SPARED SYNTAX AND IMPAIRED SPELL-OUT:

THE CASE OF PREPOSITIONS IN BROCA'S AND ANOMIC APHASIA

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I, Simone Mätzig, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Date   Signature

Abstract

The present study deals with the impairment of prepositions, a somewhat neglected topic in aphasia research. It is the first to investigate the availability of all types of prepositions (i.e., spatial, temporal, other meaningful, subcategorized, syntactic prepositions, and particles) in a variety of comprehension and production tasks in one anomic aphasic and four Broca's aphasic patients and healthy speakers. While the availability of spatial, temporal, or subcategorized prepositions has been investigated, other preposition types have never been studied before.

The data revealed that prepositions were impaired in the patients, and that the degree of impairment differed for different types of prepositions. Three of the main findings are: first, meaningless prepositions were not the most vulnerable subcategory of prepositions in the patients. In fact, four of the five aphasic patients performed best on (meaningless) syntactic prepositions. Second, patients made few omissions and many substitution errors which were mostly within-category (a preposition was substituted by another preposition). Third, there was no difference in the performance of Broca's and anomic aphasic patients. These results differ from those of previous studies (e.g., Bennis et al., 1983; Friederici, 1982). They found that (i) meaningful prepositions remained relatively well preserved in Broca's aphasia, while meaningless subcategorized and/or syntactic prepositions were very impaired, (ii) that Broca's aphasic patients tended to omit rather than substitute prepositions, and (iii) that patients of contrasting clinical profiles performed differently.

The preservation of syntactic prepositions together with the large number of within-category substitutions (which indicate sensitivity to the grammatical class of prepositions) were interpreted to suggest that the preposition deficit of the patients is not due to syntactic impairments. Rather, a post syntactic deficit in selection of the correct preposition at spell-out – a construct in modern linguistic theory that links syntax with phonology – is put forward.

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Most importantly, I am indebted to my family, especially my parents and Alex, *weil Ihr immer für mich da seid und unerschütterlich an mich glaubt.*

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Abbreviations

AgrP	Agreement Phrase
A-P interface	acoustic-phonetic interface
CP	Complementizer Phrase
DET	determiner
DP	Determiner Phrase
F	functional
f-heads	functional heads
I-C interface	intentional-conceptual interface
INFL	inflection
IP	Inflectional Phrase
L	lexical
LGU	longest grammatical utterance
MLU	mean length of utterance
NP	Noun Phrase
P	Preposition
PP	Prepositional Phrase
TP	Tense Phrase
UG lexicon	Universal Grammar lexicon
VP	Verb Phrase

Für meine Eltern

'[…] *I have to say 'of' - I know it's a preposition, but then I have to think
is it 'to' or 'of' or 'from'. Prepositions are always a bother to me.'*
An aphasic patient (Head, 1926, p. 254)

Outline of the study

One of the characteristics of (agrammatic) aphasic language production is impaired production of grammatical morphemes, including prepositions. Yet our current knowledge of the preposition deficit in aphasia is limited. Only relatively few previous studies worked on prepositions, mainly in the 1980s and 1990s, and they often used linguistic constructs that today are outdated. The paucity of research on prepositions is in sharp contrast with the interest aphasia researchers have in verbs, noun-verb differences and verb inflections, for example (see Mätzig, Druks, Masterson, & Vigliocco, in press). The neglect of prepositions in aphasia research is surprising as prepositions are a particularly interesting grammatical class to study because they share properties of both lexical and functional categories.

The aim of the present study is, first, to investigate the extent of the deficit in the production, comprehension and grammaticality judgment of prepositions in a group of one anomic and four agrammatic Broca's aphasic patients, second, to re-evaluate, in light of the evidence obtained in the present study, previous hypotheses about the parameters that may affect the relative preservation and impairment of prepositions, and, third, to propose a new explanation for the underlying source of the preposition deficit.

The first two chapters consist of an overview of the linguistic and aphasia background literature pertaining to prepositions. The literature review of the linguistic studies in Chapter 1 illustrates the difficulty in identifying the members of the class of prepositions and in classifying prepositions along the traditional lexical/functional divide, and outlines the different functions prepositions have. In Chapter 2 a brief introduction to aphasia with special reference to theories of agrammatic Broca's aphasia is provided. The main emphasis in Chapter 2 is placed on the review of studies that deal with the availability of prepositions in aphasia. In this section the parameters that have been identified by previous studies to affect the preservation/impairment of prepositions in aphasia are also outlined.

In the third and fourth chapters the methodology of the study is described. Chapter 3 gives a detailed description of the aphasic and control participants' linguistic abilities based on their connected speech and background testing.

Background tests investigated spatial and semantic abilities, object and action picture naming, and syntactic comprehension. In Chapter 3 the characteristics of connected speech of aphasic and control participants are also compared. Chapter 4 outlines the tasks used to test the availability of different prepositions in different modalities. It starts with those tasks that investigated the *extent* of the preposition deficit in production and comprehension. Next, the results of the study are used to *re-evaluate* the parameters that were identified by previous studies to affect the availability of prepositions. The results are presented along with short discussions of the findings.

The fifth chapter presents an interim discussion of the main findings. It reviews the results obtained in light of previous parameters: to what extent individual patients' performance patterns can be explained by them. Chapter 6 is dedicated to a new proposal for accounting for the preposition deficit. As previous theories failed to provide an adequate explanation, a new account is proposed that places the preposition deficit at spell-out, the interface that maps syntactic representations to phonology.

Chapter 1: Introduction to the linguistics of prepositions

Many languages express relations between objects and events in space and time by adpositions. Adpositions which precede their complements are called prepositions (e.g., *about these facts*), those which follow their complements are postpositions (e.g., *these facts notwithstanding*) and those which enclose the object are circumpositions (e.g., *from then on*, French: *à un détail près*; lit. 'at one detail near', 'except for one detail'). All types of adpositions are said to belong to the syntactic category P(reposition) (see Emonds, 1985; Jackendoff, 1973; van Riemsdijk, 1978). Prepositions are the largest group of adpositions in English and are focus of this study.

1.1   PREPOSITIONS AS A CONTROVERSIAL CATEGORY

The classification of prepositions is a challenge for two reasons. First, there is no consensus about which lexical items precisely belong in the category. Second, the syntactic nature of the category is controversial because prepositions do not fit neatly into the functional/lexical dichotomy. The following exposition is an overview of the different ways different linguists approach and analyze prepositions. Only some of these will be adopted for understanding the results of the present study.

There are two different opinions with respect to membership within the category of prepositions. One view holds that prepositions, particles and prepositional adverbials form a single class (e.g., Emonds, 1985; Jackendoff, 1973; Littlefield, 2006). This view is based on three observations. First, particles and prepositional adverbials are often homophonic with prepositions. This phonological similarity is taken to indicate a close link between them (Jackendoff, 1973). Second, homophonic particles, prepositional adverbials, and prepositions often share meaning. *Up*, for example, irrespective of its particle, adverbial or prepositional usage, conveys the meaning of path (Emonds, 1985). Third, particles, prepositional adverbials, and prepositions can all occur in similar syntactic configurations which are thought to be unique to prepositions (e.g., modification with *right* as in (1)).

(1)   *Right modification*

   with prepositions   The picture fell (right) off the wall.

   with prepositional adverbials   She put the knife (right) down.

with particles   He looked the number (right) up.

with adjectives   She wore a (*right) red hat.

with non-prepositional adverbials   She spoke (*right) loudly.

At least two different accounts have been put forward to argue that prepositions, though they fulfil different functions, belong to the same syntactic category. According to one, prepositions, like verbs, have subcategorization frames that specify the number and type of complements they can take (Jackendoff, 1973). Every prepositional phrase (PP) obeys the following phrase structure rule: PP → P-(N(oun)P(hrase))-(PP), with some of the elements being optional. Which of the optional complements are realized depends on the function a preposition fulfils in a sentence. For example, a preposition that functions as prepositional adverbial can occur without a noun complement (i.e., PP → P as in *she fell down*). A preposition with a meaningful, subcategorized or syntactic function can take a noun complement (i.e., PP → P-NP as in *the kite went up the sky*, *he relied on the weather, the translation of the book*); and some meaningful prepositions can also take a preposition complement (i.e., PP → P-PP such as *the kite went up in the clouds*) or a noun and preposition complement (i.e., PP → P-NP-PP such as *Max sent the trilogy to Bill in New York*[1] (some of the examples are taken from Jackendoff, 1973, p. 350/1)). According to this account, the different functions of prepositions are expressed by having different subcategorization frames. The phonological, semantic, and syntactic features of prepositions with different functions remain identical.

According to a second account, prepositions with different functions are represented as having different sets of features (e.g., Littlefield, 2006). Based on the binary features approach introduced by Chomsky (1970), Littlefield claims that the two crucial features that distinguish functions within the prepositional category are [+/–L(exical)] and [+/–F(unctional)]. Lexical features refer to the ability to assign theta-roles and functional features to the property of case marking. A preposition that has only a syntactic function in the sentence contains the feature specification [–L, +F] because it lacks semantic content, does not assign theta-roles and only licenses

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[1] According to Jackendoff (1973), (*Max sent the trilogy) to Bill in New York* must be analyzed as having the structure PP → P-NP-PP because, among other reasons, it forms a single constituent, and, therefore, fronting is only permitted for the whole PP (*To Bill in New York, Max sent the trilogy* / **Bill in New York, Max sent the trilogy to* / **To Bill, Max sent the trilogy in New York*).

case. The most typical example of a [–L, +F] preposition is the syntactic *of*. According to Littlefield, subcategorized prepositions (due to their perceived lack of meaning and due to being case assigners) and the dative *to* and the benefactive *for* also belong to this subgroup. If a preposition takes the function of a prepositional adverbial, it carries the feature specification [+L, –F]. In this function, it is a purely lexical preposition as it does not assign case but can assign theta-roles and contributes (mostly spatial) meaning to its complement. A preposition that functions as meaningful preposition contains the feature specification [+L, +F]. Prepositions of this function have the ability to assign case *and* theta-roles. Finally, if a preposition functions as particle in a sentence, it lacks case and theta-marking capacities and thus carries the features [–L, –F].

Littlefield, like Jackendoff, is able to account for the different functions that members of the syntactic category of prepositions can fulfil in the sentence. The difference is that in Littlefield's account, different functions of prepositions are understood in terms of *different* features, unlike Jackendoff who assumes *identical* features but different subcategorization frames.

Other linguists have argued for a complete separation of prepositions from particles and prepositional adverbials on the basis of differences in their syntactic distribution (e.g., Bolinger, 1971; van Riemsdijk, 1978). In the case of particles and prepositional adverbials, for example, the prepositional element may precede *and* follow the object. In contrast, in the case of prepositions, the order of object and preposition is fixed. It has also been noted that, although *right* modification does apply to all three prepositional elements, there are differences between them. In the case of particles and prepositional adverbials *right* modification is allowed only when the prepositional element follows the object, and, in the case of prepositions, when the prepositional element precedes the object (see examples in (2)).

(2)   Prepositions   The picture fell (right) off the wall.

       Prepositional adverbials   She put the knife (right) down.

                                       She put *(right) down the knife.

       Particles   He looked the number (right) up.

                                       He looked *(right) up the number.

This is taken to indicate that particles and prepositional adverbials pattern somewhat differently than prepositions, and, thus, led to the view that they do not constitute a single class (see e.g., Bolinger, 1971; van Riemsdijk, 1978). Dissimilarities among them in terms of phonology further question a unified account. While it is probably true that almost all particles (at least in English) are homophonic with prepositions, there are some prepositional adverbials that do not also occur as prepositions (e.g., 'away' as in 'he pushed (away) the plate (away)', Littlefield, 2006, p. 21). Also, the semantic overlap between the three prepositional elements may have been overstated. Littlefield (2006) whose analysis of prepositions favours a unified account, nevertheless acknowledges that, as with homophonic nouns and verbs, homophonic prepositional elements, while they share core meaning, may convey fundamentally different meanings in sentences: '*prepositions relate one thing to another, [prepositional] adverb[ial]s modify, and particles add telicity or an idiomatic sense to the verb*' (p. 23). These conflicting accounts of membership illustrate the dilemma with prepositions, particles and prepositional adverbials: they are different and alike at the same time.

