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SHORT REPORT

Variation in spatial language and cognition: exploring visuo-spatial thinking and speaking cross-linguistically

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Abstract Languages differ strikingly in how they encode spatial information. This variability is realized with spatial semantic elements mapped across languages in very different ways onto lexical/syntactic structures. For example, *satellite-framed languages* (e.g., English) express MANNER in the verb and PATH in satellites, while *verb-framed languages* (e.g., French) lexicalize PATH in the verb, leaving MANNER implicit or peripheral. Some languages are harder to classify into these categories, rather presenting *equipollently framed systems*, such as Chinese (*serial-verb* constructions) or Greek (parallel *verb-* and *satellite-framed* structures in equally frequent contexts). Such properties seem to have implications not only on the formulation/articulation levels, but also on the conceptualization level, thereby reviving questions concerning the language–thought interface. The present study investigates the relative impact of language-independent and language-specific factors on spatial representations across three typologically different languages (English–French–Greek) combining a variety of complementary tasks (production, non-verbal, and verbal categorization). The findings show that typological properties of languages can have an impact on both linguistic and non-linguistic organization of spatial information, open new perspectives for the investigation of conceptualization, and contribute more generally to the debate concerning the universal and language-specific dimensions of cognition.

Keywords Space · Language–Thought interface · Typology · Linguistic Variation · Spatial representations · Categorization · Motion events

Introduction

How do people apprehend motion from what they see? Is the way we think about motion closely related to how we talk? People can perceive and consciously apprehend space by dissecting different spatial components (i.e., shapes, colors, spatial relations). However, for motion events, when communicating, people use language in very different ways, selecting to encode only some aspects of motion while ignoring others. Talmy (2007) demonstrated that such variable coding of spatial properties exist across but also within language systems. In his framework, constructions that describe motion are classified according to whether they express PATH/MANNER components in surface elements: verb roots or satellites.[1] Depending on their lexicalization patterns, languages are classified either as *verb (V)-framed* (e.g., French)—languages that lexicalize PATH in the verb stem, leaving MANNER information implicit or placing it at the periphery of the sentence (example 1); or as *satellite (S)-framed* (e.g., English)—languages that lexicalize the MANNER of motion in the verb and use satellites (i.e., particles) to express PATH information within one compact structure (example 2).

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[1] According to Talmy, a satellite is a "grammatical category of any constituent other than a nominal complement that is in a sister relation to the verb root" (2007: 139).

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(1) *Il* ***entre*** *dans une maison* *(en courant).*
PATH MANNER
'He is.entering in[to] a house (by running).' (*V-framed pattern*)

(2) *A man* *is running* ***into*** *a house.*
MANNER PATH (*S-framed pattern*)

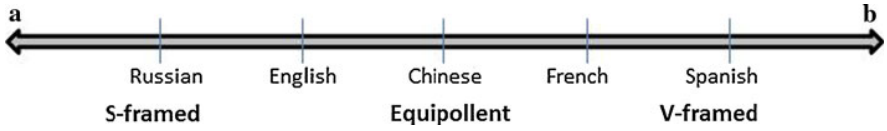

Fig. 1 Language classification along a bipolar continuum: **a** *left S-pole*; **b** *right V-pole* (inspired by Slobin 2004: 7)

Current typologies (e.g., Slobin 2004), tend to highlight the co-existence of *V-* and *S-framed* constructions in some languages (e.g., Thai, Mandarin Chinese, Modern Greek) for the expression of the very same motion event opting for a classification that forms a continuum (Fig. 1). Additional empirical investigation has confirmed such striking intra-typological variation concerning the adequacy of the *V-* and *S-framed* dichotomy and further suggests that lexicalization patterns have cognitive implications for the speakers of different languages (cf. Slobin's '*Thinking for speaking hypothesis*', 1996).

