Fictive Motion in Spanish: Travellable, non-travellable and path-related manner information

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This work is part of an on-going research (Rojo & Valenzuela 2002, 2004a, 2004b, 2006) aimed at elucidating the factors that enable a scene to be described in fictive motion terms. The purpose of the present study is to investigate the psycholinguistic reflection of two linguistic distinctions that occupy a prominent place in the literature on fictive motion (Matsumoto 1996). Our first experiment involves a self-paced reading task in which the grammatical subjects of fictive motion expressions are either "travellable" (e.g., paths, roads, etc.) or "non-travellable" (e.g., walls, fences, etc.). Our results show that Spanish speakers are sensitive to this travellable/non-travellable distinction, non-travellable objects being harder to process. In a second experiment, we investigate the types of manner information that can be included in a verb describing a fictive motion scene. According to Matsumoto's Manner Condition, when a fictive motion expression uses a manner-conflating verb, the information on manner conveyed by the verb must be path-related (that is, the manner of motion should describe some shape in the displacement). In order to test this condition, another self-paced reading task was designed in which Spanish participants read sentences which included verbs with path-related manner information (e.g., *to zig-zag*) or non-path-related manner information (e.g., *to roll*). Our results reveal that verbs including non-path-related manner information were harder to process.

KEYWORDS: Fictive motion, travellable/non-travellable distinction, types of manner of motion information in fictive motion

1. Introduction: fictive motion as mental simulation

Fictive motion (a.k.a. *abstract* motion (Langacker, 1987) or *subjective* motion (Matsumoto, 1996) is a label that has been applied to those cases in which verbs of motion are used but no real, physical movement occurs (Langacker 1987, Matsumoto 1996, Talmy 2000). Compare, for instance, the real movement described in (a) *Tarzan climbed to the top of the hill*, where Tarzan actually changes his physical location from the bottom to the top of the hill, with (b) *the path climbed to the top of the hill*, where the path does not move in any physical (or metaphysical) way. In the type of Fictive Motion Expression (FME) such as that of (b), the displacement is 'mental' rather than real, that is, when reconstructing the scene evoked by the sentence, the hearer mentally traces a given object in a certain direction. In these cases, the fictive motion expression signals

> "the direction of a mental scanning performed by the conceptualizer in building up the mental representation of the situation. The position of an elongated entity is represented gradually, as if mentally proceeding along the entity". (Huumo, 2001)

The phenomenon of fictive motion is particularly interesting because it is one of the cases in which the notion of "mental simulation" can be more clearly seen into action. This is specially relevant for the on-going debate between the two main versions of knowledge representation: the amodal-system view and the embodied-view. Currently, one of the basic assumptions about the format into which knowledge is represented in the human mind, has been challenged. The classic view, known as the "symbolic" view[1], stated that perceptual information coming through the different modalities (e.g., vision, smell, etc.) is transduced in the brain, and converted to a different format, this time not connected to any particular perceptual modality (hence its other name of "amodal systems"). It is on this "digital" format, whose internal structure is unrelated to the perceptual state which produced them, that thought processes like memory, reasoning or language are carried out. According to this view, the main goal of cognitive studies should be to study the computational properties of these amodal, disembodied systems.

On the contrary, the challengers to this "symbolic" theory have vindicated the role of embodiment in cognition: to this other line of research, information in the brain is never completely divorced from its modality-origin, and knowledge is therefore analogical and not digital. Cognition shares systems with perception at all levels of functioning, even in high-level processes like reasoning or language. Authors like Barsalou (Barsalou 1999, 2002) with his Perceptual Symbol Systems theory, Glenberg (1997) or Zwaan (1999) are some of the most conspicuous defenders of this view[2]. For these theorists, understanding language engages perceptual or motor systems for the purpose of mentally "simulating" the content of a given utterance. The connection between language understanding and motor systems of the brain has been shown experimentally in many studies (e.g., Pulvermüller *et al*., 2001; Glenberg & Kaschak, 2002; Hauk, 2004; Bergen & Wheeler, 2005).