A second complication is that prepositions share properties of both lexical and functional categories (Grimshaw, 2005; Rizzi, 1985; Svenonius, 2004; 2007; van Riemsdijk, 1990). Lexical words per definition '*have a relatively 'specific or detailed' semantic content and as such carry the principal meaning of the sentence*'. Functional elements (or function words), however, fulfil a syntactic role in the sentence '*to glue the content words together, to indicate what goes with what and how*' (Corver & van Riemsdijk, 2001, p. 1). While most natural language words can be defined along this distinction, prepositions behave differently which led to an ongoing controversy about their status. Initially, prepositions, along with nouns, verbs, and adjectives were analysed as belonging to the lexical categories on the basis of their similarities with other lexical classes (Chomsky, 1970): like verbs they are able to license case, to assign theta-roles, and to select noun and/or prepositional complements (e.g., Jackendoff, 1973); and like all members of the lexical class, prepositions can have rich meaning and receive stress. Crucially, however, it has been observed that not all prepositions have these properties. Some prepositions, such as the syntactic *of*, are more function word-like in that they do not have theta-marking capacities, are meaningless and unstressed. In addition, prepositions, due to their limited number in natural languages, are closed class. The fact that prepositions

as a group behave heterogeneously in terms of their semantic, syntactic, and phonological properties led to a re-analysis of prepositions as a complex class. Different linguists divided prepositions into different sub-classes: lexical versus non-lexical prepositions (e.g., Rauh, 1993), theta-marking versus non-theta-marking prepositions (e.g., Hestvik, 1991), true prepositions versus words that are almost pure case assigners (e.g., Rooryck, 1996) and so on. None of these proposals, however, solves the two problems associated with the category of prepositions: none of them is able to define which members do belong to the prepositional category and which members do not *and* explain the syntactic nature of the prepositional class in terms of the functional/lexical dichotomy.

A potential solution is provided by a recent approach which avoids the strict division into lexical and functional categories. According to this account, the difference between lexical and functional words is not absolute in that all words are either lexical or functional. Instead, while some words are indeed at the (opposite) ends of the lexical/functional division, other words fall in between. These *in between categories* are labeled semi-lexical categories (see Corver & van Riemsdijk, 2001). With respect to the exact definition of semi-lexical categories, there is no consensus yet. To give just a few examples, semi-lexical categories are assumed (i) to be lexical heads that have no semantic content (e.g., Emonds, 2001), (ii) to be lexical heads that differ in their semantic content (but not functional content) from functional heads (e.g., Powers, 2001), or (iii) to combine lexical and functional characteristics (e.g., Bhattacharya, 2001). Some nouns, verbs and prepositions have been characterized as semi-lexical categories. One of the most recent analyses of prepositions using the semi-lexical approach has been put forward by Littlefield (2006). Littlefield proposes the re-analysis of prepositions as a single syntactic category with four discrete functions, each of them defined by different features (see above for an outline of Littlefield's proposal). Two of these functions correspond to lexical (prepositional adverbials) and functional categories (syntactic prepositions), respectively, while two other functions are neither purely functional nor purely lexical (i.e., particles and meaningful *semi-lexical* prepositions). Thus, Littlefield is able to account for both the membership problem and the classification of prepositions into lexical/functional categories.

Littlefield's theory is based on syntactic, semantic and phonological evidence, and is supported by language acquisition data. Yet, her account ignores that

prepositions of the same feature specification, for example, subcategorized and syntactic prepositions, can be very different in other respects than theta-role assignment and case marking. Subcategorized prepositions are licensed through idiomatic selection by the verb (lexical selection) while the syntactic *of* is inserted into a structure as last resort when case cannot be marked by other means (structural selection). Moreover, whether or not subcategorized prepositions assign theta-roles is controversial. Neeleman (1997), for example, suggests that subcategorized prepositions are idiomatically selected by the verb in order to assign a theta-role to their complements which also matches the verb's internal theta-role. The theta-role of the subcategorized preposition may be opaque, nevertheless, it is present. Lastly, Littlefield's account fails to acknowledge alternative analyses of the dative *to* and benefactive *for* as meaningful prepositions, and of the passive *by* as a syntactic preposition.

This brief sketch of the state of the art on the linguistic analysis of prepositions has illustrated the two major points of disagreement among linguists: determining which lexical items are members of the category, and determining their status in terms of the functional/lexical dichotomy. The objective of the present study, however, is not to contribute to the linguistic analysis of prepositions. Its objective is to examine the impairment and preservation of prepositions with different functions in aphasia. For this purpose, the view adopted here will be that meaningful, subcategorized, syntactic prepositions, and particles and prepositional adverbials are members of one syntactic class following Jackendoff (1973) and Littlefield (2006) but contra Bolinger (1971) and van Riemsdijk (1978). As for the functional/lexical dichotomy, the view adopted here will be that prepositions are a heterogeneous category; some preposition types being functional, others lexical, and others semi-lexical (following Littlefield, 2006). This is also the traditional view taken by many previous researchers of prepositions in aphasia (see 2.2).

1.2   THE FUNCTIONS OF PREPOSITIONS

It is widely agreed upon that the function of a preposition can vary. The functions are not exclusive, that is, a preposition, *on*, for example, can have different functions: within a similar, maybe even identical, structural context *on* can be of spatial meaning (*the cat walked on the roof*), of temporal meaning (*the group met on the weekend*), it can be subcategorized by the verb (*the man relies on the woman*), or it

can be part of a complex preposition (e.g., *John apologized on behalf of his team*). Moreover, the properties of functions are not exclusive. The most intriguing example is meaningfulness which is not confined to meaningful prepositions but present across functions. This explains why simplex as well as complex prepositions can be meaningful, and why even some subcategorized prepositions, some syntactic prepositions and some particles have meaning. Nevertheless, some functions of a preposition are mutually exclusive. A subcategorized preposition (*the man relies on the woman*), for example, cannot simultaneously function as a particle (*the man puts on his shoes*) because the two occupy different positions in the syntactic tree[2].

Each prepositional function[3] and its characteristics, as it is understood in current linguistic theory, is described in the following sections. Linguists differentiate between simplex and complex prepositions, prepositions of space and time, prepositions that are idiomatically selected by the verb, syntactic prepositions, and prepositions that function as particles and prepositional adverbials. Most prepositions can be easily ascribed to a certain subcategory; however, for some, the categorization remains hotly debated.

Complex and simplex prepositions

English distinguishes simplex (single-word) and complex (multi-word) prepositions (e.g., *by dint of*, *ahead of, in front of, on behalf of, next to)*. While the former are referred to as 'free expressions', the latter are considered 'fossilized' (Pullum & Huddleston, 2002, p. 618/9). The fossil-like status prohibits syntactic operations such as additions, omissions, substitutions, or genitive alternation that are applicable to free expressions, probably due to the somewhat idiomatic meaning of complex prepositions (i.e., the meaning of the whole preposition is different from the meaning

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[2] This claim is based on the assumption that particles and verbs, unlike subcategorized prepositions and verbs, form a complex predicate, that is, they occur together in a complex head in a syntactic tree (e.g., Ackema & Neeleman, 2000; Neeleman, 2002). This syntactic configuration results in ungrammaticality if an adverbial is inserted between the particle and verb in sentences where the particle precedes the verb's complement (e.g., **the man puts slowly on his shoes* but *the man slowly [puts on] his shoes*). In contrast, separation of the subcategorized preposition (also preceding the verb's complement) and the verb by an adverbial is permitted (e.g., *the man relies completely on the woman* and *the man completely relies on the woman*).
[3] In the remainder of the thesis, the function of a preposition will also be referred to as *type* or *subcategory* of a preposition.

of its components)[4]. The example in (3) demonstrates the effect of genitive alternation for simplex and complex prepositions (the examples are taken from Pullum & Huddleston, 2002).

(3)   *simplex prepositions*   *complex prepositions*
       She put it [*on* the photo *of* her son].   She achieved this [*by* dint *of* hard work].

       She put it [*on* her son's photo].   *She achieved this [*by* hard work's dint].

Meaningful prepositions

The meaningful function of a preposition is often considered its basic function in that it conveys the original meaning of a preposition in a non-idiomatic manner (e.g., Lindstromberg, 1997). Meaningful prepositions describe the physical relation of two things. In a structure such as (4) *the boy* is the 'subject' (other terms for subject are located object or trajector; see Pullum & Huddleston, 2002) of the preposition and *the street* is its 'landmark' (also called *ground* or *reference object*). *On* is a preposition of place that describes where the subject is in relation to the landmark (see also Lindstromberg, 1997).

(4)   The boy is walking on the street.

Subject and landmark can also refer to temporal events (see (5)). Here, *John* is the subject and *Friday* is the landmark of the temporal preposition *on*. Other subcategories of prepositions can be analysed in the same manner even if subject or landmark refer to abstract entities (e.g., 'the environment is in danger' or 'you are in trouble', see Lindstromberg, 1997).

(5)   John left on Friday.

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[4] There is variance in the degree of fossilization of complex prepositions (Pullum & Huddleston, 2002). This accounts for the observation that some (less fossilized) complex prepositions permit some but not all syntactic manipulations that are possible with simplex prepositions (e.g., omission as in 'she was sitting [in front of the car] / she was sitting [in front]' taken from Pullum & Huddleston, 2002, p. 620).

It was suggested that the semantic relation between subject and landmark of a preposition corresponds to the syntactic relation between external (subject) and internal (landmark) arguments (e.g., Lang, 1993; Svenonius, 2004). The selection of the internal argument/landmark is constrained by the semantic requirements of the preposition (see Rauh, 1993). The spatial preposition *in*, for example, requires a landmark that has the properties of a container, while *on* needs a surface as landmark and so on.

The examples in (4) and (5) have demonstrated that meaningful prepositions denote semantic information of different types, that is, they assign clearly defined theta-roles to their complements which, in turn, refer to a variety of different events. For example, spatial prepositions assign thematic roles associated with location such as place (e.g., *in/on/under/at the table*), source (e.g., *he is from London/he jumped off the roof*), goal (e.g., *he walked to/into the house/he jumped onto the car*), path (e.g., *he travelled through/flew via Rome/he ran down/up/across the street*), and direction (e.g., *he walked towards the woods*). Temporal prepositions assign thematic roles associated with the time of the utterance (deictic, e.g., *in two weeks, next week, three years ago*), with the calendar and clock times of points of orientation (*in 1999, on Wednesday, at 3pm, since Monday*), and with other times or situations (*during the interval, after/before his death, on the same day, at the same time*)[5].

The semantic relation a meaningful preposition establishes between subject and landmark can be even more fine-grained. To give just a few examples, spatial prepositions such as *on, above,* and the emphatic alternative of *on*, *on top of,* all assign the theta-role *place* to their complements. They all locate the subject directly over the landmark. However*,* while *on* and *on top of* prototypically describe contact between subject and landmark, *above* does not denote direct contact of subject and landmark. Similarly, *between* and *in (*and the complex preposition *in the middle of)* all describe the surrounding of a subject by a landmark. *Between*, however, implies the location of a subject in relation to at least two landmarks (in contrast to *in* and *in*

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[5] It should be noted, however, that some linguists (e.g., Lindstromberg, 1997) consider the distinction between spatial and temporal prepositions misleading as almost all meanings of temporal prepositions are based on spatial meanings, and temporal meanings of prepositions developed historically from spatial meanings. According to this view, the spatial meaning constitutes the core meaning of a homophonic preposition with both spatial and temporal meanings (see also van Schooneveld, 1978). Indeed, there are striking similarities between spatial and temporal prepositions such as the notions of starting points and endpoints.

the middle of) and that the subject is not contained by the landmark (in contrast to *in*) (see Lindstromberg, 1997).

