Abstract

Cognitive linguistics holds that meaning in language is the mapping between linguistic expressions and cognitive structures that arise from our direct sensory experience and actions in the world. The present paper investigates that claim by exploring the perceptuomotor representational basis of causal and concessive discourse connectives. Taking as a starting point Lakoff and Johnson's theory of image schemas (1987) and Talmy's work on force dynamics (1988), in two experiments, we tested naïve subjects' intuitions about the image-schematic component of four causal and concessive discourse markers. In the first experiment, subjects were asked to select the sentences that best described a series of animations that depicted forceful relations between two entities. English and Spanish participants consistently preferred descriptions with the connectives *because / porque* when one of the entities involved in the interaction was overcome by the other; whereas they favoured sentences with the connectors *although /aunque* if one of the entities was able to impose itself in spite of the opposition from the other entity. Similar results were obtained in a second experiment where subjects' judgements were only guided by the presence of a causative or concessive marker in the animations' descriptions. In this case, any lexical reference to the notion of force that could have biased participants' responses in Experiment 1 was avoided by using nonce words instead. Altogether, these results support the hypothesis that force dynamics image schemas underlie the core meaning of causal and concessive connectives, which act as pointers to a concept of causation that seems to recruit our experiential knowledge with forces.

Key words: conceptualization, connectives, causation, concession, force dynamics, image schemas.

How language conveys meaning continues to be an open question. Traditionally, linguistic meaning has been characterized as the match between an expression and an (objective) situation in the world or possible worlds. Nowadays, however, cognitive semantics provides an alternative account for the representation of meaning that highlights the relations between linguistic meaning and embodiment. (Gibbs, 2005a, 2005b; Lakoff & Johnson, 1980; Lakoff & Johnson, 1999). In this view, meaning is actually the mapping from linguistic expressions onto cognitive structures which are grounded in the sensorimotor experiences that arise from our bodily interactions with the world (Evans &Green, 2006; Gibbs, Beitel, Harrington & Sanders, 1994; Johnson, 1987; Lakoff, 1987; Sweetser, 1990, inter alia). Thus, words do not encode meaning themselves but are only 'prompts' for the construction of meaning, pointers to concepts, many of which are clearly tied to internalizations of recurrent prior kinaesthetic experience, known as image schemas (Johnson, 1989; Lakoff and Johnson, 1980; Lakoff, 2003).

Research conducted in disciplines as diverse as cognitive psychology (Richardson, Spivey, Edelman & Naples, 2001; Olivetti Berlardinelli, 2009); developmental psychology (Mandler, 2005, 2010); psycholinguistics (Spivey, Tyler, Richardson & Young, 2000; Standfield & Zwaan, 2001); neuroscience (Aziz-Zadeh, Koski, Zaidel, Mazziotta & Iacoboni, 2006; Gallese & Lakoff, 2005; Mahon & Caramazza, 2005; Rohrer 2005, 2007); artificial intelligence (Spranger & Loetzsch, 2009) and spontaneous gestures (Cienki, 2005) has provided evidence that supports the claim above mentioned. Image schemas play a key role in conceptualization and meaning being one of the main principles by which humans organize their knowledge of the world and structure not only concrete concepts but also abstract ones (for a review see Gibbs, 2001 and Hampe, 2005).

In line with the embodiment thesis, the claim put forward here is that the meaning associated with connectives (causal and concessive markers in particular) has an image-schematic basis, which arises from embodied experience. In this respect, we argue that their meaning is not completely different from that of open-class words, since both reflect and encode fundamental aspects of embodied experience, structured information derived from our world knowledge. Traditionally, however, the tendency has been to think that connectives have a "core meaning, which is procedural, not conceptual" (Fraser, 1999, p. 931) — to analyse them not as mapping directly onto concepts but instead as encoding instructions that constrain the inferential phase of verbal communication (Blakemore, 2000, 2007; Sperber & Wilson, 1995; Wilson & Sperber, 1993) —. This situation has led to give little thought to the possibility that their meanings might actually be motivated by embodied experience. In fact**,** a quick review of the research on connectives conducted over the last two decades reveals that their main focus has been on the effect of connectives on discourse comprehension (Millis & Just, 1994; Millis, Golding & Barker, 1995; Murray, 1995, 1997; Sanders & Noordman, 2000). These studies — most of which compared recall performance and reading time for connective-present vs. connective-absent versions of sentences or short texts— seem to converge on a similar conclusion: causal and concessive connectives favour the integration of the text content into a unified and coherent representation (Sanders & Noordman 2000) in the following ways:

a) by facilitating the reactivation of the first clause and triggering connector-specific inferences (Millis& Just, 1994); and

b) by invoking an "expectancy of the content of the post-connective sentence" (Murray, 1995, p.120) that, in the case of the concessive connectives, for example, informs of

content discontinuities or disruptions in the continuous sequence of events that readers

expect by default;

In short, research on discourse markers has shown that connectives undoubtedly favour

discourse comprehension, since they play a prominent role in the integration of text content by

instructing readers on how to connect two pieces of information, but they have not delved into

how they are conceptualised, in other words, into how connectives mean.