In the realm of motion, there are also some relevant studies that support simulation theories. For example, Zwaan *et al*. (2004) presented participants with pairs of pictures and they had to decide whether the two objects were the same or not. Before completing the task, they heard a sentence that implied mo-

1 Other related names are the Physical Symbol Hypothesis (Newell & Simon, 1976) or Amodal Symbol Systems (Fodor 2006).

2 Bergen & Chang (2005)'s Embodied Construction Grammar is an attempt at establishing close connections between a grammatical component and a semantic component within a simulation-based model

tion towards them (e.g., *the pitcher hurled a ball at you*) or away from them (e.g., *you hurled a ball at the pitcher*). Then they saw one picture describing the object (in this example, a ball), and 500 ms later a second picture of the ball was presented, which was either slightly bigger or slightly smaller (suggesting motion towards or away from the participant). Participants were quicker to decide that both objects were the same when the motion described in the sentence matched the direction implied in the sequence of pictures. Kaschak *et al.* (2005) presented a variant of this experiment; participants had to judge whether a sentence made sense or not while simultaneously watching a line animation that suggested motion. The animations were a spiral (that could suggest motion towards the viewer or away from him/her) and a series of horizontal lines ("moving" either upwards or downwards). This time, when the sentence implied the same direction of motion as the visual percept, the reaction times were slower. The explanation provided by the authors suggests that in this case, the fact that the neurons responsible for the processing of a certain direction of motion are engaged in its visual processing, makes them less available for the construction of the linguistic simulation, and thus, reaction times in matching cases become bigger. In a further experiment, the same authors (Kaschak *et al*., 2008) were able to obtain similar results, but this time using auditory probes (that is, clips of sound that suggested upwards or downwards motion or motion towards or away from the speaker).

Not only has "implied motion" been shown to activate motor areas in the brain. Wallentin *et al*. (2005) show that reading a fictive motion sentence activates the left posterior middle temporal region, responsible for the processing of complex action knowledge and sensitive to "implied motion" (as for example, in still pictures depicting motion). They presented subjects with four types of sentences, crossing human and inanimates subjects with static or dynamic readings (e.g., *the man/pipe goes into/lies within the house*). The results showed that this brain area was activated even in the cases where no real motion was ocurring (i.e., the fictive motion cases). Their interpretation of the results suggested that in these cases, the hearer somehow applies motion to the scenario depicted by scanning it egocentrically.

Fictive motion has also been examined psycholinguistically. Matlock (2004a) gave subjects a number of stories which depicted some kind of travel. The type of travelling described in the stories could vary along three dimensions: fast vs slow travel, long vs short, and through easy or difficult terrain. After reading one of these stories, participants were presented with a fictive motion sentence related to the story. This sentence was read faster when the stories had involved fast, short and easy-terrain travel, in opposition to slow, long or difficult terrain travel stories. This is taken as evidence that participants are effectively simulating motion in their minds. Another study by Matlock (Matlock

2006) had participants making drawings of fictive motion sentences. Matlock gave a group of participants a number of sentences depicting a given scene using fictive motion (e.g., *The pond runs between the barn and the corral*). The other group of participants was given a variant of the sentence which used no fictive motion (e.g., *The pond is between the barn and the corral*). Both groups were asked to make a drawing of the scene depicted in the sentence. Participants who had been given a fictive motion version tended to draw longer objects (e.g., a longer pond) than those that had been given a non-fictive motion sentence.

Finally, there is also evidence that hearing a fictive motion description affects the way in which we look at the scene described, that is, it affects our eye movements by evoking mental representations of motion. Thus, Matlock and Richardson (2004) presented participants with drawings of paths such as roads, rivers and pipelines. Then, they heard descriptions of these paths which involved either fictive motion or non-fictive motion sentences (e.g., *the road runs through the valley* vs *the road is in the valley*) while their eye-movements were being tracked. The authors found out that when the descriptions involved fictive motion sentences, participants spent more time inspecting the path area. Also, Richardson & Matlock (2007) found that if participants were given information that suggested that the motion could be more or less difficult (e.g., through easy or difficult terrain), this influenced the way in which they looked at a picture when it was described with fictive motion. Thus, the time spent looking at the path, as well as the eye movements scanning along the path were higher during fictive motion descriptions when the terrain was described as difficult (e.g., *The desert is hilly*) than when the terrain was described as easy (e.g., *The desert is flat*). Such effects only appeared when the description of the scene involved fictive motion sentences, demonstrating that processing fictive motion evokes a mental representation of motion.

