Spatial language and spatial representations in agrammatism: evidence from non-verbal tasks and eye-movements

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Abstract
Languages show striking differences in how they encode motion. They are classified into those expressing syntactically objective components of motion (Path), and those lexicalizing it. Such typological properties raise questions concerning the language-thought interface and aphasiology, where little is known about universal vs. language-specific aspects of spatial representations and language use. This study investigates how speakers of typologically different languages with and without agrammatism allocate attention (eye-movements) when categorizing motion events and when encoding them verbally. The findings suggest that typology should account for the language-thought interface investigation and for aphasiology as a factor that can affect performances in various levels.

Keywords: Motion events, categorization, spatial language, typology, agrammatism, eye-tracking

Introduction
Recent typological and crosslinguistic research has begun to examine the implications of linguistic diversity for human cognition [1] in normal as well as in pathological states [2]. More specifically, in the domain of space, languages are found to encode lexical and syntactic structures in strikingly different ways (satellite-framed vs. verb-framed languages) [3]. With respect to the expression of motion, languages are classified into: those expressing Manner (the subjective component of motion) in verb roots and Path (the objective component of motion) in satellites (e.g., English), see example (1); and those lexicalizing Path in the verb leaving Manner implicit or peripheral (e.g., French), see example (2).

(1)  The mouse climbs up the table
      Manner Path
(S-framed pattern)

(2)  La souris monte sur le pied de la table [en courant]
      Path  Manner
Lit. ‘The mouse ascends on the table leg [by running]’. (V-framed pattern)

Such striking cross-linguistic differences, apart from their typological interest [4], are significant for the study of the relationship between language and cognition [5], contribute to the debate opposing universalist approaches — according to which spatial cognition is based on universal, perceptual and cognitive processes that are independent from language-specific properties — and relativity approaches — according to which language-specific factors affect how speakers construct spatial representations — [6], and are of great interest for the investigation of the lexical vs. syntactic strategies of aphasic speakers during verbal encoding [7]. In this context, and despite a few cross-linguistic studies of aphasia [8], little is still known about universal vs. language-specific aspects of aphasia in language use and beyond [9].
The present study aims to determine the role of typological (language-related/typological) vs. language-independent (universal/syndrome-related) factors for cognition, in accounting for similarities and differences in the categorization, verbalization, and visual attention patterns of speakers with agrammatism and controls.

**Method**

In order to measure the relative role of language-independent and language-specific factors, we compared how several groups of speakers: English and French controls (N=40); English and French speakers with agrammatism (N=2), first categorize voluntary motion events presented visually (video clips) in a ‘Non-verbal’ Categorization task, then how they describe these events in a Production task, and finally how they again categorize those events in a ‘Verbal’ Categorization (sentence-contamination) task. The verbal and non-verbal data collected were all coupled with an eye-tracking paradigm.

In the non-verbal categorization task participants first saw a short target video showing a motion event performed in a certain Manner and along a certain Path (3a). The target video was then followed by two other videos, variants of the target that differed from it with respect either to Manner (3b) or to Path (3c). Participants were asked to choose the variant that looked most like the target and to press a key as fast as they could to indicate their choice. The verbal categorization task was exactly the same, except that the target video was replaced by a target sentence (verbal contamination).

(3)  
   a. Target Video/sentence: a woman roller-skating out of a building  
   b. Variant Video 1: a woman riding a scooter into a building  
   c. Variant Video 2: a woman roller skating out of a building

The analysis examined participant’s categorical preferences, their reaction times and their eye-fixations (frequencies and durations) performed to specific areas of interest corresponding to the main Path (p) or Manner (m) criteria, as illustrated in Figure 1.

--- figure 1 ---

With respect to the Production task, participants were asked to describe what had happened in the clips presented visually. The analysis examined the type of information expressed (Manner/Path), the linguistic means used (verbs/other devices), and the eye fixations to specific areas of interest in the clips corresponding to the main motion components (Path (P) and Manner areas (P+/−M)), as illustrated in Figure 2.

--- figure 2 ---
Results and discussion

The results from the production task confirmed the main V- vs. S-framed typological differences in the patterns of French and English control speakers: main focus on Path-component typically lexicalized in French; systematic lexicalization of Manner together with Path in the verbal network in English. With respect to speakers with aphasia, the French speaker either expressed no semantic information in his utterances or when selected one, he preferred to express Path in the verb and no other information in the periphery. In parallel, in English the participant mainly produced utterances expressing only one component (in contrast to the typical compact Manner+Path pattern) and encode either Manner or Path in the verb, and either only Path or no semantic information in peripheral devices.

The data from the production eye-tracking paradigm showed that, depending on the language group and irrespective pathology, spatial components were not only encoded differently, but also filtered visually in different way. French Path-fixations were more frequent than those performed by the English viewers on the same Areas, whereas, with respect to the time spent fixating these areas, participants’ fixations to the specific Path and Manner areas did not depend on the language factor.

The findings from the categorization tasks showed significant typological variation with respect to the categorical choices but not with respect to reaction times. Depending on their native language, participants were found to categorize events with significantly different criteria: French participants selected mostly Path as their criterion, English participants mostly Manner. With respect to the categorical choices of people with aphasia, there were no significant differences in the responses of the French or the English participants, as compared to the performances of their respective control groups.

Finally, the findings from the eye-tracking paradigm during categorization showed once more that motion components attracted participants’ visual attention to different degrees in both controls and speakers with aphasia. The analysis of the fixation frequency rates revealed a language effect in that, in both tasks French participants attended significantly to a greater extent to Path areas as compared to English participants. With respect to the time spent on different component-areas, a language effect was only found when auditory material was involved in the task (verbal categorization), with English participants fixating longer Manner-areas, as compared to the French speakers who spent significantly more time fixating Path-areas, as compared to the English.

Conclusion

We examined speakers’ verbal and non-verbal responses in various tasks that required speakers to construct representations of motion events. Overall, the results showed important differences in their linguistic verbalizations (production), but also in their representations beyond language use as revealed by non-verbal measures (categorical preferences, fixations). More specifically, findings showed language-specific variations in the encoding patterns across control participants, but only a partial language effect on the verbalizations of speakers with agrammatism. Significant
language variation was found in the categorical choices and the fixation counts of both the categorization and production tasks, but only partial effects for the durations. These findings support a moderate relativistic/typological view and rather indicate the need for additional research directions before definitive conclusions can be reached. It is clear that the use of multiple methodologies, and the account for multiple factors are essential in order to deeply investigate how language relate to thought and what is the relative impact of language- and syndrome-related factors for the cognitive processes involved in aphasia.
References


Figures

Figure 1. Areas of interest in the variants presented during the categorization tasks (m: manner criterion area; p: path criterion area)

Figure 2. ‘into’ motion event divided in different areas of interest (Source (S), Goal (G), Path (P), and Manner (P+/-M))