In this context, we state that to provide a complete description of the semantics of

connectives it must be considered that they are also prompts for concepts that reflect fundamental

aspects of embodied experience and, therefore, they should be semantically typified along the

same lines as open class words. As cognitive linguistics has argued there is no need to posit a

strict boundary between words that encode procedures (i.e., closed-class words, such as

connectives) and those that encode concepts (open-class words). They must be seen as poles of a

continuum that only vary in the level of specificity of their meaning: open-class words tend to

possess rich and specific conceptual meaning whereas closed-class words usually provide more

schematic conceptual content (Evans & Green, 2006; Langacker, 2008).

In this view, the main purpose of this study is to explore the conceptual representation of

a subset of connectives, causal and concessive markers, which seem to have a special status in

the establishment of coherence relations (Louwerse, 2001; Lynch & van den Broek, 2007;

Murray, 1997; van den Broek, 1989a, 1989b; Sanders & Noordman, 2000). To investigate how

these connectives mean and in what sense their meaning is similar to that of open class words,

we take as a starting point the hypothesis that causative and concessive discourse markers get

their meaning by means of a mapping onto cognitive structures that arise from our everyday forceful interaction with the world around us (Lakoff &Johnson, 1999; Talmy, 2000).

Causation as Force

According to Lakoff and Johnson (1999) the most fundamental case of causation is "the direct application of force resulting in motion or other physical change" (p.77). Consequently, causes are mostly conceived of as forces (Lakoff, 1987; Lakoff 1998; Lakoff & Johnson, 1980, 1999). In this context, our understanding of the notion of causality seems to rely on our own embodied experience of how we act upon objects or they act upon us, and our ability to make inferences about causation does not depend on the understanding of an abstract rule; instead, it is grounded in our recurrent bodily encounter with physical forces (Gibbs, 2008).

Recent studies in developmental psychology (Krogh, 2009; Rakison & Krogh, 2011) have indeed confirmed the critical role that direct causal experience has to the concept formation in infants. As opposed to the studies that argued that we are receptive to causation and distinguish between causal and noncausal events because all humans are equipped with an innate concept of causal power from infancy that undergoes little or no variation over time (Michotte, 1963; Leslie, 1982, 1984, 1988, 1995; Leslie & Keeble, 1987), developmental psychology has now provided evidence that it is actually our action experience that facilitates our ability to perceive causality. Krogh (2009) and Rakison (2011), for example, have found that 4½-month-old children are able to perceive causality in simple event displays designed in accordance to the launching effect after they are given real-world experience of causal action; that is, once they have had the chance to engage in causal actions, such as interacting with balls by using Velcro mittens to catch them. It seems that "infants abstract information about causality from their self-produced actions and

generalize them to other contexts" (Krogh, 2009, p.16). This would explain why only those children that have real-world causal experiences can go beyond a pure kinetic interpretation of what they perceive (i.e., two independent objects that move at certain times and in a certain direction) to assign agent and recipient roles to the objects involved in such events and to understand that agents cause recipients to change their physical state. These findings provide an embodied explanation for a phenomenon that, as shown above, had been traditionally explained as innate, both in adults and children.

Within the framework of cognitive semantics, the theory of force dynamics (Talmy, 1988) also highlights the role that embodied experience plays in the way causality is conceptualised. This theory argues that our understanding of causality relates to our ability to detect the force patterns that underlie causal events, and that this ability relies on the knowledge structures that are drawn from our kinesthetic and somesthetic experience (i.e., the direct experience of muscular effort, motion and sensory inputs such as pressure). On the basis of the information that we recruit from our embodied experience, we are able to perceive forceful interactions in causal events, in particular, the interrelationships among two forces of unequal strength: the agonist and its opposing element, the antagonist, which have an intrinsic tendency towards either action or rest that can either persist or be overcome during their interaction depending on their relative strengths. As a result of these interactions different patterns of force may arise, with instances of effective and ineffective compulsion, blockage and attraction being among them.

All in all, from cognitive psychology to linguistics, the theories of causal meaning support the thesis that the notion of causation is grounded in a form of representation that derives from embodiment and captures prior experiences with forces (i.e., force image schemas). On the

basis of this assumption, if, as cognitive semantics states, embodiment is evident in the meaning associated with words, force dynamics should be reflected by the linguistic items that speakers use to encode the concept of causation. In order to explore this hypothesis, in the next section, we examine how force relations manifest in language.