Within the prepositions that denote spatial meanings, some linguists (e.g., Pullum & Huddleston, 2002) make further distinctions between spatial prepositions of place/location and prepositions of movement/direction. Temporal prepositions are subdivided into those specifying an open interval of time and those that indicate a closed interval of time. An open interval indicates duration while a closed interval denotes a specific point in time. Examples are in (6).

(6)   The team played hockey in the hall.   → location

       He drove the car into the garage.   → direction/endpoint of path

       Sue arrived at 5o'clock.   → closed time interval

       The station is closed from 11pm onwards.   → open time interval/starting
                                                         point of interval

The difference between prepositions of location and closed time intervals, on the one hand, and direction and open time intervals, on the other, is in semantic complexity. The latter carry an additional semantic feature which may render these prepositions more complex (e.g., while *in* only represents [PLACE], *into* is specified as denoting [PATH] in addition to [PLACE]).

Spatial and temporal prepositions are, probably, the most prototypical members of the group of meaningful prepositions; however, there are other meaningful prepositions that assign theta-roles other than spatial and temporal. These are benefactor (*he bought a present for his father*), recipient (*he gave the present to his father*), instrument (*he opened it with a knife*), manner/degree (*he opened it with care/with pleasure, he found it by accident*), substance (*it was filled with sand*), animate source (*he received a present from his son, this book is by Steven Pinker*), comitative function (*he went shopping with a friend*) or agent (*this book was written by Steven Pinker*).

Subcategorized prepositions

Subcategorized prepositions, sometimes also referred to as collocative, dependent or grammaticized prepositions, occur together with a verb (or a noun, or an adjective) with no obvious thematic relation between them and their PP complement. Instead,

there is a strong relation between the verb and the preposition. Neeleman (1997) proposed that subcategorized prepositions are specifically selected by the verb in order to match the verb's internal theta-role with their own. According to this account, subcategorized prepositions assign theta-roles to their complements that are not semantically motivated. This would violate the principle of *Full Interpretation* (Chomsky, 1986) which claims that every constituent of a sentence must have a semantic function that licenses its existence. However, Neeleman (1997) proposes that there are more forms of licensing a syntactic representation than thematic licensing. In the absence of a thematic relation between the verb and the PP (and the preposition and its complement), the preposition is specifically licensed by the verb through idiomatic selection and forms a lexical union with its 'selector'. In the clearest cases, this excludes any other preposition from selection (e.g., *she relies on/*at/*in/*over him*). Since the selection is arbitrary, there is cross-linguistic variation with respect to the prepositions a verb subcategorizes. A verb such as *think that*, in English, subcategorizes *of* does not necessarily subcategorize the same preposition in another language (e.g., Dutch: aan icts denken 'think on something' taken from Neeleman, 1997).

The evidence by Neeleman (1997) as presented below shows not only the closeness between the verb and the subcategorized preposition but also the difference between subcategorized and meaningful prepositions. One piece of evidence Neeleman cites comes from Dutch double object constructions. Dutch verbs can select only *one* PP which is headed by a subcategorized preposition (see 7a and 7d). Other arguments such as PPs headed by a meaningful preposition (see 7c) or determiner phrases (see 7b) are however permitted to co-occur with a PP headed by a subcategorized preposition.

(7) (a) iemand naar/om iets vragen

someone for $_{\text{subcategorized}}$ something ask

'ask someone for someone'

(b) aan/van iemand iets vragen

of $_{\text{subcategorized}}$ someone something ask

'ask something of someone'

(c) dat Jan tijdens $_{\text{temporal}}$ de lunch aan $_{\text{subcategorized}}$ Maria denkt

that John during the lunch of Marie thinks

'that John thinks of Marie during the lunch'

(d) *aan/van iemand naar/om iets vragen

of~subcategorized~ someone for~subcategorized~ something ask

'*ask for something of someone'

This syntactic constraint only applies to PPs headed by subcategorized prepositions. The reason is that, idiomatic selection of a preposition by a verb can take place only once, that is, only one PP headed by subcategorized preposition can be licensed by the verb.

Neeleman's analysis of subcategorized prepositions as case and theta-marking prepositions is in contrast to other accounts that consider subcategorized prepositions as being purely case marking prepositions. Littlefield (2006), for example, although she acknowledges the unique relationship between verbs and subcategorized prepositions, postulates that they are unable to assign theta-roles. Instead, subcategorized prepositions are inserted to match the verb's (internal) argument structure (because the verb requires a PP complement) and to assign case to the object (which in these cases the verb fails to do, see also Ouhalla, 1999).

In the present study, the analysis of subcategorized prepositions as case and theta-role assigners, following Neeleman, is assumed. The reason is that this account is able to explain differences between subcategorized prepositions and prepositions such as the syntactic *of* whose analysis as pure case assigner is generally agreed upon (see the next section). Among his arguments, Neeleman (1997) refers to the fact that subcategorized prepositions are selected by a verb that is a case assigner, while the syntactic *of* is head of a PP that is a complement to a noun (or an adjective), both non-case assigners. Hence, Neeleman concludes that prepositions that head PP complements of verbs are full lexical heads while PP complements of a noun are most likely not. Neeleman also shows that while the syntactic *of* can co-occur with PPs headed by subcategorized prepositions (see (8)), the combination of two PPs headed by subcategorized prepositions results in ungrammaticality (see (7d)). Thus, it appears that PPs headed by subcategorized prepositions are different from PPs headed by the syntactic *of*.

(8)   Het stellen van~syntactic~ vragen aan~subcategorized~ de leraar.

'The posing of questions to the teacher'

Syntactic prepositions

There are several prepositions that fulfil syntactic functions only. The most obviously syntactic preposition is *of*[6]. It is widely believed that the syntactic *of* assigns case but not a theta-role (e.g., Littlefield, 2006; Neeleman, 1996; 1997; Ouhalla, 1999; Rooryck, 1996; Ura, 2001). Some linguists even claim that *of* is '*a case-marker rather than a true preposition [...]*' as '*it displays some behaviour that is more consistent with the cross-linguistic behaviour of case-markers than of adpositions*' (Svenonius, 2004, p. 26). However, most commonly *of* has been described as a semantically empty '*dummy preposition*' whose insertion is '*comparable to do-insertion in English, in that it is a last resort operation*' (Neeleman, 1997, p. 130): in order to satisfy the *Case Filter*, *of* is inserted in a sentence as the marker of case whenever the structure consists of adjectives and nouns which cannot assign case (Haegeman, 1994).

Linguists differentiate between sentences with the syntactic preposition *of* in which the first determiner phrase (DP) (or noun phrase, NP) is morphologically derived from a verb (*translate a book/translation of a book*) and those in which the first DP is not derived (*glass of wine*). The first case illustrates that *of* is the most syntactic and most meaningless preposition in English as shown by the fact that no difference in meaning is apparent between *translate the book* and *translation of the book* (Ouhalla, 1999). This provides further evidence that the insertion of *of* is entirely syntactically motivated.

The passive *by* is another syntactic preposition. In passives, the subject of the active sentence surfaces in the *by*-phrase. *By* assigns case to its complement, and it is argued to assign a thematic role of, usually, *agent* (e.g., Haegeman, 1994; Littlefield, 2006). This seems likely as *by* also assigns an agentive theta-role in non-passive structures (e.g., *the book by Steven Pinker*). However, it is also acknowledged that the theta-role of the complement of *by* in a passive sentence depends not on the preposition but on the verb (as illustrated in (9) taken from Svenonius, 2004).

(9)   Lila was investigated *by* the CIA.   → agent

         The window was broken *by* the storm.   → cause

         The bread cannot be cut *by* an ordinary knife.   → instrument

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[6] For historical interest, it could be pointed out that before the 11th century *of* was a '*full blooded, depictable preposition meaning off/from*' (Lindstromberg, 1997, p. 195).

These examples show that during the process of passivization, the complement of the *by*-phrase maintains the theta-role that was assigned by the verb[7]. This implies that the function of *by* is case assignment only.

Another preposition that is thought to fulfil a syntactic function only is *for*. *For* is sometimes argued to act as a case marker in structures like (10) (taken from Lindstromberg, 1997).

(10)   What I want is [*for* him to meet the deadline].

For is inserted into a structure with an infinitival clause (*to meet the deadline*) to assign case to the subject (*him*) which it could not receive otherwise because of the non-finiteness of the verb. Hence, due to this 'last resort-insertion' of *for,* the *Case Filter* is satisfied. The sentence in (10) can be rephrased as in (11) without the insertion of *for*.

(11)   What I want is [that he should meet the deadline].

This shows that *for*-insertion is not required once the structure contains another case assigning element and that *for* (and the infinitival *to* in (10)) does not contribute meaning and merely fulfils a syntactic role. This is different to the meaningful function of *for* (e.g., *he bought a present for Sue*), where *for* not only assigns a distinct theta-role to its complement (i.e., benefactor) but also forms a PP constituent with it. In contrast, in (10) *for* and the subject of the sentence (*him*) do not form a constituent because *for* occupies the head position of the complementizer phrase (CP, and thus is often referred to as 'prepositional complementizer', see Haegeman, 1994). The difference can be illustrated using a constituency tests (see (12)).

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[7] Note, however, the problem of c-command: some linguists may claim that theta-role marking by the verb to the complement of P is impossible because a complement must c-command the head from which it receives theta-roles (e.g., Chomsky, 1981; Reinhart, 1981; 1983), and the complement of P in these sentences does not c-command the verb that is argued to theta-mark it. Since the complement of P c-commands the preposition *by* it is likely that *by* functions as theta-marker. This further illustrates that the linguistic analysis of the passive *by* remains controversial.

(12)   **For him* I want [to meet the deadline].

For Sue he bought a present [   ].
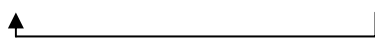
Although the analysis of *for* as a prepositional complementizer which fulfils a syntactic function only is generally agreed upon, Lindstromberg believes that the complementizer use of *for* contains semantic information in that the subject (*meeting the deadline*) is intended for the landmark (*him*) as in (13) (taken from Lindstromberg, 1997).

(13)   Meeting the deadline is *for* him.

The fourth grammaticalized preposition is the infinitival *to*. Its status is highly controversial. It has been classified as a preposition (e.g., Hyde, 2000), a complementizer (e.g., Postal & Pullum, 1978), an inflection (e.g., Chomsky, 1981), and a verb (e.g., Pollard & Sag, 1994) or modal auxiliary (e.g., Mittwoch, 1990). However, it is agreed upon that, historically, the infinitival *to* is derived from the preposition *to* (e.g., Haspelmath, 1989) and has characteristics of a preposition.

In the present study, the analysis of the infinitival *to* as a preposition that heads simple non-finite verbal phrases is adopted (Hyde, 2000). There are two different structures headed by an infinitival *to* (see (14)). While the 'in order to' infinitival assigns the theta-role of *purpose* (14a), the 'bare' infinitival is entirely meaningless (14b).

(14) a) Helen travels [*to* increase her knowledge].
     b) James prefers [*to* travel by plane].

The two types of *to* are different as to whether or not they can be rephrased. Clauses with a bare infinitival *to* can be rephrased using the progressive form (15b), while this is not permitted in clauses with the *in order to* infinitival (15a).

(15) a) *Helen travels increasing her knowledge.
     b) James prefers travelling by plane.

Lastly, some linguists (e.g., Larson, 1988) argue that the dative *to* is a syntactic preposition. This claim is grounded on the assumption that s*he gave me the cat* is derived by dative shift (a syntactic operation) from s*he gave the cat to me*. As structural case but not inherent case can be absorbed (as observed in passivization), the preposition (assigning structural case) is deleted during dative shift (see Larson, 1988). A further indication that the dative *to* does not fulfil a semantic function is that its presence/absence does not alter the meaning of the sentence. Hence, its only function is case assignment to the (indirect) object – a property which renders the dative *to* a syntactic preposition.

