An Embodied Approach to Treating Aphasia: __ Missing ___ Prepositions and Bringing Them In

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Abstract

Persons affected by Broca's aphasia are known to face challenges in dealing with prepositions with treatment outcomes that render current therapy approaches ineffective. For the present study, an interdisciplinary analytical literature review was conducted in combination with an exploratory clinical pilot study that put image schema theory into practice. Results showed improvement in most tasks of the key assessment areas, including sustained effects. Raising doubts regarding underlying causes of prepositional deficits, the findings of this embodied method may have an impact on current therapy approaches.

Keywords

aphasia, embodiment, multimodality, container schema, inside-out framework, second language learning

1. Introduction

The wide variety of potential deficits following a stroke render designing effective therapies for non-fluent aphasia a highly complex matter. Unsurprisingly, current therapy approaches are reported to lack efficacy [1]. Prepositions in particular pose a challenge to individuals with Broca's aphasia and foreign language learners alike, and difficulties with prepositions may linger tenaciously [2, 3]. While developmental language learning is claimed to be embodied, embedded and active [4, 5], this embodied and dynamic aspect appears to be neither accounted for in Broca's aphasia therapy nor in second language learning. In the context of aphasia, partly this may be due to a lack of informative interaction between theoretical research, current therapies and research on therapy efficacy. A potential factor for unsatisfactory treatment outcomes may be a misconception of the nature of the deficit that underlies the loss of prepositional use in Broca's aphasia.

The primary purpose of this paper is to suggest an interdisciplinary alternative approach which shows potential in enabling persons affected by Broca's aphasia to (re-)grasp the meaning of locative and directional prepositions. The approach is grounded in embodied theories and illustrates how image schema, or more accurately, *embodied schema* theory [6, 7] can be employed in therapy settings. The starting point of the study is the container schema, with a focus on the senses of the preposition *in* in verb-particle constructions such as phrasal verbs. It is an embodied schema that is ubiquitous in everyday life and acquired early in developmental language learning. This paper has three main objectives: (1) to explore ways of synthesising theories in different disciplines and fields to suggest a practical therapy approach for individuals with Broca's aphasia that may also be utilised in second language learning, (2) to demonstrate how this may be applied by reporting promising findings of an exploratory clinical case study conducted by the author, and finally, (3) to outline potential factors that may in part explain the underlying mechanisms.

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It ought to be emphasised that this account of applied linguistics in a clinical context is merely a small overview of a considerably bigger research area. Thus, this paper aims at initiating interest and research on a wider basis. Due to the current scope, it will not be able to cover the complexity in its entirety.

2. Aphasia: __ missing ___ prepositions

Aphasia is an acquired severe language disorder that mainly occurs as the consequence of a cerebrovascular accident. After an acute phase that lasts approximately six months, a chronic phase sets in. While aphasia affects communicative abilities, intelligence remains intact. The symptoms can be misinterpreted in social interactions and are associated with poor quality of life.

Types of aphasia are classified according to speech fluency, speech comprehension and the ability to repeat words or phrases. In what follows, I will restrict myself to a non-fluent type, viz. *Broca's aphasia*, also referred to as *expressive aphasia*. For affected persons, uttering words or generating sentences is effortful. Broca's aphasia is characterised by elliptic speech, which may result from the omission of function words (e.g., prepositions), word finding problems or the inability to repeat words or phrases. The affected cortical region associated with these symptoms is Broca's area, concerned with language production. Wernicke's area, associated with language comprehension, tends to be regarded as unaffected. Recent research raises doubt whether this is indeed the case [8].

Where aphasia treatment is concerned, many types of therapy exist. However, neither impairment-based nor functional communication approaches are reported as effective since a substantial proportion of the subjects do not seem to benefit in any way [1]. Thus, new therapy approaches are required to tackle prepositional deficits in Broca's aphasia.

3. Putting embodied (image) schema theory into practice

A key question that arises concerning therapy approaches is how meaning emerges. Given the premises that meaning is grounded in experience and that this is reflected in language, one may thus ask how initially meaningless sound patterns obtain a strong association with content and indeed acquire meaning. Furthermore, how does the 'binding' of meaning to linguistic units occur? In other words, when use of prepositions is lost, how can it be (re-)acquired?

