuguese and Spanish (e.g., López-Astorga, 2017). Those works have a strength: they are derived from a contemporary cognitive theory with a strong empirical support. That theory is the one of mental models (e.g., Byrne & Johnson-Laird, 2020; Khemlani et al., 2018; López-Astorga & Torres-Bravo, 2020). However, the purpose of the research reported here was

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different. Those works often refer to situations in which inter-understanding can be easy, as well as circumstances in which inter-understanding can be hard. But the study below, rather than describing cases in which inter-understanding can happen or not, tried to offer an approximate minimal percentage of understanding in a particular activity: when a person that speaks only one of the two languages mentioned reads a text written in the other language. To work in this way, a paragraph, which is the abstract of a scientific paper written in Portuguese (Gouveia et al., 2002) was addressed.

Thus, the structure of the present paper is as follows. First, it comments on Peano's idea and explains how that idea was applied in the study. Second, it presents the results obtained. Finally, those results, the limitations of the study, and possible lines for further research are analyzed.

The relation of intersection between sets

The relation of intersection is known in logic. The symbol '∩' expresses it. This relation refers to the common elements among sets. For instance, let A and B be two sets.

$A = \{a, b, c, d\}$

$B = \{c, d, e, f\}$

The elements of A are a, b, c, and d. On the other hand, the elements of B are c, d, e, and f. Therefore, the intersection of A and B consists of the elements c and d. This is because c and d are the elements that A and B share. This can be expressed in this manner:

$A \cap B = \{c, d\}$

Following Peano (1904), this operation can be made with words. That allows identifying the letters that those words have in common. Words (1) and (2), which also appear in Table 2, can be taken as an illustrative example.

(1) Raciocínio

(2) Razonamiento

These two words have the same meaning. Both of them mean 'reasoning'. However, (1) is a Portuguese word and (2) is a Spanish word. The idea is to deem both (1) and (2) as sets whose elements are their letters. Thereby, (1) can be considered to be set C, and (2) can be considered to be set D.

C = {r, a, c, i, o, c, i, n, i, o}

D = {r, a, z, o, n, a, m, i, e, n, t, o}

The relation of intersection between C and D is obvious.

$C \cap D = \{r, a, o, n, i, o\}$

The study described below adopted a conventional thesis: if the intersection of the letters of two words with the same meaning in different languages is equal to or greater than 2/3 of the letters of each word, any speaker of only one of those languages can understand both words. This is what (3) points out.

(3) If $P \cap Q \geq 2/3$ of P and $\geq 2/3$ of Q, then anyone knowing P can understand Q and anyone knowing Q can understand P.

Where 'P' and 'Q' are words in different languages, those words are deemed as sets, and the letters of each of those words are deemed as the elements of each of those sets respectively.

Given (3), in principle, someone knowing (1) could not understand (2). Likewise, someone knowing (2) could not understand (1). Nevertheless, this is not necessarily the case. Someone knowing one of these words can understand the other one for several reasons. For instance, without the tilde, (1) also exists in Spanish (although it is not very used). So, a Spanish speaker without knowing Portuguese could understand (1). This is because, although the intersection of (1) and (2) does not fulfill (3), (1) is, without the tilde, a Spanish word with a similar meaning.

Hence, the conditional included in criterion (3) is a material conditional. In logic, material conditionals can be true even if their antecedents are false. It is enough that the consequents are true. The only case that is not permitted is the one in which the antecedent of a conditional happens and its consequent does not hold (e.g., Jeffrey, 1981). In other words, (3) provides a sufficient condition for inter-understanding, not a necessary condition for it (for this distinction, see also, e.g., Moldovan, 2009). If the antecedent of the conditional in (3) is true, inter-understanding occurs. Nonetheless, other causes can lead to inter-understanding as well. The case in which one of the words exists in the other language is, as said, an example. But other situations can also cause a correct interpretation, for instance, an appropriate context (e.g., Bonvino et al., 2015; López-Astorga, 2017).

Accordingly, it is necessary to take into account that what the present paper offers is only an initial proposal. As a proposal, it needs to keep being analyzed and developed. Perhaps, Spanish and Portuguese are the romance languages having more similarities between them. This is an advantage, but it can also lead to confusions. Very similar, or even identical, words can have different meanings in both languages. In addition, it is obvious that not only lexical overlap can have an influence on inter-understanding. The circumstances in which the word is used and the other words in the sentence can have it as well (e.g., Almeida Filho, 1995).

This implies that what (3) actually offers is just a criterion to establish the least that, in an approximate way, the speaker of a language can understand from a message in another language. The exact manner it can obtain positive results can be seen by means of words such as (4) and (5), which appear in Table 1 too.