However, there are alternative views according to which the dative *to* is lexical and meaningful. For example, the difference of structures such as s*he gave me the cat* and s*he gave the cat to me* can also be explained in terms of verb alternation (Levin, 1993). Dative alternation only occurs with verbs of giving, transfer or future having whereby the argument structure of *give* may change from requiring the dative PP to requiring a DP. This phenomenon happens also with verbs having benefactor arguments introduced by *for* as in *he bought a flower for her/he bought her a flower* (see also Huddleston, 2002). It has been further argued that there is a great deal of semantic involvement in the dative alternation. Dative alternation can only occur with verbs which require recipient (or possessional goal) arguments. Other '*major classes of verbs fail to participate in the alternation precisely because the critical phrase does not have the same semantic character as the critical argument of verbs like give*' (Grimshaw, 2005, p. 109). Consequently, the dative *to* can be interpreted as carrying the meaning of a recipient that is similar to the meaning of *to* in spatial constructions (goal). If this view is accepted, the dative *to* is unlikely to be a purely syntactic preposition.

Particles

Some prepositions combine with verbs to form a phrasal verb also known as multi-word verb, compound verb, discontinuous verb, or verb-particle construction. Particles are generally considered to lack case and theta-marking capacities and they do not take complements (e.g., Kayne, 1985). This and other characteristics led to the analysis of particles as a subcategory that is different from other types of prepositions. For example, the combination of a verb and particle is different from the fusion of a verb and a subcategorized preposition: a particle in a phrasal verb

bonds with the verb, while a subcategorized preposition bonds with the complement noun. Bolinger (1971) suggested many diagnostics to distinguish between particles and (subcategorized) prepositions, four of them are discussed here. The first maintains that subcategorized prepositions can be fronted in combination with the complement noun (*in her friends, Sue believes*) while a true particle cannot (**in this form, Sue filled*). According to the second, if a preposition can occur on either side of the noun, it is likely to bond with the verb, and is a particle (e.g., <u>look</u> the information <u>up</u>/<u>look</u> <u>up</u> the information but not <u>believe</u> <u>in</u> the idea/*<u>believe</u> the idea <u>in</u>). According to the third, in structures with a pronoun in object position a preposition precedes the pronoun (e.g., *I fell over it/ *I fell it over; I believe in it / *I believe it in*), while a particle follows it (e.g., *Sue filled it in / *Sue filled in it*) (Palmer, 1974). A fourth way to determine whether a preposition acts as a true particle in a phrasal verb is by checking if it can be replaced by a single verb. *Fill in* can be paraphrased by *complete* while *believe in* cannot be replaced without losing or changing meaning. Cross-linguistic examples also provide evidence for the independent status of particles and other prepositions. While English has *in* used both as a preposition and a particle, Norwegian and German differentiate between the particle (*inn*, *ein*) and the preposition (*i, in*; Svenonius, 2004).

Some consider particles to be meaningless (e.g., Littlefield, 2006). According to Littlefield, for example, their meaninglessness is reflected in some phrasal verb constructions where the meaning of the sentence is not changed irrespective of the presence or absence of the particle (e.g., 'he wrote (out) the cheque/ they finished (off) the ice cream/ she ate (up) the sandwich' taken from Littlefield, 2006)[8]. Littlefield takes this to indicate that particles do not contribute descriptive meaning, or create a novel and often unpredictable meaning in combination with the verb (e.g., *he gave up hope*).

Other linguists make a distinction between meaningful and idiomatic particles (e.g., Lindstromberg, 1997, Neeleman, p.c.). This is the view adopted in the present study. A meaningful particle has maintained traces of its core meaning, usually the meaning of *path* and, in some contexts, *endpoint* or *result*. As a consequence, any preposition of pure location (e.g., *near, beside*) is thus ruled out to be used as

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[8] While it is true that the presence/absence of *up* in the last example does not change the meaning of the sentence, it could be argued that *up* is not meaningless but in fact adds meaning that is already present in the verb: *eat* conveys the meaning of an inherent endpoint and *up* emphasizes this endpoint of the action (Neeleman, p.c.).

particle. Purely temporal prepositions (e.g., *during, since*) or almost purely temporal prepositions (e.g., *before*) also never occur as particles. Abstract prepositions (such as *of, for*) and prepositions that are derived from *by* and *side* (e.g., *beside, below, alongside*) are unlikely to be used as particles. Given these semantic constraints, it is not surprising that *up,* prototypically describing a path, is the most common particle in English. Since meaningful particles often express the meaning of *result*, they are also referred to as resultative particles (e.g., *throw up the ball*). Idiomatic particles, in contrast, have lost all reference to their original meaning and create a novel meaning in combination with the verb (e.g., *he gave up hope*). Therefore, idiomatic particles are also referred to as non-resultative particles. A diagnostic to examine whether or not a particle is resultative is to rephrase the sentence with the noun and particle in a copula construction. A resultative particle will allow rephrasing (*the ball is up*) while a non-resultative particle cannot be rephrased (*smoking is up) (see Bolinger, 1971). This diagnostic also shows that a resultative particle's meaning is more concrete. Thus, phrasal verbs can be grouped into (i) non-idiomatic/literal/resultative particles (e.g., *take* something *off*), (ii) semi-idiomatic/non-resultative particles (e.g., *knock* someone *out),* and (iii) idiomatic/metaphorical/non-resultative particles (e.g., *take* someone *in → deceive*) (examples taken from Lindstromberg, 1997).

Finally, the question remains how phrasal verbs are stored and retrieved. There are two contrasting accounts: one maintains that the verb and particle form a complex verb and are base-generated together (e.g., Johnson, 1991); the second maintains that the particle incorporates into the verb but is base-generated separately from it (e.g., Kayne, 1985). There are two pieces of evidence for the existence of phrasal verbs as lexical units, first, slips of the tongue by healthy speakers (e.g., *go overring the exercise / are we set asiding the rule?*, taken from Bolinger, 1971) and second, the existence of nouns derived from phrasal verbs (e.g., 'make up', Lindstromberg, 1997).

Prepositional adverbials
Prepositional adverbials are distinguishable from non-prepositional adverbials. Prepositional adverbials can occur in syntactic configurations unique to prepositions while non-prepositional adverbials cannot. *Right* modification, for example, is only permissible for prepositional adverbials (as shown in example (1) in 1.1 and partly repeated here in (16)).

(16)   *Right modification*

with prepositional adverbials   She put the knife (right) down.

with non-prepositional adverbials   She spoke (*right) loudly.

Prepositional adverbials can also occur on either side of the object of a transitive verb (e.g., *she put (down) the knife (down)*) while non-prepositional adverbials cannot (e.g., *she sang *(loudly) the song (loudly)*) (Bolinger, 1971).

In order to claim that prepositional adverbials constitute their own subcategory of prepositions they must be differentiated from other types of prepositions. Because of their strikingly similar appearance, a difference must be made between prepositional adverbials and particles. Bolinger notes that prepositional adverbials can be preceded by non-prepositional adverbials (e.g., *she fell slowly down*) while particles cannot (e.g., **she grew slowly up*), and prepositional adverbials (in intransitive structures) can be fronted (e.g., *down she fell*), but particles cannot (e.g., **up she grew*). What is additionally noticeable is that prepositional adverbials are relatively independent of the verb while particles are closely linked with the verb.

It has been argued that prepositional adverbials are purely lexical prepositions, that is, unlike most particles, they contribute to meaning and can assign theta-roles but, like particles, they cannot assign case (e.g., Littlefield, 2006). Similar to meaningful particles, prepositional adverbials usually convey spatial meaning. Bolinger (1971) made an interesting observation. Probably owing to their lexical status, new prepositional adverbials can relatively easily be coined (which is in contrast to all other types of prepositions discussed). Bolinger refers to nautical adverbials such as *ashore, aport, afield, aboard, overboard*, and so on that have the same distributional patterns as prepositional adverbials.

Summary

Prepositions are a hybrid category. At least in English, prepositions, like functional heads, are caseless free standing morphemes that do not combine with tense or aspect morphology (Svenonius, 2004). Some prepositions do not receive stress and the limited number of prepositions in natural languages indicates that, like pronouns and determiners, prepositions belong to the closed class. On the other hand, prepositions also have lexical features. Some prepositions, like lexical heads, mark case, assign clearly defined theta-roles, can have a rich meaning and receive stress. The

heterogeneous status of prepositions is emphasized by the fact that they have different functions: some prepositions carry both semantic and syntactic information, that is, they assign theta-roles *and* case to their complements (i.e., meaningful prepositions), while other prepositions have the purely syntactic role of case assignment in the sentence (i.e., syntactic prepositions) or make a purely semantic contribution (i.e., prepositional adverbials). There are also prepositions that are idiosyncratically selected by the verb (i.e., subcategorized prepositions). Although they assign case and theta-roles to their complements, the choice of the preposition is not semantically motivated. Finally, there are prepositions that neither assign case nor convey (considerable) meaning (i.e., particles).

Previous analyses of prepositions (e.g., Bolinger, 1971; Emonds, 1985; Hestvik, 1991; Jackendoff, 1973; Rauh, 1993; Rooryck, 1996; van Riemsdijk, 1978) have addressed one of the two problems with prepositions − the classification of prepositions in terms of the lexical/functional divide *or* the definition of the membership within the prepositional category − but failed to address both. A recent account of prepositions however is somewhat more successful (e.g., Littlefield, 2006). It suggests a classification of prepositions into purely lexical prepositions (prepositional adverbials), purely functional prepositions (syntactic prepositions) and prepositional subcategories that are both lexical *and* functional such as semi-lexical prepositions (meaningful prepositions) or *neither* lexical *nor* functional (particles).

1.3   PREPOSITIONS AS A POLYSEMIC CATEGORY

Polysemy is a typical feature of the prepositional class in that many preposition tokens (e.g. *to*) have multiple functions (e.g., spatial, temporal, recipient, subcategorized, syntactic). The significance of polysemy among (particularly meaningful) prepositions is hotly debated among linguists. Polysemy commonly defines the '*variety of lexical ambiguity'* with '*which the distinct senses associated with a single lexical form are semantically related*' (Brugman, 1997, p. 4.). While it is sometimes suggested that the different meanings associated with a preposition are accidental (e.g., Chomsky, 1995), some researchers have argued that there is system in polysemy by assuming that the meanings of prepositions, like those of verbs and nouns (see e.g., Huttenlocher & Lui, 1979), are represented in a systematically organized network. There are two competing analyses of polysemic prepositions in linguistics – the strong polysemy hypothesis and the weak polysemy hypothesis. The

strong view (e.g., Lakoff, 1987) maintains that prepositions are organized in the semantic network according to their primary and secondary senses: each polysemic preposition has a primary sense (also called basic or central sense, or core meaning) in addition to a variety of other meanings (secondary or non-central senses). The primary meaning of a polysemic preposition is its spatial meaning. Additional meanings are derived from the core meaning and tend to be more abstract (e.g., temporal, benefactor, recipient meaning etc.). They are not predictable from the core meaning and have to be acquired one by one (see Lakoff, 1987).

Evidence from language development supports this view of polysemy. Different functions of prepositions were shown to be acquired in a fixed hierarchical order with the spatial meaning – the core meaning according to the radical view – being acquired first (see e.g., Grimm, 1975; and Rice, 1999, who found that spatial prepositions were produced earliest in the speech of children (aged 1.6 - 7.6 years) and that only those temporal (and subcategorized) prepositions occurred in children's speech that were used earlier with spatial function).