Force Dynamics in Language

According to the force dynamics theory, force oppositions are captured by language. In fact, Talmy states that force "has a direct grammatical representation" (Talmy, 2000, p. 409) in a set of closed-class words, which includes causal and adversatives conjunctions along with causative and modal verbs. In this view, causal and concessive connectives are grammatical markers of force dynamic relations, which act as lexical cues for the reader to infer patterns of force between adjacent sentences. The advantage of this analysis is that, as Talmy (1988) points out, "it provides a framework in which a set of basic notions not usually considered related are brought together in a natural way that reveals their underlying character and actual affinity" (p. 416). That is the case of causative and concessive relations, which, in the view of the force dynamics theory, are understood as two poles of the same concept only distinguished by the fact that in causative situations the agonist is not able to impose its initial tendency whereas in concessive situations, being the antagonist weaker than the agonist, the former is able to enforce its intrinsic tendency (see Tables 1 and 2).

	Patient tendency for the resultant state	Antagonist-agonist opposition	Occurrence of result
Cause	No	Yes	Yes

Table 1. Causal Pattern

	Patient tendency for the resultant state	Antagonist-agonist opposition	Occurrence of result
Concession	Yes	Yes	Yes

Table 2. Concessive Pattern

The analysis of linguistic data conducted under Talmy's model (2000) supports that bidirectional relation between causative and concessive expressions and force dynamics. However, it remains to be seen whether naïve language users share the same intuitions and forms of representation for those expressions or they are just a theoretical construct used by linguists. Several studies have provided empirical evidence that seems to point out in the first direction. Wolff and associates (Wolff & Zettergren, 2002; Wolff & Song, 2003; Wolff, 2007, 2008), for example, have analyzed whether the force-dynamics theory is able to predict the type of vector configurations that people will judge to be causal and non-causal, and to specify distinct types of causal concepts. Their results have confirmed that the force-dynamics theory can foretell subjects' judgments about causation and captures the underlying meanings of two types of English causal verbs. Thus, according to these authors, lexical causatives (i.e., verbs that encode the notion of cause and result in a single verb (as in *Rose destroyed the letter*); and periphrastic causative constructions (i.e., structures that encode the notions of cause and effect by using various verbs, as in *The rain forced us to stop the game*), can be analyzed and grouped into different subtypes on the basis of the three parameters of force described in Tables 1 and 2.

More recently, Morera and de Vega (2010) have also used Talmy's model to provide a characterization of causality underlying sentences linked with causal and adversative connectives

in Spanish. Their results have confirmed that "sentences with causal and adversative connectives mainly differ in their polarity or continuity" (Morera & de Vega, 2010, p. 522), where continuity implies causing or enabling forces and discontinuity describes preventing forces.

In sum, the existing empirical research supports the hypothesis that force-dynamic interactions underlie the conceptual representation of causative items, but there are still some questions that remain to be answered. First of all, it is necessary to determine whether causal and concessive connectives are semantically characterized along the same basis as causal verbs, given the fact that "research on expressions of causality rarely moves beyond the examination of lexical and periphrastic causatives" (Song & Wolff, 2003, p. 2), and when it does, connectives tend to be interpreted as procedural devices. In fact, as far as we know, only the study conducted by Morera and de Vega (2010) explores the force dynamic relations conveyed by discourse markers. Secondly, it necessary to conduct cross-linguistic experiments that replicate and expand previous results, so as to observe whether similar patterns are found in different languages.

Given this state of affairs, the present paper tries to deepen on the semantic foundations of causative and concessive connectives by conducting an English - Spanish contrastive study. Our main goal is to examine whether English and Spanish causal and concessive markers encode force dynamics themselves, a fact that would support the thesis that they are pointers to a concept of causation that is tied to internalizations of prior experiences with forces. To achieve this aim, we empirically test the claim that between subjects there is a coherence to the image-schematic component of word representations; and examine whether in the case of the representational basis of causative and concessive connectives such coherence between subjects coincides with the predictions of the force dynamics theory. Finally, we analyse whether the force dynamics

model is able to advance effects of priming in language processing. By using a lexical decision task we try to observe whether priming subjects with visual displays designed in accordance with force patterns facilitates a lexical decision for words such as *because*/*porque* and *although*/*aunque,* as it would be expected if it was the case that the conceptual representation of causative and concessive connectives was grounded in force dynamic relations.