2. Linguistic studies of Fictive Motion.

From a linguistic point of view, there has been a widespread interest in crosslinguistic studies of motion; a substantial number of studies have been devoted to examining Talmy's seminal distinction between path vs manner languages (Talmy, 1975, 1978, 1983, 1996). Most of these studies adopt a crosslinguistic perspective (Brown, 2001; Choi & Bowerman, 1991), English and Spanish being in fact two of the most frequently compared languages (Aske, 1989; Naigles & Terrazas, 1998; Naigles *et al.*, 1998; Slobin, 1996).

The study of motion has also been extended to the related area of fictive motion, which has also been explored from a crosslinguistic perspective (albeit with a more restricted scope). Thus, Matsumoto (1996) focused on establishing crosslinguistic differences in the fictive motion expression of English and Japanese. He detected a number of interesting similarities and differences in English and Japanese Fictive Motion Expressions (FMEs). He summarized the similarities between both languages in two types of conditions he formulated as the PATH and the MANNER condition. Briefly, the PATH condition states that in FMEs some property of the path must be necessarily expressed. Thus, a FME must always include some path-related information, which may be either encoded in the verb or conveyed by some adverbial or adpositional phrase. Consider then the examples in (1):

(1) a. * The road runs
b. The road runs along the coast
c. The road began to ascend/descend

Comparing (1a) and (1b), it can be seen that *run* needs an adverbial expressing some property of the path for its proper use in fictive motion. On the contrary, when the verb incorporates some information on the path, as the verbs *ascend* and *descend* in example (1c), no complement is required. This condition does not appear to be controversial, since a FME is actually a prompt for the computation of a "mental path", an invitation for the hearer to "scan sequentially" the length of a given object in a certain direction, and thus the linguistic presence of a path seems consubstantial and indispensable to these expressions.

The MANNER CONDITION is perhaps a bit more questionable. Matsumoto states that when a manner-conflating verb participates in a FME, the information on manner conveyed by the verb must be somehow related to some specific feature of the path. Literally, he states that "no property of the manner of motion can be expressed unless it is used to represent some correlated property of the path" (Matsumoto, 1996: 213). Consider, for example, the sentences in (2):

(2) a. The cyclist zig-zagged along the valley
b. The path zig-zagged along the valley

In (2a), the verb *zig-zag* provides information about the manner in which the motion is carried out by a human agent. However, when the subject is an inanimate object, as in (2b), no physical motion is performed and this information is therefore related to the overall shape of the path. In some cases, the information can make reference to other aspects of the path, such as its gradient or slope. This can be seen in (3):

(3) a. The road plunged downhill
b. The road inched uphill

The verb *plunge* in (3a) includes information about the manner of motion (specifically, speed); such information can be readily mapped onto the slope of the road, so that we understand that the road was very steep. Conversely, the verb *inch* means roughly ‘to move slowly and carefully’; in the example (3b), this information is again mapped onto the slope of the road, which becomes gentle, increasing its elevation slowly.

Some manner verbs participate more readily in FMEs than others, depending on how easily their information is mapped onto details of the path which the conceptualizer must imagine. So, verbs such as *zig-zag* or *snake* make a very clear reference to the overall shape of the path (cf. example 4a). Others, such as *slide* or *roll* seem harder to relate and are therefore less natural in these contexts (e.g. example 4b).

(4) a. The path zig-zagged/snaked up the hill
b. ??The path slid/rolled up the hill

Regarding differences between English and Japanese FMEs, Matsumoto notes that, while in English all paths are in principle amenable to a FM description, in Japanese, certain objects cannot participate in FMEs; only objects which relate to “travellable paths”, i.e. paths that would normally be travelled by people (Type 1 for Matlock 2001), can participate in a FME[3]. Non-travellable paths, that is, linear objects onto which an image of human motion is not normally projected, such as walls, telephone lines, wires, etc. (Type 2 for Matlock 2001), are perfectly fine in English FMEs, but unacceptable in Japanese. Japanese verbs cannot be used to represent untravellable paths because the description of this type of paths requires a high degree of abstraction and Japanese motion verbs usually demand a high degree of concreteness.