A less strong view on polysemy offers the 'principled polysemy model' (Tyler & Evans, 2003a). Under this view the multiple meanings associated with a polysemic preposition are also organized around a central or protoscenic sense in a semantic network. In contrast to the strong view, the protoscenic sense is however not necessarily spatial and other meanings are not derived from the protoscenic meaning but become associated with it because speakers use the preposition with a new (non-protoscenic) meaning in sentence context. If this new meaning is frequently repeated in similar semantic contexts, it will eventually become associated with the preposition and constitute a distinct meaning different from but related to the protoscenic meaning (see also Tyler & Evans, 2004). For example, the protoscenic sense of *over,* according to Tyler and Evans (2004), is the (locational) spatial notion of an object being located higher than another object (e.g., *the picture is over the mantel*). In addition to the protoscenic meaning of *over*, the authors have identified 13 additional distinct senses of *over* which, for example, involve notions of an

endpoint[9] (called ABC-trajectory by Tyler and Evans and identical with a directional spatial interpretation of *over* as in *the cat jumped over the wall*), covering (e.g., *John nailed the board over the hole in the wall*), transfer (e.g., *the teller at the bank switched the account over to a local branch*), repetition (e.g., *Marty keeps making the same mistake over and over*), preference (e.g., *I prefer coffee over tea*), completion (e.g., *the film is over*) and so on (examples taken from Tyler & Evans, 2004).

Which view of polysemy is to be favoured remains debatable to date. It is possible that the investigation of different functions of polysemic prepositions in aphasia, which, however, has not been attempted so far, may contribute to the discussion.

1.4   AN OVERVIEW OF THE PREPOSITIONS INCLUDED IN THE PRESENT STUDY

The present study focused on the analysis of simplex prepositions: meaningful, subcategorized, syntactic prepositions and particles. Prepositional adverbials were not included. The main reason for this was that prepositional adverbials can be optional (e.g., *she fell [down]*) and therefore it is difficult to detect errors. In addition, their elicitation is complicated[10].

The dative *to* (recipient) and the passive *by* were included among the meaningful prepositions in the present study, though, admittedly, their classification is problematic: they are analysed as syntactic prepositions by some linguists and as meaningful prepositions by others. The focus of the present study was not on

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[9] For clarification, the development of a non-protoscenic notion (say, endpoint) of the preposition *over* is briefly illustrated here. Tyler and Evans (2004) argue that the meaning of an endpoint is only inferred but not encoded by the linguistic information in the sentence (i.e., *the cat jumped over the wall)*. The speaker implies an endpoint because his knowledge of the world tells him that jumping is not an indefinite process and that the cat, due to the force of gravity, at some point must reach the ground again. Tyler and Evans maintain that due to repeated experience of similar situations (i.e., an element changing its position by moving over another and finally reaching an endpoint) and exposure to utterances which contain *over* with an endpoint meaning, this non-protoscenic meaning of *over* develops into a distinct meaning of its own and may even be involved in the development of other distinct meanings (such as the transfer meaning of *over*).

[10] Prepositional adverbials almost always require pictures for elicitation which is a disadvantage for two reasons. On the one hand, prepositional adverbials cannot be probed in all tasks of the present study (e.g., grammaticality judgment which only involves prepositions that can be identified from sentence frames). On the other hand, depicting prepositional adverbials is difficult as motion is involved (e.g., s*he pulled her sleeve up*). The depicting of motion would have required arrows to indicate movement and direction among other things and this would have made the pictures more abstract than those for spatial prepositions. This in turn may cause aphasic patients to have difficulty understanding the pictures, and, hence, result in more incorrect first responses. As only first responses were scored this was undesirable.

disentangling their membership but to contrast performance of different subcategories of homophonic prepositions (i.e., spatial *to* versus dative *to*, meaningful *by* versus passive *by*) and hence, the dative *to* and the passive *by* were placed in the same group as their meaningful counterparts. The emergence of a noteworthy difference between the ambiguous categories and their meaningful counterparts could motivate future investigations which may be able to contribute to the membership debate of dative *to* and passive *by*.

Chapter 2: Introduction to aphasia and prepositions in aphasia

Having sketched the linguistics of the different subcategories of prepositions, in this chapter, following a brief introduction to aphasia, the characteristics of agrammatic Broca's aphasia and the theories that attempted to explain the language pattern of agrammatism with special reference to prepositions will be discussed. The central part of this chapter reviews previous studies that investigated the availability of prepositions in aphasia and outlines the parameters identified by these studies to influence the impairment/preservation of prepositions in aphasia. The chapter ends with an outline of the objectives of the present study.

Aphasia

Aphasia is a language disorder due to brain damage, usually, to the left hemisphere. Although the degree of severity of aphasia differs among individuals, patterns of anatomical and (pathological) language features tend to co-occur in most aphasic patients (approximately 75%, see e.g., Poeck, 1983). These recurring patterns form the classical syndromes of Broca's aphasia, Wernicke's aphasia, and anomic aphasia (among other syndromes such as conduction aphasia, transcortical motor and transcortical sensory aphasia and global aphasia (see Murdoch, 1997). Agrammatic Broca's aphasia is the syndrome that is most relevant for the study of prepositions. This is because (i) one of the main characteristics of agrammatic Broca's aphasia is the impaired production of grammatical morphemes, including (at least some) prepositions, (ii) most previous studies examined the availability of prepositions in Broca's aphasia, (iii) agrammatic Broca's aphasia has attracted more research than any other form of aphasia, and (iv) the majority of patients in the present study are Broca's aphasic patients. For these reasons, the language impairments in agrammatic Broca's aphasia will be discussed in some detail in the next section.

Agrammatic Broca's aphasia

The core features of agrammatic speech production are short and syntactically simplified (and often ungrammatical) sentences, the deletion and/or erroneous use of grammatical morphemes in the face of relative preservation of lexical morphemes (Caramazza & Berndt, 1985; Menn & Obler, 1990) and the paucity of verbs in comparison to nouns. Typically, it has been claimed, free grammatical morphemes

such as conjunctions, determiners, (some) prepositions, pronouns, and auxiliary verbs are omitted, and bound grammatical morphemes such as verb and noun inflections are substituted (e.g., Grodzinsky, Swinney, & Zurif, 1985; Grodzinsky, 1990).

Initially the term *agrammatism* was used to describe impairments of speech production only. Only later it has been shown that agrammatic production in Broca's aphasia may be paralleled by a comprehension disorder for syntactically complex sentences (e.g., Caramazza & Zurif, 1976).

2.1 THEORETICAL ACCOUNTS OF AGRAMMATISM WITH RESPECT TO PREPOSITIONS

Over the last 100 years a number of theories that aimed to explain the language deficits of agrammatic patients have been suggested. Pick (1913; translated in Friederici, 1994) who coined the term *agrammatism,* claimed that patients with agrammatism resort to an emergency language with the aim of producing speech with the least possible expenditure of effort. Pick's *economy of speech* account influenced subsequent theories (e.g., Isserlin, 1922; see also Isserlin, 1985; Goldstein, 1948), the most recent of which is the *adaptation hypothesis* of Kolk and colleagues (Hofstede & Kolk, 1994; Kolk, van Grunsven, & Keyser, 1985). All these theories explain agrammatism in terms of processing limitations. Alternative theories assume deficits to the representation of linguistic elements or operations such as grammatical morphemes, traces, or verb movement. Some, but not all of these theories were informed by linguistic frameworks available at their time (see e.g., the 'continuity hypothesis' by Jakobson, 1964; the 'central syntactic deficit' hypothesis by Berndt & Caramazza, 1980; the 'impaired selective access route hypothesis' by Bradley, Garrett, & Zurif, 1980; the 'mapping hypothesis' by Linebarger, Schwartz, & Saffran, 1983; the 'trace deletion hypothesis' by Grodzinsky, 1984; the 'lexical node' hypothesis by Caplan, 1985; the 'theory of an impairment of global syntactic structures' as described in Bayer, De Bleser, & Dronsek, 1987; the 'tree pruning hypothesis' by Friedmann & Grodzinsky, 1997; the 'impaired verb movement' hypothesis by Bastiaanse & van Zonneveld, 1998; the 'argument structure complexity' hypothesis by Thompson, 2003; and the 'tense underspecification hypothesis' by Wenzlaff & Clahsen, 2004 (in chronological order)). In the next

sections, those accounts of agrammatism are discussed that aimed to explain, or have implications for, the impairment of prepositions.

The impaired phonology hypothesis

Kean (1977; 1979) approached the phenomenon of the deletion of grammatical morphemes in agrammatism by suggesting that the words that are produced (and comprehended) by agrammatic patients are those that receive stress (i.e., the class of phonological words) and the words that are omitted are those that do not receive stress – non-phonological words which tend to be grammatical morphemes. Kean argued that grammatical morphemes are a mixed set of words (prepositions, adverbs, pronouns, determiners, verbal and nominal inflections) that do not form a natural homogeneous class except in terms of phonology. Setting the locus of impairment at the level of phonology led Kean to describe agrammatic production as the reduction of '*the structure of a sentence to the minimal string of elements which can be lexically construed as phonological words*' (Kean, 1977, p. 25). Kean's hypothesis in terms of phonology met with much criticism. Among other problems, Kean's hypothesis fails to account for substitution errors in using grammatical morphemes, for omission and substitution errors affecting content words and for variability in performance *within* the class of non-phonological words. Importantly for the purposes of this study, since Kean's distinction '*runs close to the grammatical morpheme – content word division but puts multisyllabic prepositions […] in with the content words because of their stress-bearing properties*' (Goodglass & Menn, 1985, p. 10), it predicts that unstressed, short prepositions should be impaired while longer prepositions that are stressed should be spared.

The loss of functional nodes

Ouhalla (1993) proposed that in the language of agrammatic patients the structural representation of sentences lacks functional nodes. The rest of the sentence structure is intact. Consequently, linguistic operations that require functional nodes (e.g., case-marking, tense-marking, subject-verb-agreement, and movement from lexical nodes to functional nodes) and functional categories which reside in the functional nodes (e.g., determiners, pronouns) become unavailable. The reason, according to Ouhalla, is impaired access to the Universal Grammar lexicon (UG lexicon) that contains the abstract representations of functional categories and their corresponding grammatical

features. However, the inaccessibility of functional categories from the UG lexicon does not prevent the (occasional) occurrence of functional categories in the speech of patients because each functional category is also represented in the grammatical lexicon which contains its corresponding lexical entry. In the words of Ouhalla (1993, p. 28), '*the impairment affects the structural representation of functional items but not necessarily their appearance*'. Ouhalla's proposal can therefore account for omissions and substitutions of grammatical morphemes and for word order errors (due to the inability to move elements from lexical to functional nodes in the syntactic representation). Ouhalla's account predicts the selective impairment of different types of prepositions in aphasia. Only prepositions that do not assign theta-roles are impaired. Theta-role assigning prepositions are preserved. The reason for this distinction lies in the definition of functional categories adopted by Ouhalla: functional categories encode grammatical features such as case or agreement assignment, and do not assign thematic roles.

The impairment of non-theta-role assigner prepositions

Rizzi (1985), who took a different approach, arrived at the same conclusion as Ouhalla. He argued that linguistic elements are either theta-role assigners, theta-role assignees, or do not participate in theta-theory. The characteristics of agrammatic speech (as described in the literature) suggested to Rizzi that '*the elements which are more likely to be integrated into linguistic representations by agrammatic Broca's aphasics are those which fall within the scope of theta-theory (either as assigners or as assignees)*' (1985, p. 156). This makes clear distinctions within the class of grammatical morphemes. Rizzi would expect pronouns (theta-role assignees) and meaningful prepositions (theta-role assigners) to be better preserved than determiners and syntactic prepositions which neither assign nor receive a theta-role.