Experiment 1

As stated above, our understanding of causality seems to depend on the ability to detect the force patterns that underlie causal events, an ability that is thought to emerge from our kinesthetic and somesthetic experience. If this is true, subjects should agree with each other about the force dynamic component of causative expressions such as causal and concessive connectives. In other words, the same image-schematic representations should be accessed by subjects when using of facing causative and concessive connectives. Using visual displays designed in accordance with the force dynamics model we tested subjects' agreement in judging a situation to be causal, concessive or non-causal/non-concessive, as well as in selecting the most suitable linguistic encoding for that situation. Our hypothesis was that participants would select descriptions with the causal connectives *because*/ *porque* over descriptions with the concessive connectives *aunque*/ *although* to encode effective interactions of force; whereas they will prefer the use of *aunque*/ *although* when ineffective interactions of force were depicted. Finally, we hypothesized that when visual display depicted something other than force, connective choice bias would be null, and participants would judge that none of the above mentioned connective could describe the event.

Method

Native English and native Spanish speakers were presented with a series of dynamic spatial primes, short videos that depicted forceful interaction between two entities, and then they were asked to rate the effectiveness of a set of sentences connected by the markers: *because* and *although*, on the one hand, and *porque* and *aunque*, on the other, to describe those displays.

Participants

English speaking participants: 25 undergraduates at the University of New Haven, Connecticut, participated in this experiment. All were native speakers of English and only 12 of them reported the ability to speak Spanish. Their level of proficiency in Spanish was A2 according to the Common European Framework of Reference for Languages (CEFR). The mean age of the participants was 20.2 +/- 2 years, all had normal or corrected to normal vision and none reported being dyslexic.

Spanish-speaking participants: 30 undergraduates at the University of Barcelona took part in this experiment. All were native speakers of Spanish and were in the third or fourth year of their degree in English philology. The mean age of the subjects was 21 +/- 1 years, all participants had normal or corrected to normal vision and none reported being dyslexic.

Visual stimuli

Twenty seven short videos made from an animation package (Adobe Flash CS5) were created. Of these videos, 18 (9 + 9) were designed to depict effective and ineffective cases of compulsion, blockage and attraction by showing the forceful interaction between two entities (e.g., vehicles, boats, or footballs). The remaining 9 videos did not describe any type of forceful

interaction —frames illustrating the beginning, middle, and end of some of the animations used in the experiment are provided below.

Compulsion:

Three of the animations depicted effective compulsion (i.e., causative compulsion). In each display, one of the objects (the agonist), appeared in a resting state in the middle of the screen while a second object (the antagonist) entered the scene to collide with the first object, thus causing the agonist to move. Whereas another set of three videos were designed to represent non-effective compulsion (i.e., concessive compulsion), that is, in this case the agonist remained unmoved despite the force exerted by the antagonist
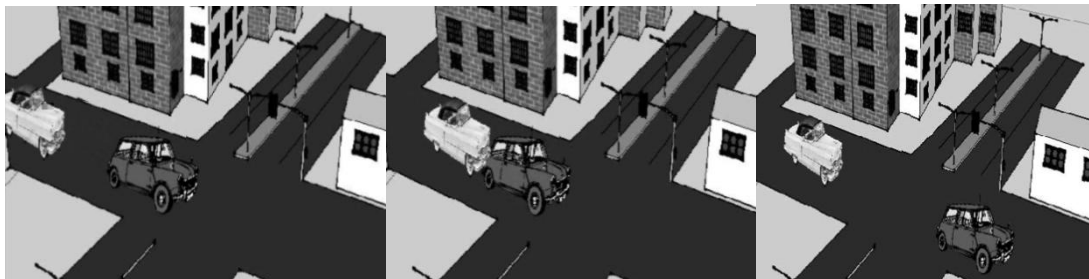

Figure 1. Causative compulsion pattern. The yellow car acts as the antagonist, which is more powerful than the agonist, the green car, and therefore it causes it to move upon impact.

Blockage

Three more animations depicted effective blockage (i.e., causative blockage): an object (a car, boat or ball) obstructed the trajectory of another, whose progress was halted by the first object.

Figure 2. Causative blockage pattern. The red boat acts as the antagonist, which is stronger than the agonist, the grey boat, and effectively blocks its path.

Another group of three animations depicted ineffective blockage (i.e., concessive blockage). In this case the entity (a car, boat or ball) was able to manifest its tendency towards motion by overcoming the blockage of an opposing object.