In this line of research, recent experimental studies report intra-typological variation as attested in the Modern Greek system (hereafter Greek), not only with respect to participants' verbalizations (Talmy 2007: 105), where both *S-* and *V-framed* patterns may be equally frequent (examples 3a, b), but also with respect to the attention allocation patterns as compared to those in other languages (English and French), suggesting that verbal and non-verbal performance may differ substantially as a function of language-specific factors (Soroli 2011).

However, some studies seem to contest such parallel *V-* and *S-conflations* in this language and consent that Greek is a clear *V-framed* system that preferentially lexicalizes PATH in the verb leaving MANNER implicit as the *inferable* subjective component that can heavily mitigated by inferential structures (Papafragou et al. 2006). Moreover, and despite evidence for extensive *S-framed* patterns in this language (Talmy 2007; Soroli 2011), such kind of variation seems superficial to some authors, additionally characterizing parallel conflations as "surface linguistic representations of events" that "cannot be taken too literally as indices of how speakers mentally represent aspects of their reference world" (Papafragou et al. 2006: B85).

In the context of this debate, the present paper investigates the way speakers not only talk about what they see but also how they categorize it, as an attempt to capture the processes involved at the conceptualization level (Levelt 1989). More specifically, the study addresses a series of general questions: Does linguistic encoding differ significantly across languages and what are the dominant patterns? If verbal performance differs as a function of language properties, is such an effect strong enough to have an impact beyond language use? How can typologically ambiguous languages inform us on language–thought relationships?

(3) a. ***Ανέβηκε*** *(τρέχοντας)* *στον τρίτο*
He.ascended running to-the third.[floor]
PATH MANNER (Greek *V-framed pattern*)

b. *Έτρεξε* ***πάνω*** *(στον τρίτο)*
He.ran up to-the third.[floor]
MANNER PATH (Greek *S-framed pattern*)

An additional issue relevant to this parallel *V-* and *S-framed* typological status of Greek is *prefixation* (Imbert 2008). Greek exhibits a set of preverbs of motion verbs (e.g., *ανα*, *κατα*, *εκ*, *εις*, in verbs like: *ανεβάζω* 'to up-put'; *κατεβαίνω* 'to down-walk/go'; *ξεγλιστρώ* 'to out-slide') which function as satellites for MOTION, PATH, and/or MANNER verb roots, forming a third type of conflation: a *prefixed S-framed pattern* (example 4).

(4) ***Ανέβηκε*** *(τρέχοντας)* *στον τρίτο*
He.up-walked running to-the third.[floor]
PATH + MANNER MANNER (Greek *prefixed S-framed pattern*)

Experimental prospectus and hypotheses

The design involved three tasks: a *non-verbal categorization*, where participants had to group visual stimuli

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together, a *production*, where they had to verbally describe what had happened in a series of visual stimuli, and a *verbal categorization task,* where participants had to decide which visual stimulus best corresponded to a sentence.

The study tested different general hypotheses: (a) according to the *universal* hypothesis, no major language effects should be found in either task; (b) according to the *linguistic relativity* hypothesis, variation should only be shown in participants' linguistic performance but not during non-linguistic tasks; or (c) according to the *linguistic determinism* hypothesis, language effects should be found in all measures, verbal and non-verbal, where speakers should be strongly influenced by the properties of their language for both the categorization and the verbalization of motion events.

Methods

Participants

The study included 42 native speakers of French, English, and Greek (14 per language). They were all native, monolingual speakers, above 18 years of age that reported no known (cognitive/psychiatric/language) disorder.

Materials, procedure, and coding

The material used in the experiments involved stimuli depicting voluntary motion events in which an actor performed a displacement that varied along different MANNERS (e.g., walking, jumping, riding a bicycle) and PATHS (up/down, into/out of, across/along). Testing started with the *non-verbal categorization* task, followed by the *production* task, and then by the *verbal categorization* task.