The present work aims to test whether the difference reported by Matsumoto for English and Japanese with regard to the distinction between ‘travellable’ and ‘non-travellable’ subjects also applies to Spanish, and whether this linguistic distinction has a psycholinguistic counterpart. In order to test this difference, an experiment is designed which attempts at checking whether a fictive motion description of a scene which includes a travellable object is easier to imagine that one involving a non-travellable object. Thus, the basic assumption is that difficulties in constructing a mental image from a fictive motion sentence can be related to the type of entity submitted to a fictive motion description. Our

3 Matsumoto mentions another difference in the expression of some Japanese constructions, which concerns specific aspectual characteristics of verbal constructions in this language. However, these differences, being language-specific and pertaining specifically to Japanese, are outside the scope of this paper.

study also aims to investigate whether difficulties in processing fictive motion can also be related to Matsumoto's Manner Condition and whether this condition applies to Spanish. To this purpose, a second self-paced reading task is designed in order to check whether non-path related information is in fact harder to process than path-related information.

3. Experiment 1: Travellable vs. non-travellable subjects in Spanish

3.1. Participants

Forty-four Spanish native speakers volunteered to participate in the experiment. All of them were undergraduates from the Psychology Degree at the University of Murcia (Spain), with normal vision or corrected to normal. Twenty-eight were male and the rest female. Their mean age was 23.15. They received course credit for their participation

3.2. Materials

A set of sixteen experimental sentences were created which depicted some type of fictive motion scene. Out of these sixteen stimuli, eigth had subjects that were classified as travellable entities (e.g., *the path climbed to the top of the* hill) and eight as non-travellable entities (e.g., *the pipe*….).

- *Travellable subjects:* carretera (*road*), camino (*path*), sendero (*track*), jardín (*garden*), pradera (*field*), valle (*valley*), bosque (*forest*), sierra (*mountain range*).

- *Non-travellable subjects:* pared (*wall*), muro (*wall*), alambrada (*wire fence*), tubería (*pipe*), tendedero (*clothesline*), línea de árboles (*line of trees*), precipicio (*precipice*), frontera (*frontier*).

Each experimental sentence (i.e. each fictive motion sentence) was counterbalanced with a real motion equivalent, read by a different participant group (Group B).

A	Exp	El valle ascendía lentamente hacia el norte (*The valley ascended slowly towards the north*)
	Con	El autobus ascendía lentamente hacia el norte (*The bus ascended slowly towards the north*)

B	Exp	El muro bajaba por la colina hasta el lago (*The wall descended downhill up to the lake*)
	Con	La liebre bajaba por la colina hasta el lago (*The hare descended downhill up to the lake*)

Table 1. Experimental vs. control sentences in Experiment 1

3.3. Procedure and task

The task used was a self-paced reading task to be performed on a computer screen. Participants were instructed to read (and understand) a sentence, which was divided into four chunks or periods. To see the next period, they had to press the spacebar, as illustrated in the following drawing:

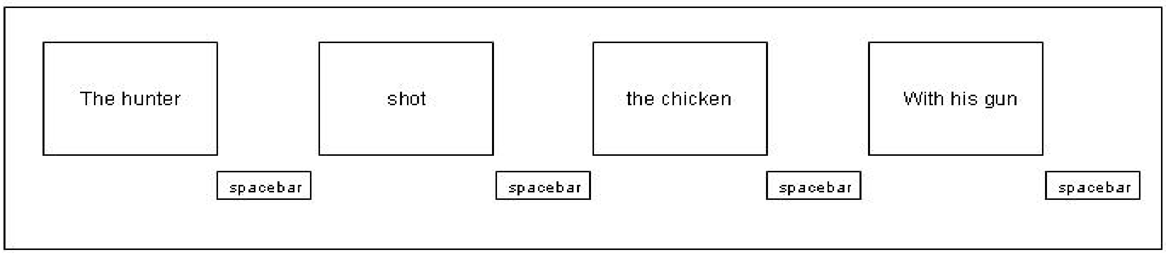

Figure 1. Experiment 1 stimulus display

To ensure proper reading and understanding of the sentences they were presented with, participants were shown a picture after each block of four sentences and were asked whether the picture corresponded to any of the sentences they had seen in that previous block. In this way, they were forced to mentally "visualize" (or "simulate") the image of the fictive motion sentences. For example, after reading a block of sentences such as this:

1. The dog chased the cat all over the garden
2. The hunter shot the chicken with his gun
3. The road ran up the mountain through the forest
4. The lorry parked in the square in front of the kiosk

participants were shown the picture that appears in Figure 2 below:

Figure 2. Sample illustration used in Experiment 1 to ensure understanding

After the drawing, they had to answer the following question: *Does this drawing correspond to any of the previous sentences (y/n)?* (in Spanish, ¿Se *corresponde este dibujo con alguna de las oraciones anteriores?*). The pictures were the same for both groups, and thus, always corresponded to filler sentences.