Attraction

Six more animations were designed to depict the force dynamic patterns of effective and ineffective attraction respectively. In the first case, three videos showed how an entity pulled on a rope attached to another entity until the former was able to set the latter in motion and move it towards itself. In the second case, three animations showed how the agonist (the entity that was being pulled) remained in place despite being tugged vigorously.
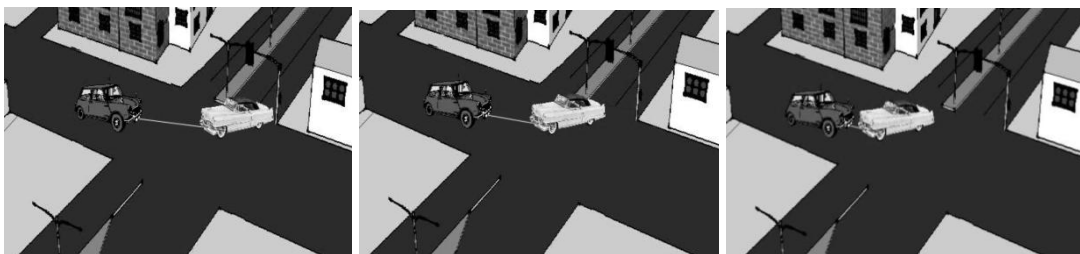

Figure 3. Causative attraction pattern. The green car acts as the antagonist, which is stronger than the agonist, the yellow car, and is able to pull on it.

Finally, nine more videos described events that did not map onto any of the six force configuration described above. In this case, the visual stimuli did not show any type of forceful

interaction between entities. The objects appeared simultaneously on the screen and moved independently from each another. We predicted that subjects would not assign agonist or antagonist roles in these cases and, therefore, the events represented in these videos would not be judged as either causative or concessive.

Linguistic stimuli

English and Spanish provide several ways of expressing causal and concessive relations including conjunctions (e.g., *because*, *although*), verbs (*to cause*, *prevent*, etc.) and prepositions (*because of*, *thanks to*, *despite*, *in spite of*). While all these structures can be used to encode the notions of cause and concession, in this study, as we already anticipated, only subordinating conjunctions were examined. The Spanish connectives *porque* and *aunque* and their direct counterparts in English, *because* and *although*, were selected for this experiment due to the fact that the observed absolute frequency of *porque* and *aunque* in the CREA corpus, with 185.700 and 121.723 matches respectively, was higher than that of the other linking conjunctions within their category

Using these connectives two possible linguistic descriptions were created for each of the experimental visual stimuli. The only difference between the two descriptions was the connector (either *because*/*porque* or *although*/*aunque)* linking the main and subordinate clauses. Subjects were also provided with a third option labelled *none of the above*, which we expected participants to choose when confronted with non-forceful events, fillers. One of the linguistic descriptions always was congruent with the event depicted in the video whereas the others were not.

Procedure

The experiment was run using E-prime 2.0 software on a PC running Windows XP and the keyboard was used as the input device. As shown in figure 4, after being given on-screen instructions, participants were presented with the experimental animations and their linguistic descriptions; and they were asked to choose the sentence that best described what they had watched by pressing a designated button.The task comprised a total of 27 visual stimuli that were divided in three conditions on the basis of the force dynamic configurations underlying every display: causative (9), concessive (9), and non-causative/non-concessive (9). All visual stimuli were randomized for each participant and crossed with two different orderings of the sentences. Administration was counterbalanced across subjects

1. The green car crossed the intersection **because** the yellow car hit it from behind.
2. The green car crossed the intersection **although** the yellow car hit it from behind.
3. None of the above.

Figure 4. Example of a trial. The first phase is the visual stimulus; and the second shows the possible descriptions the participants could choose to describe the visual stimulus.

Results

Our results corroborated an impressive degree of agreement between subjects about the force dynamic component of causative and concessive discourse markers, which can be

interpreted as a confirmation of the thesis that subjects share a common conceptual representation for this type of causative expressions. Moreover, in line with the findings on causative verbs of Wolff and Zettergren (2002, 2007), our results also showed that the force dynamic model could predict which situations would be judged to be causal, concessive or unclassifiable by participants and that the language (i.e., English or Spanish) did not affect the predictions of the model. More importantly, this first experiment showed that to replace the causative verbs employed by Wolff and Zettergren (i.e., *cause*, *help* and *prevent*) with causative and concessive connectives had no influence on subjects' ability to select what they thought was the best description for cases of effective and ineffective compulsion, blockage and attraction. In fact, data analysis showed that Spanish speakers categorized as expected 83.5% of the events. Only 16.5% of events were erroneously classified. Results for English speaking participants were similarly consistent with the predictions of the force dynamics theory: 81.6% of events were identified correctly and only 18.4% incorrectly.

	CAUSE			CONCESSION			
Configuration of forces	Compulsion	Attraction	Blockage	Ineffective Compulsion	Ineffective Attraction	Ineffective Blockage	Unclassifiable
Porque	92.5%	95%	94.4%	-	-	-	-
Aunque	-	-	-	82.5%	78.3%	73.3%	-
Ninguna	-	-	-	-	-	-	80%

Table 3. Percentage of Times Spanish Speakers Chose Each of the Three Possible Options for Each of the Force Patterns.