In the non-verbal categorization task (experiment 1), participants first saw a target video showing a motion event performed in a certain MANNER and along a certain PATH (e.g., a video with a man running into a house), which was then followed by two variants that differed from the target with respect either to PATH or to MANNER (e.g., a video with a man running out and a video with a man jumping into a house). Participants were asked to choose the variant that looked most like the target. The verbal categorization task (experiment 3) was exactly the same as the non-verbal categorization task, except that the target video was replaced by a target sentence presented auditorily. The rationale for these tasks was to analyze to what extent language has an impact on non-verbal performance (choice of MANNER vs. PATH criterion for event categorization) when language material is absent (non-verbal categorization) or actively involved (verbal categorization). Finally, in the production task (experiment 2), the analysis

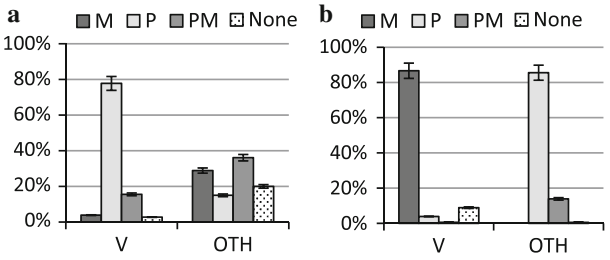

Fig. 2 Component types expressed across languages (**a** French; **b** English)

examined the types of information speakers selected to express (PATH, MANNER, or both) and the means (verbs or other devices) whereby they expressed this information. The Greek data were coded twice, once as a *V-framed* system and once as an *S-framed* system (see Hickmann et al. 2012).[2]

Results and discussion

For the production data, the prediction was that speakers should produce structures based on language-specific features; although they should express PATH in all three languages, participants should add MANNER more frequently in English than in Greek and French. English responses should contain MANNER verbs and other devices marking PATH, French responses should mostly contain PATH verbs and few other devices, while Greek should either demonstrate a preferential *V-framed* pattern, where PATH should be lexicalized and MANNER inferred, or equally encode MANNER and PATH in *S-* and *V-framed* constructions analogously.

As expected, French speakers mostly focused on PATH (P) information that was expressed in the verb (V) and either provided less information about MANNER (M) in the periphery of the sentence or did not use any other devices (OTH) in the verbal network to express this information (Fig. 2a). In contrast, English speakers used compact structures that expressed both PATH and MANNER information (PM) and in which they systematically encoded MANNER in verbs and PATH in other devices (Fig. 2b).

With respect to Greek, the pattern was rather complex: some utterances followed the typical *V-framed* lexicalization pattern (example 5), with the PATH component expressed in verbs and MANNER in peripheral devices (Fig. 3a); others followed a rather *S-framed* system of conflation, either by lexicalizing MANNER together with PATH adverbials (example

[2] The *V-coding* did not differentiate prefixed and plain verb forms, while the *S-coding* decomposed prefixed verb forms into a verbal root and a satellite-like verbal prefix. As a result, verbal prefixes were treated as part of the verb in *V-coding*, but not in *S-coding*.

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6), by double-marking PATH in cases where prefixation was involved (example 5 and Fig. 3b), or by showing another less-described pattern where MANNER preceded (in verbal/participle or adverbial form) the main verb root (examples in 7).

(5) *Ένας κύριος* ***μπήκε*** ***μέσα*** *κάνοντας πηδηματάκια*
A man entered inside doing small.jumps
PATH **PATH** MANNER

(6) *Κάνει τζόκιν* ***κάθετα*** *στο δρόμο*
He.does jogging across to.the road
MANNER **PATH**

(7) a. *Η κοπέλα με το ποδήλατο* ***διέσχισε*** ***κάθετα*** *τις ράγες*
The girl with the bicycle crossed across the railways
MANNER **PATH** **PATH**

b. *Η κοπέλα τρέχοντας,* ***δισχίζει*** *το δρόμο*
The woman running, crosses the street
MANNER **PATH**