The impairment of the s-structure

Grodzinsky (1984) explains agrammatic production (and comprehension) by assuming a partial impairment of syntax which affects s-structure (in the linguistic frame work of Principles and Parameters by Chomsky, 1981). According to Grodzinsky, the terminal nodes of lexical categories are normally represented on the syntactic tree of the agrammatic speaker, but the terminal nodes of functional categories remain underspecified. A sentence such as *the boy kissed the girl* will be

represented at s-structure as [boy---kiss---girl] with no specification for the functional categories DET(erminer) and INFL(ection). This underspecification may lead to both omissions and substitutions. Empty categories, in particular, traces are affected too with consequences for the comprehension of sentences that involve movement. With respect to prepositions, Grodzinsky acknowledged their heterogeneous status being in-between functional and lexical categories and claimed that some types of prepositions are spared while others are impaired in aphasia. Grodzinsky's proposal in relation to prepositions is discussed in 2.2.2 under *Government*.

The tree pruning hypothesis

The tree pruning hypothesis by Friedmann (Friedmann & Grodzinsky, 1997; Friedmann, 2002) is based on the split IP theory (Pollock, 1989) which maintains that inflectional processes and their corresponding representations on the syntactic tree are split between tense and agreement marking: the IP (Inflectional Phrase) node is replaced by two separate TP (Tense Phrase) and ArgP (Agreement Phrase) nodes. Using this linguistic framework, the core of Friedmann's theory is (i) that agrammatic aphasic patients cannot project a full syntactic representation of a sentence (i.e., C(omplementizer)P(hrase)→TP→AgrP→V(erb)P(hrase), from highest to lowest), (ii) that higher nodes are more vulnerable to 'pruning' than lower nodes, (iii) that pruning of the syntactic tree can occur at different heights of the tree depending on the severity of the impairment, (iv) that according to the evidence tense is often impaired in agrammatism (and more so than agreement), therefore, TP is the most frequent pruning site, and (v) that pruning at TP results in the unavailability of nodes above the pruning site (i.e., CP) and, consequently, leads to the impairment of structures depending on those nodes (i.e., questions and subordination) while lower nodes remain accessible (i.e., AgrP)[11].

   Friedmann's theory is able to account for problems agrammatic aphasic patients have with the production of verb inflections such as tense and agreement or the production of complex structures such as questions and embeddings. But is her theory able to accommodate the impairment of prepositions in aphasia? Prepositions

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[11] This ordering of the syntactic nodes (i.e., CP→TP→ArgP→VP) is based on the tree structure originally proposed by Pollock (1989). Since then it has been noted that there might be variation in the ordering of TP and AgrP in different languages.

are inserted into the syntactic structure either as part of the VP (depending on the linguistic analysis, this applies to particles), or in a PP as complement to the verb (meaningful and subcategorized prepositions) or NP (the syntactic *of*). Neither is positioned higher than TP, and thus, when TP is impaired, prepositions need not be unavailable. There are two exceptions: the prepositional complementizer *for* and the infinitival *to*. The prepositional complementizer *for* is inserted into the CP node in order to assign case to the subject of a non-finite sentence such as *For him to attack Bill (would be surprising)* (Haegeman, 1994, p. 167). Thus, it occupies a vulnerable position in the tree. Similarly, the infinitival *to* is argued to reside in TP as it behaves distributionally like other elements that are inserted in this node (i.e., auxiliary/modal verbs: *It is important [that Bill should practice spelling]/It is important [for Bill to practice spelling]*). Functionally, the infinitival *to* is thus similar to auxiliaries/modal verbs. If the analyses of the infinitival *to* and the complementizer *for* are correct, a deficit in TP should impair the production of the infinitival *to* and the complementizer *for*. Friedmann's proposal thus divides prepositions into two classes: those that are located lower than TP and those that are located higher than TP. It predicts deficits in relation to the latter group only – the prepositional complementizer *for* and the infinitival *to* – and is able to explain different patterns of availability for prepositions depending on their *structural* distribution. A shortcoming of the theory is that pruned syntactic nodes make a too strong claim in that they predict omissions, but not substitutions of prepositions.

A relation between the production of case assigners and case morphology

Ruigendijk (2002) showed that case marking in aphasia depends on the availability of the case assigning categories. Her work is interesting for the present study because case assigners are often prepositions. Using cross-linguistic data she found that agrammatic Broca's aphasic patients (and a Wernicke's aphasic patient) were more likely to produce case morphology (e.g., a case marked determiner in German or a case marking affix attached to a noun stem in Russian) when a case assigner (i.e., a verb or preposition) was present. If the case assigner was missing, the patients tended to omit case morphology or made case substitution errors. She concluded, therefore, that aphasic patients are sensitive to the relationship between case assigner and case morphology.

Ruigendijk found that the identity of the case assigner (whether it was a verb or a preposition) was not important for the patients (that is, the number of correctly case marked DPs produced that have been assigned case by a verb or preposition was similar)[12]. Nominative case was relatively unimpaired and the patients tended to use the accusative case as a substitute if dative case assignment failed. This led Ruigendijk to suggest that structural case assignment was relatively well preserved while lexical case assignment was impaired.

Ruigendijk does not make the claim that the reason for the paucity of prepositions (or verbs) in agrammatic speech is their function as case assigners. All she proposes is that an impairment to access the syntactic features of case assigners leads to omissions or substitutions of case morphology. Her theory nevertheless might be extended to make a prediction about which types of prepositions would be preserved and which would be impaired in aphasia. Particles and prepositional adverbials do not assign case while all other types of prepositions do. Thus, it could be predicted that particles and prepositional adverbials will be spared in aphasia.

Garrett's model of sentence production

The theories of agrammatism presented so far have been based on evidence from agrammatic language impairments. Garrett's approach is different. His model of sentence production was informed by speech errors of healthy speakers. In Garrett's model the grammatical encoding of sentences is represented by postulating two levels: the functional and positional level (Garrett, 1984). At the functional level lexical elements are selected on the basis of meaning. At this stage, lexical items are specified for grammatical class and argument structure, but not for tense, number, or their position in the sentence. At the positional level, the phonological forms of the words are specified and their position in the sentence is determined. The ordering of lexical elements is supported by planning frames that have pre-specified slots for the words in their surface order and are pre-specified for the positions of the bound and free grammatical morphemes.

Garrett's model is relevant for research into agrammatism because it represents the grammatical encoding of sentences by postulating two levels which correspond to

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[12] This suggests that the presence of a case assigner and not finiteness of the verb facilitated the production of correct case marking. This is contrary to previous arguments that it was the finiteness of the verb that triggered the production of functional categories such as determiners.

open and closed class words (Garrett, 1984). Therefore, the locus of impairment in agrammatic sentence production can be identified. Due to agrammatic patients' prominent problems with grammatical morphemes, most researchers located the source of their language problems at the positional level (e.g., Caramazza & Hillis, 1989; Garrett, 1984).

Speech errors by healthy speakers support the division of grammatical encoding into functional and positional components. Garrett noticed that word exchanges affect lexical items of the same grammatical class only (e.g., *he rode his bike to school tomorrow; they left it and forgot it behind; it's too hungry for you to be early, 1984, p. 176, 177*). These errors appear to take place at the functional level where lexical words are specified for grammatical class thereby providing evidence for its existence as a distinct stage in sentence production. In contrast, phoneme stranding in word exchange errors such as *it waits to pa*y (Garrett, 1984, p. 177) demonstrates the existence of the positional level with planning frames that predetermine word order and the position of inflections. Only the content words (*wait* and *pay*) have been exchanged (at functional level) while verb inflections remained in their planned position. Erroneous positioning in the phrasal planning frame at the positional level is also possible and it surfaces in word and morpheme shifts (*forgotten about → forgot abouten*).

Garrett also observed that speech errors divide words into open and closed class words (i.e., lexical and grammatical morphemes). Lexical morphemes are susceptible for semantically motivated word exchange errors (*yesterday → tomorrow*), form-based word substitutions (*consisted → considered*), and sound exchanges (*rat pack → pack rat*). Grammatical morphemes are prone to stranding (*pays to wait → waits to pay*) and word and morpheme shifts (*forgotten about → forgot abouten*). Surprisingly, errors of prepositions do not conform to this pattern. Prepositions, like lexical morphemes, are involved in word exchange errors (e.g., *tickets for two at the box office → tickets at two for the box office*). Garrett (1984), therefore, concluded that prepositions pattern together with nouns, verbs, and adjectives. However, unlike nouns, verbs, and adjectives, prepositions are not involved in sound exchange errors. In this sense, prepositions display properties of grammatical morphemes. Garrett's solution to this dilemma was that prepositions change their status from lexical to grammatical during the shift from functional to positional level. This change is

necessary because phonologically (being short and unstressed) prepositions are grammatical morphemes and in order to be realized phonologically they have to be treated as such at the positional level (Garrett, 1984). What is problematic about this account is that it treats prepositions as a homogeneous category, and, thus, implies that all prepositions, even meaningless syntactic prepositions, are selected at the functional level which operates on the basis of meaning.

A modification of the account suggested by Friederici (1985) is that meaningful prepositions and particles are inserted at the functional, and meaningless syntactic and subcategorized prepositions at the positional level. Friederici tried to find evidence for this claim. In a word monitoring task she compared reaction times of healthy speakers to detect meaningful prepositions, particles, and subcategorized prepositions in related and unrelated contexts[13]. She found that meaningful prepositions and particles were recognized faster in related contexts, while context had no effect on subcategorized prepositions. This suggests that meaningful prepositions and particles are processed at a level '*where semantic factors operate*' while subcategorized prepositions are '*processed as features of sentence frames at the structural level*' (p.150).

It seems that, although Garrett acknowledged the hybrid status of prepositions, his model fails to provide an adequate account for the apparently homogeneous speech errors of a heterogeneous grammatical class. Nevertheless, if it is true, as suggested by Friederici, that meaningful prepositions are inserted at the functional level and meaningless prepositions at the positional level and if it is true that agrammatic Broca's aphasic patients have a deficit at the positional level, it is predicted that production of meaningless prepositions (syntactic and subcategorized prepositions, and some particles) should be impaired in aphasia while meaningful prepositions should be spared.

Levelt's model of sentence production
In Levelt's (1989) model, there are four main components of language production: the conceptualizer, the formulator, the articulator and the central lexicon. The conceptualizer formulates the preverbal message which is the communicative intent.

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[13] For example, the meaningful preposition *on* in the target sentence *The cat is on the tree* was once preceded by an unrelated sentence (*The boy is trying to hit the girl*) and once by a related sentence (*The dog is trying to chase the cat*) (examples are translations from German).

The preverbal message is input to the formulator which transforms it in two steps – the grammatical and phonetic encoding – into phonetic plans for articulation. In order to do so, the formulator interacts with the lexicon that contains the words speakers know. For each word semantic, syntactic, morphological, and phonological properties are specified in its lexical entry. Levelt distinguishes between two types of lexical entries: lemmas and lexemes. Lemma information contains semantic and syntactic features of a word. For example, the lemma of a verb includes information about its grammatical class, its argument structure, and the theta-roles it assigns. The ordering of the arguments, however, is not specified at the lemma level. Lexeme information about a word contains morphological and phonological specifications such as syllable, phoneme and stress structure.

Lexical retrieval takes place at the formulator. The formulator selects the lemmas required by the preverbal message. Simultaneously, syntactic mechanisms are activated that produce phrase structure. These syntactic mechanisms order the retrieved lemmas according to phrase structure rules. The lemma *give*, for example, provides information of its grammatical class which, in turn, signals the need to create a verb phrase (VP), and requires the ordering of the verb and its three arguments within the VP. This process is called grammatical encoding. Its end product is a sequence of phrases. Grammatical encoding is the input for phonological encoding. At this stage, the lexeme for each lemma is retrieved which, first, provides its morphological structure (e.g., *gives* is represented by the stem *give* and the affix *s* for third person, singular, present). The retrieval of morphological representation of the lexeme supplies the phonological encoding system with segment information about the word (i.e., *gives* consists of one syllable, the first phoneme is /g/, the second /i/ etc.). The result of phonological encoding is a phonetic plan of the sentence to be produced. This phonetic plan is input for the final component of language production – the articulator – that transforms the phonetic plan into an articulatory programme.