	CAUSE			CONCESSION			
Configuration of forces	Compulsion	Attraction	Blockage	Ineffective Compulsion	Ineffective Attraction	Ineffective Blockage	Unclassifiable
Because	96.25%	97.5%	96.67%	-	-	-	-
Although	-	-	-	85%	92.5%	92%	-

| Neither | - | - | - | - | - | - | 68% |

Table 4. Percentage of Times English Speakers Chose Each of the Three Possible Options for Each of the Force Patterns.

A chi-square test of independence, performed to examine the relation between the factors: Configuration Type (i.e., effective and non-effective forceful interactions) and Response Type (i.e., *because*, *although* or *none of the above*) revealed that the relation between these variables was significant in Spanish and English χ^2 (2, N = 30) = 28.614 p <0.00 and χ^2 (2, N = 25) = 70.79, p<0.00, respectively. As expected, results showed that Spanish and English participants chose *porque* and *because*—as opposed to *aunque* and *although*—for the animations in which the antagonist was able to impose its force on the agonist. Likewise, participants chose *aunque* and *although* (instead of *porque* and *because*) in those animations in which the agonist was able to withstand the force of the antagonist.

The results also showed that force-dynamics theory is able to predict fine-grained distinctions within the general category of causation, distinguishing between causal and concessive compulsion, blockage and attraction. Thus, for compulsion occurrences, the causal connective *porque* was selected when the compulsion event was fully realized and the concessive marker *aunque* selected when the compulsion gave rise to no resulting change of state, χ^2(1, N=30) = 5.48, p = 0.0019. In the case of attraction, subjects were more likely to select the causal connective (*porque*) when the antagonist was able to force the agonist to move towards itself and *aunque* when the agonist remained in place despite the force exerted against it by antagonist, χ^2(1, N=30) = 7.21, p = 0.015. Finally, for causative and concessive blockage [χ^2(1, N=30) = 14.84, p = 0.001], participants chose *porque* when the antagonist provided effective blockage of

the agonist's intrinsic tendency, and *aunque* when the antagonist only hindered the agonist's tendency.

In the case of English, our analysis revealed similar results. Most participants chose *because* when the agonist tended towards rest but was opposed and overcome by the antagonist. Similarly, participants chose *although* when the antagonist was not strong enough to make the agonist move, $\chi^2(1, N=25) = 12.12$, $p = 0.005$. In attraction patterns, the outcome of the interaction between the agonist and the antagonist was the determining factor in the participants' choice. When the agonist was set in motion by the pulling force of the antagonist, subjects chose sentences with the connector *because* as the best description, as opposed to *although*, which was chosen when the antagonist was weaker than the agonist and was not able to move it towards itself, $\chi^2(1, N=25) = 4$, $p = 0.045$. Finally, results indicated a significant preference for the marker *because* in situations of blockage if the tendency of the agonist towards motion was blocked by the antagonist, and *although* was preferred if the agonist managed to continue its path $\chi^2(1, N=25) = 6.82$, $p = 0.009$.

Altogether, this experiment showed that there is a consensus amongst subjects on the image-schematic basis of causal and concessive discourse markers. Subjects' consistent agreement in matching instances of effective and ineffective compulsion, attraction and blockage with the markers *because*/*porque* and *although*/ *aunque* respectively, provides empirical support for the thesis that various image schemas centred around the notion of force are accessed as part of the meaning ascribed to these connectives, in both English and Spanish. All in all, these findings point out that the agonist tendency, the relative strength of the agonist and the antagonist and the outcome of their interaction (i.e., motion or rest), are crucial for the categorization and

linguistic coding of an event as causal or concessive. Yet it could be argued that these results are motivated by the presence of force exerting verbs in the linguistic descriptions of the visual stimuli rather than by the fact that subjects' representation of causal and concessive connectives is underpinned by force dynamics image schemas. This aspect was investigated in our second experiment.

Experiment 2

The purpose of Experiment 2, which was conducted only in Spanish, was to test whether subjects' choices in Experiment 1 were induced by the presence of force-exerting verbs in the sentences used to describe the stimuli or by the interplay between the animations and the sentence connectives (i.e., *porque* 'because' and *aunque* 'although'). In other words, our aim in this experiment was to determine whether connectives encode force dynamics themselves. To examine this possibility, we used the same methodology as in Experiment 1. However, in this case, lexical allusions to force were avoided. The force-exerting verbs that appeared in Experiment 1 were now omitted so that the linguistic description of the events depicted by the visual stimuli did not contain any literal reference to the notion of force. Thus, an important component of the experiment described herein implies testing for the force dynamic representational format of causative expressions in an arena of language that does not exhibit any literal forceful properties: causal and concessive connectives exclusively.