Concerning prepositional deficits in Broca's aphasia, the quest for answers involves identifying factors contributing to the poor therapy outcomes reported. Two potential factors that tend not to be questioned may warrant closer inspection. Firstly, neuroscience tends to test immobile healthy subjects [9]. Secondly, a conception that may be related to this, prepositional deficits tend to be considered as syntactic deficit (*agrammatism*) [10]. This position has recently been challenged [e.g., 2]. Developmental language learning may be considered as an effective approach that may be referred to as a strong design. Infants internalise spatial relations and learn words by exploring the world in a manner that is embodied, active and multimodal [11, 5], providing a powerful model for acquiring use of prepositions. Involving many objectives, all this was factored in and pondered in the exploration of an alternative method that is semantic, embodied and dynamic in nature.

To test if an embodied methodology can be efficacious in acquiring use of prepositions, an exploratory clinical case study was conducted. For this purpose, an applied linguistic approach was developed within a cognitive semantic framework. The approach taken is grounded in *image schema*, i.e. *embodied schema*, theory [6, 7]. The latter will be used in this context, given its status

as an alternative that is regarded as more accurate.[2] Embodied schemas such as the container schema are considered to be our first conceptual structures [11]. They are defined as dynamic experiential patterns that become conceptualised as multimodal representations of sensorimotor activity. The container schema was selected for two reasons, (i) its early acquisition in developmental language learning, and (ii) the fact that in English verb-*in* constructions, it builds complexes with the locomotion and the path schema as well as with the centre-periphery schema. Mainly concerned with containment, the container schema generally involves a more salient component that is brought into relation with a less salient one that serves as a reference point. In other words, this generally involves one entity that is contained in another, in a broad sense, or moves into another entity that has the potential to contain the former.

Theoretical support from neuroscience for the embodied and dynamic approach is provided by the inside-out framework [12, 9]. It incorporates elements found in enactive cognition and dynamical systems theory in cognitive science. In particular, the brain is considered to be a self-organized system with both pre-existing networks and dynamics. Initially meaningless entities of self-generated neuronal activity carry the potential to acquire meaning by being associated with the result of self-initiated action and its consequences. Perception is thus regarded as a process that is grounded in action. In a nutshell, memorable experience involves associating self-generated activity patterns with relevant events in the world [12].

3.1. Methodology

Due to the scope and the theoretical nature of this paper, the methodology mainly comprised an analytical literature review that was conducted with a flexible survey methodology. The exploratory pilot study reported trained a 59-year-old male English native speaker with chronic Broca's aphasia 20 years after stroke and comorbidities[3] under unfavourable conditions. Despite intensive long-term treatment with a syntactic approach, prepositional deficits lingered tenaciously. As was mentioned above, the embodied schema approach applied targets locative and directional prepositions. It focuses on the different senses of container schema complexes of the English preposition *in* [13].

Premises involved in the semantic approach include that meaning that had been previously grounded in experience had been lost or was inaccessible due to brain damage and resulting consequences. Dynamic and multimodal experience targeting spatial relations would initiate a 'semantic (re-)grounding' of spatial prepositions. As a side effect, self-initiated action would establish a feeling of self-efficacy. This would in turn increase motivation, which, like volition, is a factor that often seems to be underestimated in treatment.

The training method followed a protocol yet remained flexible for the purpose of being able to adapt to the participant's respective current needs. At different stages, units of language competence assessment were administered [14, 15]. Inter alia, tasks consisted in locative relations (auditory, comprehension), elicited spontaneous speech (picture description, production), and synonymous constructions involving prepositions (auditory, comprehension). The elicited spontaneous speech task was analysed, for instance, concerning number of constructions that include prepositions (e.g., 'in *the kitchen*'), number of different prepositions used, multiple prepositions (e.g., 'out in *the garden*') and verb-preposition constructions (e.g., '*stand* up').

This pilot study showcases how an approach grounded in embodied schema theory can be applied in 16 hours of training in total. This mainly involved the participant engaging with the body in interaction with household props, deploying different techniques. Inter alia, this

[2] Embodied schemas are inherently multimodal and do not refer to 'images' as such.
[3] Inter alia, this involved paresis of right extremities, apraxia of speech and formulaic speech.

included mirroring actions and expressing their content, or triggering memory via a nursery rhyme and song that includes relevant active embodiment, when the respective sense was addressed. Senses of English verb-*in* constructions involved were mainly based on entering, as in *going in*, see Figure 1, and inserting, e.g., *throwing in a comment*, but also confining or protecting as in *locking in* or *buckling in*, and moving towards a focal point as in *handing in papers*, see Figure 2.[4] This included auditory explanation and demonstration of the schema's scope of a respective sense and corresponding schematic depictions as exemplified in Figure 1 and Figure 2 [13].