Levelt suggests that the lemma of a preposition (e.g., *toward*) contains semantic information about its arguments (e.g., place, path, direction) and grammatical information (that the preposition assigns case to its argument). Subcategorized prepositions are semantically underspecified at the lemma level, as these prepositions, due to their idiomatic relation with the verb, are listed together with the verb they are attached to. Using the example of *wait for*, Levelt proposes that *wait*

has two arguments: an (obligatory, also called external) argument specifying the one who waits *(e.g., <u>John</u> waits)* and an (optional, also called internal) argument specifying the one who is waited for (e.g., *John waits for <u>Sue</u>*). Levelt also assumes that whenever a verb's lemma requires an idiomatic prepositional argument, the non-idiomatic lemma of a homophonic (meaningful) preposition (i.e., *for*) will be accessed. In this case, the semantic information included in the lemma entry of (meaningful) *for* will be irrelevant and only the syntactic information of *for* will be important. It may be hypothesized that the same process applies to particles, (though, in their case, the lemma entry is underspecified not only for semantic but also for syntactic features). Subcategorized prepositions and particles are therefore said to be retrieved *indirectly* through another word's lemma, while meaningful prepositions are retrieved *directly* from the lexicon. For syntactic prepositions only syntactic lemma information (e.g., case) is relevant, and therefore, (although Levelt does not discuss this) their lemmas are accessed indirectly by sentence structure or through another word's lemma. For example, the lemma for the syntactic *of* is (indirectly) retrieved in order to assign case. The infinitival *to* is (indirectly) retrieved whenever the verb is non-finite. Procedures (in Levelt's terms main-verb procedures) apply that realize the verb's infinitival form by (zero) inflection. The lemma of the preposition *to* is activated by these procedures triggered by the verb's zero inflection. Similarly, the lemma of passive *by* may be (indirectly) retrieved whenever the verb is in passive form.

Direct retrieval of lemmas and lexemes can be error-prone. Levelt distinguishes between errors that occur at lemma level such as blends of words (*I would like to enlicit your support → elicit/enlist*) or semantic substitutions (*he rode his bike to school tomorrow → yesterday*) from those that occur at lexeme level such as tip-of-the-tongue phenomena, malapropisms (*gladiator → radiator*), and phoneme exchanges (*spictly streaking → strictly speaking*) (examples taken from Dijkstra & Kempen, 1993; Garrett, 1980; 1984). It is possible that indirect access of lemmas is an even more error-prone process because more steps are involved in it, and it is not semantically driven. Therefore, Levelt's model predicts that meaningless prepositions whose lemmas are accessed indirectly would be more impaired in aphasia than meaningful prepositions whose lemmas are accessed directly.

Summary

Despite numerous theories of agrammatism, there are only few accounts that capture impairments of prepositions. All of these theories make a binary division into those prepositions that are spared and those that are impaired, albeit on different grounds. Some suggest impairment to or loss of syntactic representations such as functional nodes. Because some types of prepositions reside in these nodes on the syntactic tree, their loss or underspecification results in omissions and substitutions of these prepositions. Other prepositions whose representation does not depend on these lost/impaired functional nodes are however expected to be preserved (see Friedmann & Grodzinsky, 1997; Grodzinsky, 1984; 1988; Ouhalla, 1993). Other accounts suggest that certain inherent phonological, semantic, or syntactic properties of a preposition make it more vulnerable to impairment than others. It was proposed that (i) unstressed and shorter, (ii) non-theta-role assigning, (iii) case assigning, and (iv) meaningless prepositions are more impaired than longer and stressed, theta-role assigning, non-case assigning, and meaningful prepositions (Garrett, 1984; Kean, 1977; 1979; Levelt, 1989; Rizzi, 1985; Ruigendijk, 2002).

In the next section studies that dealt specifically with preposition deficits in aphasia are outlined. At the heart of this section are studies that, in addition to exploring the availability of different types of prepositions in (mostly Broca's) aphasia, also identified the parameters that account for their relative loss or preservation.

2.2   EMPIRICAL STUDIES OF PREPOSITION IMPAIRMENTS IN APHASIA

Prepositions are reported to be frequently omitted in agrammatic aphasia (see e.g., Menn & Obler, 1990). Nevertheless, they did not receive a great deal of attention in aphasia research. Initially, it seemed that there are only a handful of studies that dealt with the availability of prepositions in aphasia. However, a careful review of the literature resulted in a total of 27 papers on the production, comprehension, and grammaticality judgment of prepositions of 305 patients (including three therapy studies) published during the last three decades. This is nevertheless in sharp contrast to the considerably larger interest into verbs, noun/verb differences, and verb inflections (see e.g., Mätzig, Druks, Masterson, & Vigliocco, in press). Moreover, previous research on prepositions has been 'sporadic' in that some studies have hardly ever been cited, reviewed, and related to each other.

All previous preposition studies were, naturally, influenced by knowledge available at their time about forms of aphasia and the linguistic status of grammatical morphemes in general and prepositions in particular. Two different approaches were taken: some studies focused on *one* subcategory of preposition, usually spatial prepositions. The reason is probably that, initially, it was believed that *all* grammatical morphemes are affected to a similar extent (e.g., Kean, 1979; Pick, 1913) and therefore, it was adequate to probe one subcategory. In other studies, the heterogeneity of prepositions was acknowledged with the tendency to show that not all types of prepositions are equally impaired.

The following section reviews this body of research. First, studies that investigated only *one* type of preposition and/or were not interested in finding differences in performance between different types of prepositions are presented. Next, studies that compared the availability of two or more types of prepositions in order to identify the parameters that determined their relative preservation/impairment are described and discussed.

2.2.1   Studies that focused on prepositions in general

The availability of spatial prepositions in aphasia was tested in comprehension (Friederici, 1981; Friederici, Schönle, & Garrett, 1982; Goodglass, Gleason, & Hyde, 1970; Kemmerer & Tranel, 2000; 2003; Morton & Patterson, 1987; Schwartz, Saffran, & Marin, 1980; Tranel & Kemmerer, 2004), production (Friederici, 1981; Friederici et al., 1982; Froud, 2001b; Kemmerer & Tranel, 2000; 2003; Leikin, 2002; Morton & Patterson, 1987; Smith, 1974; Tranel & Kemmerer, 2004), and in acting out, a combination of both, comprehension and production (Leikin, 2002; Mack, 1981; Morton & Patterson, 1987; Smith, 1974). The review of these studies is structured chronologically.

Goodglass and colleagues (1970) used a sentence-picture-matching task carried out in English to test the comprehension of spatial prepositions in a large group of aphasic patients of different clinical profiles. They found that anomic and Broca's aphasic patients did relatively well on this task while conduction, Wernicke's and global aphasic patients were severely impaired. The availability of subcategorized prepositions (e.g., *wait for*) and meaningful prepositions (e.g., *hold the door for the lady*) was also investigated in a grammaticality judgment task. Again, anomic and Broca's aphasic patients (and conduction aphasic patients) did better than

Wernicke's and global aphasic patients. The authors concluded that, although all patients performed worse than the controls, there was no or only a minimal impairment in the comprehension of prepositions and their grammaticality judgment in anomic aphasia, and that the loss of prepositions in speech does not entail loss of knowledge of prepositions. They found that even those Broca's aphasic patients who did not use prepositions in speech could comprehend them better than Wernicke's aphasic patients, who, on the other hand, use prepositions relatively well in speech.

Smith (1974) investigated the ability to act out prepositional sentences using real objects in what seemed (i.e., the type of aphasia was not specified) three English speaking Broca's aphasic, one (mild) Wernicke's aphasic and one anomic aphasic patient. The (very short) speech transcripts (derived from description of spatial arrangements of real objects) of two Broca's aphasic patients were devoid of prepositions, one Broca's aphasic patient often omitted and substituted prepositions, the Wernicke's aphasic patient made few errors involving prepositions, and the anomic aphasic patient used correct prepositions but few in number. Smith found that the Broca's and Wernicke's aphasic patients had more difficulty to act out the correct spatial relationship than to select the correct objects required in the situation. In contrast, the anomic aphasic patient made more errors in selecting the objects than acting out the prepositions. Yet, this patient together with one Broca's type patient was most impaired in acting out prepositions and objects, while the Wernicke's type patient performed best. Smith concluded that patients whose spontaneous speech production lacks prepositions are also impaired in comprehension of prepositions (in contrast to Goodglass et al.'s findings). This was indeed true for the performance of the Broca's aphasic patients and in the opposite direction for the Wernicke's aphasic patient, but not for the anomic aphasic patient for whom there was no relation between the production of preposition in speech and acting out prepositional sentences. Smith did not make an attempt to interpret the specific deficit for prepositions she found. Nor did she comment on the lack of systematic difference between patients of different types of aphasia. Instead, she came to the general conclusion that '*impaired verbal ability in aphasia is the result of failure in one or another of the individual components of the task combined with the failure to deal with the remaining components simultaneously*' (p. 383), which is clearly not a satisfactory one.

Schwartz, Saffran, and Marin (1980) used reversible sentences that described spatial situations such as *The square is on top of the circle* in a sentence-picture-matching task[14] carried out in English. All agrammatic patients performed poorly (range 42% to 58% correct), and most errors were due to the selection of the reversed role distracter and only 12% due to selection of the incorrect preposition. In a second experiment, they compared the comprehension of prepositional and verbal sentences (e.g., *The square is on top of the circle* vs. *The square shoots the circle*)[15]. The majority of patients did not show a difference between the two sentence types, while one patient made significantly more errors on prepositional sentences. All errors were reversals of the objects in the spatial relationship. The authors argued that this patient quite consistently used the strategy to map the subject role of the sentence onto the object. Interestingly, this strategy was confined to prepositional sentences and did not occur (consistently) in the verbal sentences. Nevertheless, the authors did not conclude that the strategy was associated with the type of sentence but rather claimed that this patient (and to a lesser extent the other patients too) applied it in an *'inconsistent fashion from session to session'* (p. 261).

Mack (1981) studied a group of non-fluent and fluent aphasic patients' comprehension (and production) of English spatial prepositions using an acting out task with objects from the token test. He found that fluent patients made more syntactic (spatial relationship incorrect) and semantic errors (objects incorrect) than the non-fluent patients. Thus, although performance was impaired in both groups, the non-fluent patients in this study performed better than the fluent patients. Mack concluded that spatial prepositions are difficult for both fluent and non-fluent patients, which supports '*the notion of aphasia as a generalized deficit, with nonfluents and fluents varying only in the overall degree of impairment*' (p. 89). This conclusion, however, is questionable, because the severity of the comprehension deficit was not controlled in the study. All fluent patients in Mack's study were

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[14] The same authors also conducted a second series of experiments in production (description of pictures) with the same agrammatic patients using the same stimuli (Saffran, Schwartz, & Marin, 1980a). This study is, however, irrelevant for the present discussion. This is because the authors' focus was on word order and thus their scoring system did not take performance on prepositions into account. For example, *The table is over the shoe* in response to a picture of a shoe under a table was scored as an error because the patient produced a non-dominant word order. In contrast, *The girl is under the car* was scored as correct in response to the picture of a girl *on* a car because dominate word order was maintained.

[15] In order to '*eliminate potential pragmatic biases*' (p. 259) the authors used geometrical figures as subjects and landmarks in the pictures eliciting prepositional sentences, and stick figures of the same geometrical figures representing the protagonists in the pictures eliciting reversible actions.

diagnosed with moderate-to-severe comprehension deficits. In contrast, 67% of the non-fluent patients had little or no comprehension deficits. Thus, Mack contrasted the comprehension of spatial situations in two clinical groups which per definition have very different language comprehension abilities. Consequently, it is not clear whether the difference between fluent and non-fluent patients is linked to preposition deficits or to an overall comprehension deficit present in the Wernicke's type patients but not in the Broca's type patients. The finding that semantic errors were also made points towards the latter alternative.