Method

Participants

Thirty undergraduates at the University of Barcelona took part in this experiment. All subjects were native speakers of Spanish and they were naïve as to the aim of the specific experimental question. As in Experiment 1, each participant judged the effectiveness of a set of sentences to describe the content of 27 dynamic displays.

Materials

The stimuli used here were the same as in Experiment 1, except for the fact that the sentences were manipulated to include a nonce verb in their coda, which replaced the force-exerting verbs used in the previous experiment, e.g., *El coche verde cruzó la intersección porque el coche amarillo lo planqueó* ('The green car crossed the intersection because the yellow car [nonce verb] it.) vs. *El coche verde cruzó la intersección aunque el coche amarillo lo planqueó* ('The green car crossed the intersection although the yellow car [nonce verb] it).

Nine nonce verbs were finally selected after a norming study in which 20 invented words were presented to 15 native speakers who were asked to write the three most likely meaning of each word (see Table 5). The data was created using the guidelines of the program "Cognitiva.Lectoescritura", which has been designed to assess processes of attention, visual discrimination, decodification, and assimilation of Spanish syllabic structure in children. The resultant verbs consisted of a minimum of two syllables that followed orthographical rules and met the most common syllabic structures in Spanish, cv, cvc, ccv, in accordance to their phonotactic constraints (Alarcos Llorach, 1950).

NONCE VERBS LIST

Plucar	Trafegar	Llumir
Trondear	Dispearse	Trondar
Planquear	Vimar	Bandar

Table 5. Nonce verbs

Procedure

The method of stimulus presentation and response was the same as in Experiment 1.

Results

Results revealed a pattern of response similar to that in Experiment 1. As shown in table 6, when the agonist showed resistance to move but ultimately did so due to pressure from the antagonist, participants mainly chose sentences whose subordinate clause was headed by the causal marker *porque*. However, for events that depicted ineffective compulsion, attraction or blockage, participants generally chose sentences containing the concessive connector *aunque* as the best description of the event. The chi-square test of independence confirmed that the association between the configuration of forces depicted by the videos and subjects' responses was significant χ^2 (2, $N = 30$) = 56.760 p <0.00 and, therefore, the likelihood that participants' choices agreed with the predictions of the force dynamic model by chance alone was less than 0.0%.

	CAUSE			CONCESSION			
Configuration of forces	Compulsion	Attraction	Blockage	Ineffective Compulsion	Ineffective Attraction	Ineffective Blockage	Unclassifiable
Porque	93.33%	98.33%	92.22%	-	-	-	-
Aunque	-	-	-	85%	83.3%	65.3%	-
Ninguna	-	-	-	-	-	-	69%

Table 6. Percentage of Times Spanish Speakers Correctly Chose Each of the Three Possible Options for Each of the Configurations of Force

As in Experiment 1, the Pearson chi-square test showed that subjects' choices were significantly related to specific force patterns. Thus, for causative vs. concessive compulsion the result was positive $\chi^2(1, N=30) = 54.31$, $p = 0.037$. For causative and concessive attraction, the relation was also significant $\chi^2(1, N=30) = 8.11$, $p = 0.004$, with participants selecting *porque (because)* when the antagonist overcame the agonist's resistance to movement by pulling on it and *aunque* 'although' when the agonist resisted the tugs of the antagonist. Finally, for causative and concessive blockage, findings were also significant $\chi^2(1, N=30) = 20.46$, $p = 0.001.$, with participants choosing *porque* when the antagonist completely blocked the agonist, and selecting *aunque* when the antagonist only hindered the agonist's way.

This consistency between participants' responses in experiments 1 and 2 suggests that the same image-schematic representations were being accessed by subjects in the force-exerting verb-present vs. force-exerting verb-absent versions of the experiment; and that choice connective bias was not conditioned by the simultaneous incidence of other lexical items (i.e., verbs) that elicited the notion of force. In fact, that subjects' choices in experiment 2 were only guided by the presence of a causal or concessive connective —the subordinate clause contained a

nonsense verb, which provided no information about the type of forceful interaction between the agonist and the antagonist— reinforces the hypothesis that causal and concessive connectives independently act as pointer to force dynamic relations.

All in all, experiment 2 is consistent with the idea that discourse markers are not lexically empty function words but are actually semantically rich concepts, which in the particular case we are dealing with remit to our knowledge of force dynamics by anticipating the relative strength of the antagonist and the intrinsic tendency of the agonist (Talmy, 1988). So, causal connectives introduce a stronger antagonist, while concessive connectives announce a weaker antagonist. This way they determine readers' expectations about what is going to come next and restrict the possible range of connections that can be established.