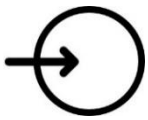

Figure 1: Entering

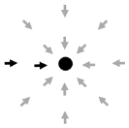

Figure 2: Moving towards a focal point

Applying this dynamic embodied approach proved to be very informative. To give an example, the utterance '*I'm sitting* on *the table*' instead of 'at *the table'* had repeatedly caused irritation in everyday life. It was requested whether this could become part of the uses covered in the training sessions despite *at* not being among the three focal prepositions. This was addressed by encouraging the participant to carry out the corresponding action while speaking. This resulted in shocked surprise and disbelief as realisation struck in terms of utterance content. In this kind of *semantic grounding*, initially meaningless sound patterns seem to have acquired meaning through concurrent self-initiated action and its consequences. Concurrently, this appears to have become incorporated with concomitant sensorimotor experience of '*this is what it feels like to sit* on *a table'* and an understanding that this was incongruent with the message that was intended. Comparatively fine adjustment was obtained by physically exploring the difference between 'on *a chair'*, i.e. support, as compared to 'in *an armchair'*, i.e. containment.

Based on a mid-training spot check, the presumed minimum of two to three words per utterance was considered to be unproductive. The underlying prepositional deficit appeared to be more severe than had initially been assumed. Thus, the approach was modified to targeting prepositions in isolation, i.e. uttering only one word per spatial arrangement or 'scene'. This was mainly limited to the preposition *in* as opposed to *on*, and *out*. The performance displayed in turn indicated further deficits that are beyond the scope of this paper yet opened up new questions. These will be briefly commented on in the final section.

Additionally, the embodied schema approach, along with observations and findings, was considered from a systems neuroscience position, the inside-out framework [12], to shed new light on relevant mechanisms.

3.2. Results

Performance improved in most tasks of the key assessment areas, i.e. involving prepositions. Performance concerning auditory locative prepositions (24 items) displayed a sustained effect five weeks after training completion. It can be considered as highly demanding due to its transient nature. With focus solely on whether the correct preposition was selected (blue and orange bar components), initial 79 per cent of correct responses prior to training increased to 92 per cent five weeks after training completion (post-training 2). This even exceeded performance assessed the week after training completion (post-training 1) as illustrated in

[4] *Going in* is intransitive and involves the locomotion schema, *throwing something in* is transitive and involves the path schema, and, finally, *handing in* involves the centre-periphery schema.

Figure 3. A mid-training spot check revealed a drop in performance below the level prior to training, as illustrated and highlighted in Figure 4.

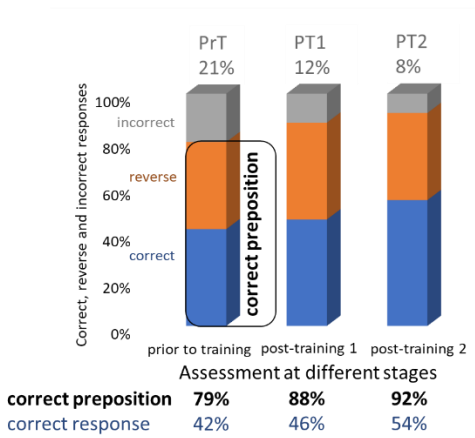

Figure 3: Locative relations (auditory, 24 items)

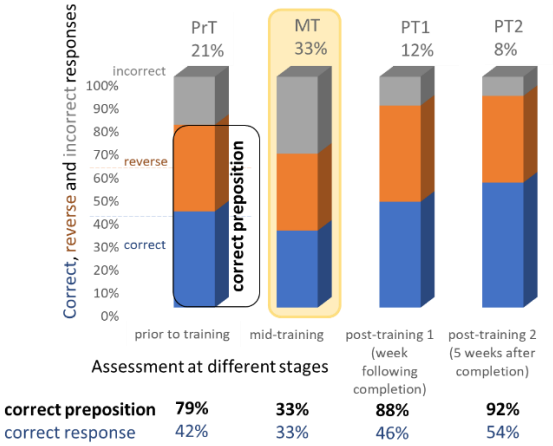

Figure 4: Locative relations (auditory, 24 items) incl. mid-training spot check

In one of the most taxing tasks, elicited spontaneous speech, performance in most areas showed substantial improvement one week after training completion. Even a split verb-particle construction could be observed (e.g., '*take something* out'). Assessment five weeks after training completion displayed a decrease in performance in most of these areas. However, performance at this stage still exceeded speech production results assessed prior to training.