A number of distractors was also included, so that out of the four sentences that were read in each block, one was an experimental sentence (i.e., fictive-motion), another one was a control (i.e., real motion) sentence and two were fillers:

Exp	*The road ran up the mountain*
Con	*The truck went down the hill*
Fill	*The dog chased the cat*
Fill	*The cat caught a mouse*

Table 2. Structure of the blocks read by participants, with experimental, control and filler sentences

3.4. Results

When looking at the difference found between experimental and control sentences in the two conditions, our results showed that sentences with non-travellable subjects took longer to read than those with travellable subjects (122 vs 46 ms), this difference was found significant in a paired t-test ($p < 0.05$):

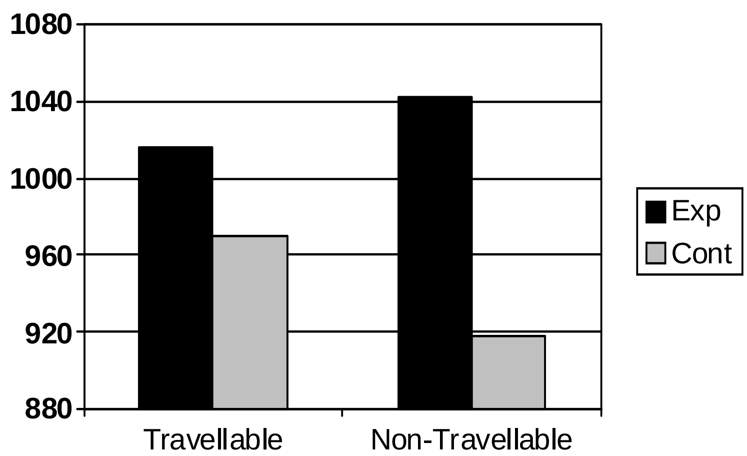

Figure 3. Travellable vs non-travellable reading times

Non-travellable subjects were further grouped into three different categories (vertical-2D, lines and surfaces) in order to analyze possible differences between the different types of subjects. Our results suggested that the non-travellable subjects which took longer to process were ‘vertical’ ones (e.g. *wall*, *wire fence*), as can be seen in Figure 4 ($p < 0.05$ in a paired t-test):

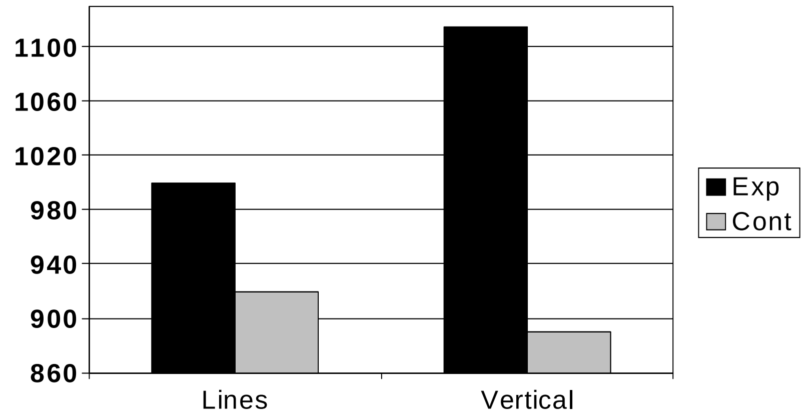

Figure 4. Different types of non-travellable subjects in Spanish

4. Experiment 2: Path-related manner verbs vs non-path related manner verbs

As stated earlier on, the second experiment focuses on the differences between path-related and non-path related manner verbs. More specifically, it aims to study whether Matsumoto’s Manner Condition affects Spanish FM verbs in the same way as English and Japanese.