Discussion

Taken together, the present study emphasizes the embodied representational basis of causation and concession by empirically corroborating that between subjects there is a coherence to the image-schematic basis of the conceptual representations of causative and concessive discourse markers. Taking as a starting point the theories of image schemas and force dynamics, in two experiments we attempted to tap the explicit components of these representations and proved that by priming subjects with animations that represented force-dynamic patterns, we could elicit specific linguistic preferences from the experimental subjects in a choice context. Hence, subjects showed a systematic preference for clauses that contained causal connectives when they perceived the interactions depicted in the animations as successful instances of exertion of force. By contrast, they preferred concessive markers if the outcome of those interactions was not successful. On the one hand, these results show that subjects share the

intuition that the conceptual representation of causative and concessive discourse markers is grounded in force dynamic image schemas; and, on the other, they sustain the thesis that at least the relations of compulsion, attraction and blockage may be prompted not only by causal verbs, as shown by Wolff and Zettergren (2007), but also by connectives.. In fact, our second experiment demonstrated that, in the absence of any literal reference to the notion of force, subjects were able to infer specific forceful relations between consecutive sentences only guided by a causal or concessive marker. This fact reinforces the hypothesis that these connectives encode force-dynamic relations on their own and, therefore, they can be semantically typified along the same basis as causal verbs although the semantic information that connectives can provide is more vague and abstract than that of open-class words —they mainly anticipate the relative strength of the antagonist, as Talmy (1988) asserted—. This information, though quite schematic, can guide us on how conceptually integrate the components of a sentence thanks to the fact that, as inferred from people's responses in this study, connectives prompt for force dynamics image-schematic. Thus, our embodied knowledge of the consequences associated with forceful interactions imbues connectives with meaning and enable us to make predictions; this way the processing constraints imposed by connectives get their meaning. In this respect, the semantic characterization of causal and concessive connectives is not completely different from that of the open class words (causal verbs, for example); both act as pointers to concepts that have corporeal import.

Our findings are just the starting point to investigate causal and concessive relations. Obviously, the relationship between causation/concession and force dynamics merits further investigation to clarify how the different interpretations of these connectives are derived.

Moreover, considering the fact that causation seems to be a radial category with the volitional application of physical force to an object as the central prototype (Lakoff & Johnson, 1999), it is essential to analyse more peripheral and metaphorical extensions of this category. Thus, among others, empirical tests to examine the role of embodied experience and conceptual metaphor in the representation of psychological and social causal relations are needed. Such experiments should investigate the claim that physical force patterns extend to intra- and inter-psychological force interactions by metaphorical analogy.

Appendix A

Linguistic stimuli in Experiment 1

1. Effective compulsion

1. a. The green car crossed the intersection because the yellow car hit it from behind. (Congruent).

1. b. The green car crossed the intersection although the yellow car hit it from behind. (Incongruent).

2. Effective attraction

2. a. The yellow car moved because the green car pulled on the rope. (Congruent).

2. b. The yellow car moved although the green car pulled on the rope. (Incongruent).

3 Effective blockage

3. a. The green car came to a halt because the yellow car stopped in the middle of the intersection (Congruent).

3.b. The green car came to a halt because the yellow car stopped in the middle of the intersection (Incongruent).

4. Ineffective compulsion

4. a. The green car couldn't move forward because the yellow car pushed it. (Incongruent).

4. b. The green car couldn't move forward although the yellow car pushed it. (Congruent).

5. Ineffective attraction

5. a. The yellow car didn't move because the green car pulled it. (Incongruent).

5. b. The yellow car didn't move although the green car pulled it. (Congruent).

6. Ineffective Blockage

6. a. The green car could cross the intersection because the yellow car blocked the street. (Incongruent).

6. b. The green car could cross the intersection although the yellow car blocked the street. (Congruent).

Appendix B

Linguistic stimuli in Experiment 2

1. Effective compulsion

1. a. El coche verde cruzó la intersección porque el coche amarillo lo planqueó.

1. b. El coche verde cruzó la intersección aunque el coche amarillo lo planqueó.

2. Effective Attraction

2. a. El coche amarillo se movió porque el coche verde lo vimó.

2. b. El coche amarillo se movió aunque el coche verde lo vimó.

3. Effective blockage

3. a. El coche verde se detuvo porque el coche amarillo lo trafegó

3. b. El coche verde se detuvo aunque el coche amarillo lo trafegó

4. Ineffective compulsion

4. a. El coche verde no pudo avanzar porque el coche amarillo lo trondeó

4. b. El coche verde no pudo avanzar aunque el coche amarillo lo trondeó

5. Ineffective attraction

11.1. a. El coche amarillo no se movió porque el coche verde lo vimó

11.1. b. El coche amarillo no se movió aunque el coche verde lo vimó

6. Ineffective Blockage

6. a. El coche verde pudo cruzar la intersección porque el coche amarillo trafegó la calle.

6. b. El coche verde pudo cruzar la intersección aunque el coche amarillo trafegó la calle.

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