(4) Incapacidade

(5) Incapacidad

(4) is a Portuguese word and (5) is a Spanish word. Both of them mean 'inability'. If (4) corresponds to set E and (5) to set F, the intersection of E and F does fulfill what (3) provides.

E = {i, n, c, a, p, a, c, i, d, a, d, e}

F = {i, n, c, a, p, a, c, i, d, a, d}

E ∩ F = F = {i, n, c, a, p, a, c, i, d, a, d}

Intersection between a Portuguese text and its translation into Spanish

Accordingly, the study was based on criterion (3). The main aim was to find an approximate minimal percentage of inter-understanding between Portuguese and Spanish from that criterion. To achieve it, a Portuguese text was addressed. It is the *Resumo* (Abstract) of a paper in a Brazilian psychology journal (Gouveia et al., 2002). Its original Portuguese version is as follows:

> Declarações condicionais com a mesma forma sintática mas conteúdos diferentes podem levar a conclusões completamente diferentes. Esse tipo de constatação tem sido apontado por alguns pesquisadores, entre os quais Wason, como evidência da incapacidade da mente humana para compreender as sentenças condicionais. No presente artigo, será discutida a importância de se considerar as influências pragmáticas no raciocínio condicional cotidiano; pois, diferentemente do raciocínio lógico, o raciocínio cotidiano não ocorre no "vazio" e, sim, inserido em um contexto onde as influências pragmáticas se fazem presentes. Inicialmente, serão apresentados alguns preceitos da lógica formal para o raciocínio condicional. Em seguida, a interpretação das sentenças condicionais na linguagem natural. Algumas evidências empíricas para a influência de fatores pragmáticos no raciocínio condicional também serão apresentadas. E, por fim, será discutida a "teoria do se" proposta por Braine e O'Brien que une lógica mental e pragmática no raciocínio cotidiano (Gouveia et al., 2002, p. 217; quotation marks in text).

In the same paper and in the same page, a translation of that *Resumo* into English is given:

> Conditional declarations with the same syntactic form but different contents may take to completely different conclusions. This point has been highlighted by some researches (e.g., Wason) as evidence of the inability of the human mind to understand the conditional sentences. In the present article, we discuss the importance of being considered the pragmatic influences in the daily conditional reasoning; because, differently of the logical reasoning, the daily reasoning does not happen in "a vacuum", but inserted in a context where the pragmatic influences occur. Initially, we introduce some precepts of the formal logic for the conditional reasoning. Next, we present

> the interpretation of the conditional sentences in the natural language. Some empiric evidences for the influence of pragmatic factors in the conditional reasoning will also be discussed. Finally, we consider the "Theory of if" proposed by Braine and O'Brien that establishes a connection between the mental and pragmatic logic in the daily reasoning (Gouveia et al., 2002, p. 217; quotation marks in text).

The study consisted of comparing each of the words in the Portuguese version to its translation into Spanish. The goal of this comparison was to check whether or not the pairs (each Portuguese word and its corresponding Spanish word) fulfill criterion (3). The next section presents the results obtained.

Results: Intersections found

The Portuguese version of the text has 144 words. It was found that, when their translations into Spanish are considered, 101 of those words meet what (3) indicates. 40 of them do not comply with criterion (3) taking into account their translations. The three remaining words are last names. Table 1 shows the 101 words following (3), their Spanish translations, and the common letters each pair has (i.e., the letters that shape the intersection between both words).

TABLE 1: Words in the *Resumo* in Gouveia et al. (2002) for which (3) holds if translated into Spanish, their Spanish translations, and the letters corresponding to the intersection of each pair. The table also points out, in the left column, the order of appearance of the words in the *Resumo*.

No.	Portuguese word	Spanish word	(Portuguese word) ∩ (Spanish word)
1	Declaraçoes	Declaraciones	Declaraoes
2	Condicionais	Condicionales	Condicionas
3	Com	Con	Co
4	Mesma	Misma	Msma
5	Forma	Forma	Forma
6	Sintática	Sintáctica	Sintatica
7	Mas	Mas	Mas
8	Conteúdos	Contenidos	Contedos
9	Diferentes	Diferentes	Diferentes