4.1. Participants

The participants were 64 Spanish native speakers, all of them undergraduates from the English Degree at the University of Murcia (Spain), with normal vision or corrected to normal. Fifty one were female and the rest male. Their mean age was 22.4. They received course credit for their participation.

4.2. Materials

A set of twelve experimental sentences were created depicting fictive motion. Out of these twelve stimuli, six had verbs that were classified as path-related manner verbs (e.g., *the path climbed to the top of the* hill) and six as non-path related manner verbs (e.g., *the pipe*….):

- *Path-related manner verbs:* reptar (*slither*), culebrear (*snake*), zigzaguear (*zigzag*), deambular (*roam*), vagar (*wander*), precipitarse (*fall*)

- *Non-path related manner verbs:* deslizarse (*slide*), rodar (*roll*), apresurarse (*hurry*), embalarse (*dash*), trotar (*trot*), arrastrarse (*crawl*)

As in Experiment 1, each fictive motion sentence was counterbalanced with a real motion equivalent, read by a different participant group (Group B). The difference with Experiment 1 was that in this experiment the sentences were divided into three syntactic periods instead of four. One period was supressed to avoid giving clues about the path of motion.

A	Exp	El sendero reptaba hacia la cima (*The path snaked towards the hill*)
	Con	El vehículo reptaba hacia la cima (*The vehicle snaked towards the hill*)
B	Exp	La autopista rodaba en dirección a Madrid (*The highway rolled towards Madrid*)
	Con	La moto rodaba en dirección a Madrid (*The motorbike rolled towards Madrid*)

Table 3. Experimental vs. control sentences in Experiment 2

4.3. Procedure and task

The procedure of Experiment 1 was replicated; participants were divided into two groups; one group read an experimental sentence (with a manner verb and a FM subject) and the other group read its "control" counterpart, the same sentence in a 'real motion' context; they were also shown some drawings to ensure correct understanding of the sentences after each block, which again consisted of an experimental sentence, a control one and two fillers.

4.4. Results

When looking at the difference between experimental and control sentences, our results showed that participants took longer to read sentences with non-path related manner verbs than with manner related ones, a difference that was found significant with a paired t-test ($p < 0.05$; see Figure 4):

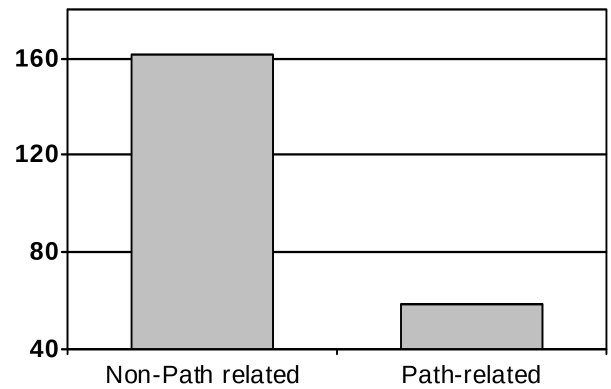

Figure 4. Difference between experimental and control sentences for sentences including non-path related and path-related verbs

In order to locate the manner features that were harder to relate to any specific feature of the path, non-path related manner verbs were grouped into three different categories: ease of progress, speed and motor pattern. As can be seen in Figure 5 below, verbs of motor pattern (e.g. *trot, crawl*) took longer to process than verbs of speed (e.g. *hurry, dash*) and verbs of 'ease' (e.g. *slide* and *roll*) (paired t-test, $p < 0.05$).

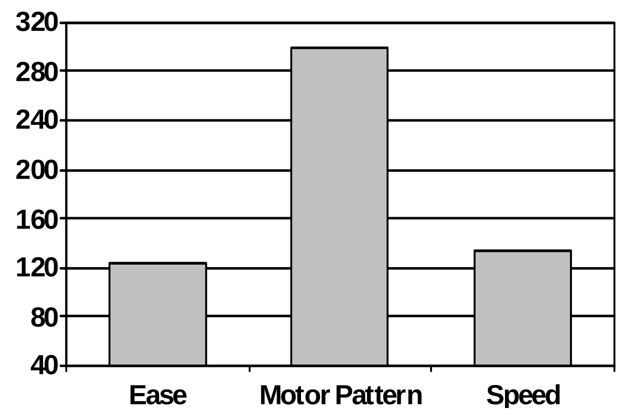

Figure 5. Reaction times of the different types of manner features in Experiment 2

5. General discussion and conclusions

In the present paper, we have looked at several pieces of empirical data concerning the expression of fictive motion in Spanish. We set out to examine (1) whether the distinction between travellable and non-travellable paths is relevant for Spanish, and (2) whether the Manner Condition affects the psycholinguistic processing of Spanish FM verbs. To achieve these aims, we have measured the reaction time of Spanish native speakers when carrying out two self-paced reading tasks.