With respect to the categorization tasks, the question was to determine whether language properties have an impact on categorical preferences. If so, participants should categorize events differently and follow the native patterns as ranging between the *S-* and the *V-poles* (see Fig. 1). French speakers should choose the PATH criterion, whereas English speakers should either choose the MANNER criterion (as the one lexicalized in this language) or show no preference for one or the other criterion (since both PATH and MANNER are typically and compactly encoded in this language). As for Greek, if lexicalization patterns are clearly *V-framed*, then Greek participants should mostly rely on the PATH criterion (closer to the *right V-pole*), and this to even a larger extent when language is involved in the task (verbal categorization). If, in contrast, *S-framed* patterns are deeply involved in the system and in the minds of Greek speakers, then MANNER choices should be either equally or more important than those of English speakers (thus closer to the *S-pole*), depending on the strength of the *S-framed* patterns and the extent to which such an involvement has been ingrained at the level of conceptualization.

The results show that participants categorize events with significantly different criteria: French participants selected mostly PATH as their criterion across categorization tasks, whereas English and Greek participants showed clear MANNER preferences during the verbal categorization task and no preference during the non-verbal task (Fig. 4a, b). More importantly, Greek participants did not choose PATH as their main categorization criterion, they did so to a lesser extent during the verbal version of the task when hearing sentences like (3a) (see Fig. 4a: Greek located between English and French), and even switched to a clear *S-framed* position when the task involved no verbal material (Fig. 4b: Greek on the left side of the continuum), suggesting that the *S-framed patterns* are rather deeply ingrained in the system and in speakers' spatial representations.

General discussion and conclusions

Overall, the data showed that participants' verbalization and categorization processes differed substantially as a function of language-specific factors, excluding the initial

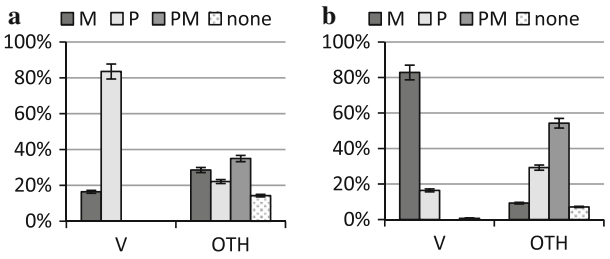

Fig. 3 Component types expressed in Greek. **a** V-framed coding; **b** S-framed coding

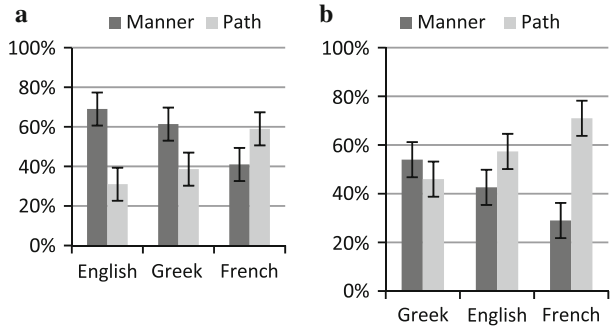

Fig. 4 Categorical choices across languages and categorization tasks. **a** Verbal; **b** Non-verbal categorization

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universalist hypothesis. With respect to language use, as expected, English, French, and Greek speakers focused on different semantic components, expressing them in different loci and with different syntactic constructions. The study went beyond language use in order to investigate the impact of the language factor for cognition and to measure its relative weight. The data from the categorization tasks provided us such non-linguistic measures allowing some access to the conceptualization level and clarifications with respect to the degree of the impact language has on our visuo-spatial representations. Evidence from Greek, a language with doubtful typological status, shed more light on the complex mechanisms that relate language to thought. The co-existence of *V-* and *S-framed* patterns, as attested across tasks, revealed that this language is far from being a clearly *V-framed* system as previously claimed and that shares some deep properties with *S-framed* systems, locating this language in an intermediate position along the typological continuum. The findings that emerge from this research do not support any simplistic hypothesis and indicate the need for the formulation of more precise and subtle views across different languages for more representative typological classifications, as well as for deeper investigations of the implications language may have on thought.

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