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No.	Portuguese word	Spanish word	(Portuguese word) ∩ (Spanish word)
10	Levar	Llevar	Levar
11	A	A	A
12	Conclusões	Conclusiones	Conclusoes
13	Completamente	Completamente	Completamente
14	Diferentes	Diferentes	Diferentes
15	Esse	Ese	Ese
16	Tipo	Tipo	Tipo
17	De	De	De
18	Constatação	Constatación	Constatao
19	Sido	Sido	Sido
20	Apontado	Apuntado	Apntado
21	Por	Por	Por
22	Alguns	Algunos	Alguns
23	Pesquisadores	Pesquisidores	Pesquisdores
24	Entre	Entre	Entre
25	Os	Los	Os
26	Como	Como	Como
27	Evidência	Evidencia	Evidencia
28	Incapacidade	Incapacidad	Incapacidad
29	Mente	Mente	Mente
30	Humana	Humana	Humana
31	Para	Para	Para
32	Compreender	Comprender	Comprender
33	As	Las	As
34	Sentenças	Sentencias	Sentenas
35	Condicionais	Condicionales	Condicionas
36	Presente	Presente	Presente
37	Será	Será	Sera
38	Discutida	Discutida	Discutida
39	Importância	Importancia	Importancia
40	De	De	De
41	Considerar	Considerar	Considerar
42	As	Las	As
43	Influências	Influencias	Influencias

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No.	Portuguese word	Spanish word	(Portuguese word) ∩ (Spanish word)
44	Pragmáticas	Pragmáticas	Pragmaticas
45	Condicional	Condicional	Condicional
46	Cotidiano	Cotidiano	Cotidiano
47	Diferentemente	Diferentemente	Diferentemente
48	Lógico	Lógico	Logico
49	Cotidiano	Cotidiano	Cotidiano
50	Não	No	No
51	Ocorre	Ocurre	Ocrre
52	Vazio	Vacío	Vacio
53	Sim	Sí	Si
54	Inserido	Insertado	Inserdo
55	Contexto	Contexto	Contexto
56	Onde	Donde	Onde
57	As	Las	As
58	Influências	Influencias	Influencias
59	Pragmáticas	Pragmáticas	Pragmaticas
60	Se	Se	Se
61	Presentes	Presentes	Presentes
62	Incialmente	Inicialmente	Inicialmente
63	Serão	Serán	Sera
64	Apresentados	Presentados	Presentados
65	Alguns	Algunos	Alguns
66	Preceitos	Preceptos	Precetos
67	Lógica	Lógica	Logica
68	Formal	Formal	Formal
69	Para	Para	Para
70	Condicional	Condicional	Condicional
71	Seguida	Seguida	Seguida
72	Interpretação	Interpretación	Interpretao
73	Sentenças	Sentencias	Sentenas
74	Condicionais	Condicionales	Condicionas
75	Linguagem	Lenguaje	Lnguae
76	Natural	Natural	Natural
77	Algumas	Algunas	Alguas

The table continues on the next page

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No.	Portuguese word	Spanish word	(Portuguese word) ∩ (Spanish word)
78	Evidências	Evidencias	Evidencias
79	Empíricas	Empíricas	Empiricas
80	Para	Para	Para
81	Influência	Influencia	Influencia
82	De	De	De
83	Fatores	Factores	Fatores
84	Pragmáticos	Pragmáticos	Pragmaticos
85	Condicional	Condicional	Condicional
86	Também	También	Tambe
87	Serão	Será	Sera
88	Apresentadas	Presentadas	Presentadas
89	Por	Por	Por
90	Fim	Fin	Fi
91	Será	Será	Sera
92	Discutida	Discutida	Discutida
93	Teoria	Teoría	Teoria
94	Proposta	Propuesta	Propsta
95	Por	Por	Por
96	Que	Que	Que
97	Une	Une	Une
98	Lógica	Lógica	Logica
99	Mental	Mental	Mental
100	Pragmática	Pragmática	Pragmatica
101	Cotidiano	Cotidiano	Cotidiano

As far as the words that do not abide (3), they are indicated in Table 2. Table 2 gives the same information on its words as Table 1: order number, Portuguese Word, Spanish translation, and letters corresponding to the intersection.

TABLE 2: Words in the *Resumo* in Gouveia et al. (2002) for which (3) does not hold if translated into Spanish, their Spanish translations, and the letters included in the intersection of each pair. The table also points out, in the left

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column, the order of appearance of the words in the *Resumo*. 'Ø' stands for empty set. In this case, it means that the intersection has no elements: the words do not share letters.

No.	Portuguese word	Spanish word	(Portuguese word) ∩ (Spanish word)
1	A	La	A
2	Podem	Pueden	Pde
3	Tem	Ha	Ø
4	Quais	Cuales	Uas
5	Da	De la	Da
6	Da	De la	Da
7	No	En el	N
8	Artigo	Artículo	Artio
9	A	La	A
10	Se	Si	S
11	No	En el	N
12	Raciocínio	Razonamiento	Raonio
13	Pois	Pues	Ps
14	Do	Del	D
15	Raciocínio	Razonamiento	Raonio
16	O	El	Ø
17	Raciocínio	Razonamiento	Raonio
18	No	En el	N
19	E	Y	Ø
20	Em	En	E
21	Um	Un	U
22	Fazem	Hacen	Ae
23	Da	De la	Da
24	O	El	Ø
25	Raciocínio	Razonamiento	Raonio
26	Em	En	E
27	A	La	A
28	Das	De las	Das
29	Na	En la	Na

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No.	Portuguese word	Spanish word	(Portuguese word) ∩ (Spanish word)
31	No	En el	N
32	Raciocínio	Razonamiento	Raonio
33	E	Y	Ø
34	A	La	A
35	Do	Del	D
36	Se	Si	S
37	E	Y	Ø
38	E	Y	Ø
39	No	En el	N
40	Raciocínio	Razonamiento	Raonio

Finally, the three last names found in the text are indicated in Table 3.