In the first experiment, our results revealed that Spanish participants took longer to process FMEs with non-travellable sujects than those with travellable entities. This differential effect was found despite the fact that Spanish FMEs which involve non-travellable entities are perfectly grammatical (a fact that it is also observed in English in contrast to Japanese). In this respect, one wonders about the relation existing between the sensitivity of a language community to a given grammatical structure and its underlying processing demands. That is, when meeting a grammatical structure with a certain degree of processing difficulty (such as non-travellable paths in fictive motion structures), some languages could reject it as ungrammatical while others could be more tolerant.

It is well known that the expression of motion is language-specific: different languages zoom on different characteristics of the world to freely express space and motion (e.g., Brown, 2001; Choi and Bowerman, 1991). On the other hand, the tight constraints imposed by the highly specific task of mentally simulating motion in a static scene would seem to favour a more universal approach. The interesting question at this point is to know whether the travellable/non-travellable distinction, which has been proved to have grammatical reflexes in some languages and to be psycholinguistically relevant in others, is a language-specific trend or hints at a more universal constraint within this specific simulation task. To analyze this question, the way in which the mental simulation is carried out in fictive motion is highly relevant. The two possibilities that have been mentioned in the literature involve either the simulation of an imagined traveller which displaces himself/herself along the path described (e.g., imagining a car ascending when we hear the sentence "*the road goes up the mountain*") or the sequential scanning of the object (not necessarily involving any traveller), in such a way that we mentally trace the object from one point to another. In this case, the shape of the object must be taken into account, since this mode of scanning makes sense only for long objects. Both possibilities do not have to be completely separate; as a matter of fact, the first encompasses the second. That is, when we imagine a traveller going from one place to another, the (virtual) trajectory described by the displacement forms a long and narrow shape in our minds (as when we imagine the scene depicted in "*the road crosses the desert*"). The relative relevance of each of these factors is important, because if the traveller is the most important factor, then, the actual shape of the object (and the fact of whether it is travellable or non-travellable) becomes a more trivial element. Note that travellable paths, by definition, include both elements (an imagined traveller and also are inherently elongated), so they are bound to be adequate objects for a fictive motion description in any possible scenario.

Within non-travellable objects, some interesting differences between the various types of subjects analyzed were also found, since vertical-2D subjects took longer to process than the rest. This opens up the possibility of the existence of subtle differences in the type of objects amenable to fictive motion description in different languages. Again, further research would be required to see which types of objects can be described in fictive motion terms in other languages and which are the parameters that figure more prominently in these cases.

In the second experiment, we investigated the different types of manner information that could be included in Spanish fictive motion verbs. Our results indicated that, in fact, non-path-related manner verbs took longer to process than path-related ones, suggesting that Matsumoto's Manner condition is psychologically real. Again, this is coherent with the constraints that are thought to guide the mental simulation of fictive motion, both if the most important parameter in the simulation is the presence of a traveller or the elongated shape of the object to be described. In some of Matlock's examples (e.g., Matlock 2004b), manner of motion has also been related to ease of motion, and the speed with which an imagined traveller moves across the path (her examples are *The freeway races past the city* vs *Interstate-5 crawls through Los Angeles*). Again, further research would be needed in several languages to test whether the weight and function of the different notions that make up the complex notion of "manner of motion" are language specific or universally constrained by the task specificity.

To conclude, while there are still many details to be clarified regarding how fictive motion operates at a psycholinguistic level, this topic of research still remains as highly relevant for cognitive studies, since it is an area in which the interaction between the parameters of mental simulation and linguistic constraints can be insightfully investigated. It seems that fictive motion research will effectively help us to move towards that direction.

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