Language and Space in aphasia: the contribution of eye-movements

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1. Background

- **Linguistic diversity and implications for aphasia**

  Languages show striking differences in how they represent motion events. In particular, they either lexicaлизе or grammaticalize information, thereby highlighting some types of information over others, out of focus.

- **Satellite-framed languages**: He is running up, down, across, into, away... (lexicalization of Manner).

- **Verb-framed languages**: Il monte, descendent, entre, forum... (lexicalization of Path).

  Despite a few cross-linguistic studies of aphasia, little is known about universal vs. language-specific aspects of the processes that underlie representation strategies of aphasia. This question is of particular interest for psycholinguistics, contributes to the debates concerning the relationship between language and cognition [3; 4] and opens new perspectives for language rehabilitation.

- **Goal of the study and tasks**

  Most language effects have been shown in language use (5; 6; 7), while non-verbal performance shows either no language effects or effects that are less clear (8; 9; 10). The present study examines the properties of a language constrain how aphasic and control speakers perform and allocate attention when constructing representations of motion events in various conditions:

  - production (motion events) during which we measured attention allocation (eye-tracking);
  - a non-verbal categorization task (categorizing events in the absence of any relevant linguistic information);
  - a verbal categorization task (categorizing events when targets were providing Path and Manner);
  - a comprehension task.

- **Specific hypotheses tested**

  - no-blinding hypothesis: no major language effects should occur in any task;
  - strong relativization hypothesis: language effects should occur in all tasks;
  - weak relativization hypothesis: language should affect production, but not non-verbal responses;
  - moderate relativization hypothesis: language should affect production, as well as non-verbal responses but only when linguistic information must be processed (production, verbal categorization).

2. Method

- **Participants**

  Monolingual adult native speakers of French and English (14 per language).

  Monolingual aphasic adult native speakers of French (1 grammatic, 1 anomic).

- **Material**

  - Visual and auditory stimuli implying voluntary motion events with varied Paths (P) and Manners (M):
    - Paths: up, down, across, into, out of, across
    - Manners without instruments: run, jump, crawl, walk
    - Manners with instruments: bicycle, scooter, rollers

- **Tasks**

  - Production (coupled with eye-tracking): Stimuli were presented in a pseudo-randomized order (Figure 1).
  - Participants were asked to describe what had happened.

  - Non-Verbal Categorization: Participants first saw a short target video showing a motion event performed in a certain Manner and along a certain Path. The target video was followed by two variants of the target that differed from it with respect either to Path or to Manner. 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.

  - Verbal Categorization: identical to the non-verbal categorization task, except that the target video was replaced by a target sentence presented auditorily at the same time as the two video variants.

- **Comprehension**: Participants were asked to select which of two events corresponded to a target sentence.

3. Results

- **Production**: Controls' linguistic performance differed in French vs. English in three ways:

  - **Density**: Utterance density was higher in English than in French (more semantic components expressed).
  - **Focus**: English speakers expressed both Manner and Path information (MP-responses), while French speakers mostly focused on Path (P-responses).
  - **Locus** → Verb vs. Other devices: English speakers used compact structures systematically encoding Manner in verbs and Path in other devices. French speakers expressed Path in the verb and provided less information about Manner in another loci and/or did not use any other devices in the verbal network (Figure 3).

  Aphasic speakers produced less dense utterances than controls, but generically showed a French-controle like pattern with more Path verbs. However, their performance in the periphery of the utterances showed some differences as compared to that of controls. The agrammatic expressed mostly Path verbs in infinitive forms and no other information in other devices, while the anomic speaker expressed some Manner in the periphery of the utterances produced (Figure 4).

- **Eye-movements**: Cartoons showed a difference in how French and English speakers allocated attention to different areas of Interest (Aoi—see Fig 1). English speakers paid as much attention to Path and to Manner, whereas French speakers paid their attention more on Path (Figure 5). As for our aphasic patients, both clearly paid more attention to Path, but the anomic also looked at Manner to some extent (Figure 6).

- **Non-verbal Categorization**: French participants preferred Path to Manner as their categorization criterion, whereas English participants showed no significant preference. Manner responses tended to be more frequent in English than in French, but this difference was not significant. Surprisingly, both aphasic showed no preference for Manner or Path criterion.

- **Verbal Categorization**: Manner choices were more frequent for both language groups in this task as compared to non-verbal categorization. English speakers showed a significant preference for Manner choices and chose this criterion significantly more than French speakers. French speakers who continued to choose Path as they did during non-verbal categorization. Contrary to our expectations and unlike controls, aphasics showed a preference for Manner rather than for Path.

- **Comprehension**: The performance of aphasics was slower but as accurate as that of controls.

4. Conclusion

The data show language effects in some tasks (but not in all), including in some non-verbal responses (eye-movements, categorization). Typological properties clearly affect how speakers express motion (production task), they can generate different categorical choices in the verbal and non-verbal categorization tasks, and they partially constrain attention allocation during subjects' exploration of visual stimuli.

Productions are in line with eye-movement and follow the typological patterns above. Both show a focus on Path in French for controls and aphasics, but the coexistence of both Manner and Path fixations in English.

The aphasic deficit seems to play an important role on their behaviour. Although the linguistic properties of French channel their production, their specific deficit (lexical or grammatical) invites them to follow different compensatory strategies:

- they make different choices in categorization tasks as compared to controls;
- they generate more dense and the agrammatic omits some components in the production task;
- they focus visually and linguistically on the most accessible information. The agrammatic uses P Verbs mostly in the periphery (only P fixation), whereas no other information in other devices (mostly P and some M fixations).

References

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