TABLE 3: Last names in the *Resumo* in Gouveia et al. (2002). The table also points out, in the left column, the order of appearance of the words in the *Resumo*.

No.	Last name
1	Wason
2	Braine
3	O'Brien

The interpretation of these results does not seem very complex. According to (3), the speaker of the other language should understand 101 words. Besides, it can also be expected that speakers of both languages will easily identify the last names (the fact that they are capitalized can help with that). So, it can be claimed that the words that can be correctly interpreted are, at least, 104. Given that the text has 144 words, the speaker of any of the two languages will understand, at a minimum, 72.2% of the words. Thus, the percentage of words that will not be probably savvied is 27,8%.

Conclusions and general discussion

Therefore, if (3) is a suitable criterion to assess inter-understanding, it can be stated that a Spanish speaker tends to understand Portuguese, and that a Portuguese speaker tends to understand Spanish. To assert this is not a great novelty (as it is shown, e.g., by several references included in this paper). However, the study described can make an additional point about this issue: (3) is intended to be a more or less objective criterion to evaluate the intelligibility between languages. One might intuitively think that cognates will be understood in most cases. Nevertheless, (3) tries to be a general rule to foresee when the meaning of a word will be identified and when not. From this perspective, it can be said that the minimal percentage of inter-understanding between Portuguese and Spanish is around 72,2%.

Nonetheless, this should be assumed as a provisional hypothesis. Further studies and research are required to unequivocally support it. First, the study above only dealt with written text, and not with oral communication. On the other hand, the study presented an ideal situation. It assumes that all of the Portuguese speakers know all of the Portuguese words in Table 1 and Table 2. Likewise, it also presumed that all of the Spanish speakers know all of the Spanish words in those very tables. These points, and, of course, aspects such as the circumstances in which communication happens, should be taken into account in future studies.

In the same way, (3) points out 2/3 as a percentage of intersection conventionally. The suitable percentage might be different. Perhaps only more empirical works could enlighten with regard to this. Those works would need participants and have to verify to what extent it is correct the following: when the intersection of the letters of two words coming from two different languages is equal to or greater than 2/3, speakers of both languages can comprehend those words (provided that the two words have the same meaning in the two languages). Obviously, this could apply not only to Portuguese and Spanish, but also to any other pair of languages.

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In addition, even supposing that (3) is correct, as indicated, it would be a criterion to obtain only minimal percentages of inter-understanding. As explained with (1) and (2), two words can be incompatible with (3). However, speakers of the other language can understand one of them because it also exists in their language (although it is less used) (to a discussion and a greater development of possibilities such as these, see, e.g., Almeida Filho, 1995). Furthermore, as also indicated, context can play a role in inter-understanding too. For example, *pelos* in Portuguese is a contraction of *por* ('by') and *os* ('the' when it refers to plural masculine nouns). The problem with this word is that there is a Spanish word that is identical to it, but with a different meaning: the Spanish *pelos* is translated into English by 'hairs'. Hence, in principle, it is difficult that a Spanish speaker notes the meaning of *pelos* in Portuguese (the Spanish translation of the Portuguese *pelos* is 'por los', and a contraction is not possible). Nevertheless, based on the theory of mental models, it has been argued that a Spanish speaker can identify the meaning of the Portuguese word *pelos* because of context (López-Astorga, 2017). Therefore, it has to be admitted that (3) is not the only criterion, but just one more of the factors having an influence on inter-understanding.

Besides, as it is mentioned in many linguistic works about different issues, it is always positive to address more extensive corpora and related to varying fields. The text selected in the study above comes from a psychology paper. Maybe it would be advisable to review, for example, whether (3) can also be accepted when the text belongs to another subject area.

In any case, the proposal is that (3) is provisionally assumed to lead future research. Those researches will probably tint it. They will almost certainly show to what extent it is suitable to accept that criterion as well.

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Conflict of interest

The author declares that there is no conflict of interest with any institution or association of any kind. Likewise, the Universidad Católica Luis Amigó is not responsible for the handling of copyrights that the authors make in their articles, therefore, the veracity and completeness of quotations and references are the responsibility of the authors.

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