4. Concluding remarks *on* missing *out* prepositions in aphasia and future work

Aphasia is an interesting research area since brain region damage and its consequences are unique. The exploratory clinical pilot study showcases how sensorimotor involvement can be utilised to mitigate prepositional deficits.

According to previous research, embodied exploration of spatial relations is also crucial to language learning in terms of prepositions, as it has an impact on learning speed and capacity [4, 16]. The compelling results of the exploratory case study corroborated these findings and even showed sustained effects. There is plenty of theoretical support for these claims from neuroscience. Furthermore, observations indicated that the underlying impairment is semantic, i.e. meaning-based, in nature, corroborating previous research [2]. This stands in opposition to the traditional view of prepositional 'agrammatism' in Broca's aphasia as a syntactic issue [10]. Importantly, this qualitative study revealed further potential deficits and thus opened up new questions, giving rise to more hypotheses. To give some examples, questions included issues concerned with the duration of the interval between an uttered single word and when another could be articulated. It was likewise targeted accordingly during training, to decrease the intervals. Observations included both a noticeable increase in working memory capacity, during the assessment unit prior to training as compared to the ones after training completion, and word retrieval facilitation after training completion. Thus, the role of working memory capacity[5] in (Broca's) aphasia may have been underestimated. This may also apply to body representation, such as concerning a topological 'body map' in the context of aphasia. Together, this may initiate a rethinking in diagnostic testing strategies in the acute phase, as comorbidities can exacerbate

[5] Depending on the respective definitions, this may also be argued to refer to short term memory capacity.

the condition. Consequently, this embodied semantic approach requires testing in a larger clinical setting as it has the potential to initiate plenty of potential research with yet more hypotheses. As was mentioned before, second language learners likewise may benefit from adopting this approach concerning prepositions, as embodied methods have been reported to yield promising results [3, 16]. This may be particularly effective in the early stages of second language learning when addressing prepositions.

To recap, this study tested whether this embodied methodology is effective in targeting prepositions and has an impact on performance. The unexpectedly compelling results after training completion may speak for themselves. Observations made raised yet further questions and hypotheses that are beyond the scope of this paper.

Where limitations are concerned, among the shortcomings of the setup was that this exploratory pilot study was conducted in a non-lab setting and under unfavourable conditions. As previously mentioned, there was an unexpected drop in performance during the mid-training spot check that would have remained undetected without assessment at this stage. Accordingly, the approach was modified before returning to the course initially intended. Given this impressive positive development, it now remains unclear whether improvement was based on an adaptation phase, as might be indicated by the spot check, or was assisted or motivated by targeting prepositions in isolation. Further limitations concern the limited sample size. Accordingly, not many claims can be made. The fact that only one person was tested was due to the language barrier. As was mentioned above, the approach focused on embodied schemas in English verb-particle constructions. Even languages as closely related as English and German do not have identical construals of spatial relations or 'scenes'. This relates to second language learners and issues regarding prepositions. Thus, testing this methodology in other languages may be expected to require respective analyses prior to testing. Despite these shortcomings, some of which may also be argued to represent strengths, this exploratory pilot study still yielded very promising results that may serve as a basis for future research.

Future work includes testing this methodology in a full clinical study that involves multiple participants in a clinical setup. A longitudinal study that covers one year or more and includes regular training sessions is suggested to monitor how performance changes over time. Further suggestions include extending the scope in terms of testing this approach in other languages than English as well as in second language learning.

To conclude, the body's role in language competence may have been neglected in current approaches. Observations of its considerable importance to acquiring use of prepositions may spark a rethinking of both current diagnostics and therapy approaches in terms of acute and chronic Broca's aphasia, as well as teaching methods in second language learning. This research agenda aims at laying the groundwork with reference to concrete recommendations for future research on Broca's aphasia as well as second language learning, concerning both spatial prepositions and phrasal verbs, and their seemingly arbitrariness.

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