Friederici and colleagues (Friederici, 1981; Friederici et al., 1982) compared the comprehension and production of English spatial (locational and directional) prepositions in Broca's and Wernicke's aphasic patients. They used a number of tasks (spoken and written word-picture-matching, spoken and written naming of spatial situations, spoken and written sentence completion, and spoken and written forced choice sentence completion (Friederici, 1981); written word-picture-matching, written sentence-picture-matching, spoken sentence completion (Friederici et al., 1982). Friederici (1981) reported that production was more impaired than comprehension in both types of aphasia and that Broca's aphasic patients were overall more impaired than Wernicke's aphasic patients. Friederici argued that the extra demand of phonology and syntax present in spoken production caused the more severe deficit in production compared to comprehension, which, she argued, only engages semantic resources. She also found that Broca's aphasic patients frequently omitted prepositions while Wernicke's aphasic patients more often substituted them. On the basis of this finding, Friederici claimed that Wernicke's aphasic patients are able to use syntactic information, but have a selection disorder. Broca's aphasic patients, on the other hand, have a syntactic deficit. In the 1982 study, the Broca's aphasic patients were not significantly more impaired than the Wernicke's aphasic patients, but there was a difference in performance in the different tasks: there were no task effects for the Wernicke's aphasic patients but there was a difference for the Broca's aphasic patients. They performed well in single word tasks (word-picture-matching) but were severely impaired in tasks involving sentences (sentence-picture-matching and sentence completion). The authors argued that because of Broca's aphasic patients' inability *'to use knowledge of phrasal organization'* (p. 531), they fail in all tasks – be it comprehension or production – that require syntactic processing, that is, tasks that involve sentences. In contrast, they have intact

'*lexically based inferential capacities*' (p. 531), and thus do well on tasks that require identifying the meaning of a single word.

Morton and Patterson's (1987) study is with deep dyslexic patients. Since deep dyslexia and agrammatic aphasia often co-occur, and because deep dyslexic patients have difficulty in reading grammatical morphemes, Morton and Patterson's study is of interest. The authors describe an English speaking agrammatic patient with deep dyslexia who was able to read correctly only 36% of prepositions (and conjunctions) and made many errors by substituting the preposition with another grammatical morpheme (e.g., *beside → because; between → sometimes*). Omissions and across-category substitutions (e.g., *through → rough*) were less frequent. In order to test the patient's written word comprehension, the authors developed the *triad method*. The patient was presented with three words: the target word and two other words that were semantically related to the target and one of them shared more features with the target word than the other. The patient had to decide which of the two words went with the target word. Spatial and temporal prepositions were used. An example of a trial using prepositions is in (17).

(17) spatial: over temporal: before
              up   since
         under   after

The patient's comprehension of spatial (81% correct) and temporal (72% correct) prepositions was moderately impaired. When the authors also looked at the comprehension of other grammatical categories (e.g., number, gender, case marking on pronouns), it seemed that performance was better on those grammatical morphemes that had more semantic content. This was true also within the class of prepositions: spatial prepositions, being semantically more concrete, were better preserved than temporal prepositions. In additional tests (association of antonym prepositions (e.g., before/after, above/below) and word-picture-matching where the patient was given a picture with, for example, three men one following the other and had to assign the prepositions *in front of, between,* and *behind* to each of the men in the picture) problems with temporal (but not spatial) prepositions were found. This led the authors to suggest that the meaningful/meaningless division not only distinguishes content and function words but also applies within the class of function words. In another experiment, Morton and Patterson tested the comprehension of

prepositions at sentence level. In acting out written sentences, the patient had no difficulty to determine the correct spatial relationship; however, he consistently reversed the order of the objects around the preposition. Thus, the patient's comprehension of prepositions at sentence level was better than at single word level (in contrast to Friederici et al.'s findings). Unfortunately, no explanation is provided as to why comprehension of prepositions in sentences was so much better preserved than single word comprehension.

Druks and Froud (Druks & Froud, 2002; Froud, 2001a; 2001b) provide another example of how dyslexia can contribute to understanding the linguistic properties of agrammatism. They present the case of an English speaking agrammatic patient with phonological dyslexia – a disorder of reading that is related to deep dyslexia and is characterized by an inability to read non-words, and impaired reading of morphologically complex words and function words. The patient had little difficulty reading content words (including abstract words) and in his spontaneous speech, which was often ungrammatical, he used many function words. In contrast, he was unable to read function words including prepositions and no difference was found between more meaningful (e.g., spatial prepositions, personal pronouns) and less meaningful function words (e.g., determiners, conjunctions). The comprehension of (meaningful) function words that he could not read was nevertheless well preserved. Froud (2001b) examined the patient's reading of prepositions that are homophonic with nouns and adjectives (e.g., *behind the house – the behind of the house / opposite the house – the opposite house*). When *behind* was used as a preposition, the patient could not read it, when, however, *behind* was used as a noun, he could. His case provided an interesting ground for testing the linguistic status of prepositions – are they lexical or functional? Because the patient treated prepositions like other function words such as determiners, complementizers, or auxiliaries, Froud concluded that a preposition's representation, even if it carries meaning, is not lexical. She suggested a re-analysis of prepositions as functional heads (f-heads) – a category that is applicable to all elements other than nouns, verbs, and adjectives. She proposed, following Ouhalla (1993), that f-heads and non-f-heads are represented in different lexicons: a UG lexicon and a conceptual (grammatical, according to Ouhalla) lexicon. The UG lexicon contains f-heads and the syntactic features associated with them. Froud claimed that access to the UG lexicon is impaired in the patient, while he has no difficulty to access the conceptual lexicon. It is problematic for Froud's

proposal that the syntactic preposition *of* was not affected (83% correctly read). Froud (2001b) suggested that the patient '*does not in fact read the possessive construction here*' (p. 17) but that production of the syntactic *of* in phrases such as *the behind of the elephant* is a strategy that links two nouns together. This however does not explain why the patient should resort to (correct) production of the syntactic preposition *of* – a prototypical f-head.

Leikin (2002) described a study of a group of Russian speaking agrammatic Broca's, Wernicke's, and transcortical sensory aphasic patients and children (whose results are not reported here) in naming, repeating, and acting out prepositional sentences, and copying spatial situations. Leikin found an overall effect of task: copying was best preserved followed by repetition, acting out and naming. Broca's aphasic patients were most impaired in naming prepositions, Wernicke's aphasic patients were poorest in repetition, and transcortical sensory aphasic patients had marked difficulties in acting out. The majority of errors in all tasks were substitutions. Leikin further observed that the patients tended to substitute one preposition for another, thus demonstrating access to a large range of different prepositions. Hence, Leikin concluded that the prepositional system is not totally damaged even in agrammatic Broca's aphasia.

The most recent studies by Kemmerer and Tranel (2000; 2003; Tranel & Kemmerer, 2004) explored the availability of spatial prepositions in a group of ten English speaking aphasic patients (Kemmerer and Tranel did not provide clinical profiles for most of their patients) and found severe impairments in the production and comprehension of spatial prepositions in eight of those patients. Five patients were more impaired in production than comprehension (Kemmerer & Tranel, 2000: patient JB; Tranel & Kemmerer, 2004: patients 1076, 1760, 1978, 2054). No difference between the two modalities was found for three patients (Kemmerer & Tranel, 2003: patient RR; Tranel & Kemmerer, 2004: patients 1726, 1962). Error analyses are provided for JB (Kemmerer & Tranel, 2000), and for the group of aphasic patients from Tranel and Kemmerer (2004). While the majority of JB's errors were within-category substitutions, in the group there were more omissions. Among the patients there were also some who had no (or only very mild) impairment of prepositions (Kemmerer & Tranel, 2000: patient PG; Kemmerer & Tranel, 2003: patient JP, a Broca's type patient). Hence, Kemmerer and Tranel's findings allow

concluding that difficulties with prepositions are a typical but not necessary feature of (Broca's) aphasia.

Summary

Most studies reported impairments in relation to prepositions in patients with different forms of aphasia. The severity of the impairment depended on the task demands and type and severity of aphasia: comprehension was found to be less vulnerable than production and some researchers (Friederici, 1981; Friederici et al., 1982) found Broca's aphasic patients more impaired than Wernicke's aphasic patients in both comprehension and production, while other studies reported that, at least in comprehension, Broca's aphasic patients performed better than Wernicke's aphasic patients (Goodglass et al., 1970; Mack, 1981), and anomic aphasic patients (Smith, 1974).

The small scope of investigation is the main limitation of most of these studies. Early studies used only small sets of stimuli and none of the early studies treated prepositions as a heterogeneous category. Thus, their conclusions are only applicable to the subcategory of preposition studied but not to prepositions in general. Moreover, some of these studies only described performance but did not offer an interpretation, or offered inadequate interpretations (e.g., Goodglass et al., 1970; Smith, 1974).

2.2.2   Studies that compared different subcategories of prepositions

By comparing different types of prepositions, emphasis is placed on the fact that not *all* grammatical morphemes are equally impaired in aphasia. However, in order to compare different types of prepositions, the subcategories of prepositions have to be distinguished correctly from one another. It will be shown that some studies misclassified the prepositions used which consequently led to misinterpretations of the results. The studies that compared performance on different subcategories of prepositions identified a number of parameters that distinguish between (better) preserved and (more) impaired prepositions. The review of these studies is structured along these parameters. It begins with describing those studies that distinguished between different prepositions on the basis of *lexical parameters*, that is, those parameters that pertain to the semantic, syntactic, morphological or phonological properties of the prepositions themselves. It continues with those studies that

distinguished between different prepositions on the basis of *structural parameters*, that is, on the basis of the linguistic context prepositions appear in.

Lexical parameters

The effects of meaningfulness, lexicality, phonological properties, and frequency, of individual prepositions were considered in studies that explored the effects of lexical parameters of prepositions.

Meaningfulness

The notion that meaningfulness of prepositions facilitates their availability goes back to Zurif, Caramazza, and Myerson (1972). Using a meta-linguistic task they tried to identify the grounds upon which agrammatic patients and control participants, speakers of English, (intuitively) group constituents of sentences: semantic, syntactic, or linear. Some sentences included prepositions such as the passive *by*, the dative *to* and the infinitival *to*. The authors argued that if the patients have intact linguistic knowledge they will group the words together according to the same phrase structure rules that non-brain-damaged control participants used (e.g., [[gifts [were given]] [by John]]). If, however, patients have impaired syntactic knowledge they will resort to the use of semantic, left-to-right visuo-spatial, or other strategies. It was found that the agrammatic patients were able to group together prepositional phrases like [to John] and [by John] but not [to eat]. Zurif et al. concluded that agrammatic Broca's aphasic patients are sensitive to phrase structure rules and to the information meaningful prepositions convey. However, they failed on purely syntactic, meaningless prepositions. It was concluded, therefore, that meaningfulness determines the availability of prepositions in Broca's aphasia.

Friederici (1982) came to a similar conclusion. She compared production and grammaticality judgement of prepositions in German speaking Broca's and Wernicke's aphasic patients. The stimuli were divided into spatial and subcategorized prepositions. Broca's aphasic patients' production of spatial preposition was better than that of subcategorized prepositions. No difference was found between types of prepositions in the judgement task. The majority of errors made by the Broca's aphasic patients were omissions and across-category substitutions. Friederici argued that Broca's aphasic patients cannot assign syntactic structure. This affects the production of 'syntactic' (i.e., meaningless subcategorized)

prepositions to a greater extent than 'semantic' (i.e., meaningful) prepositions. Wernicke's aphasic patients performed better on subcategorized prepositions in both tasks. They made many within-category substitutions but few omissions. This suggested to Friederici that these patients fail in semantic (but not syntactic) processing.

A potential problem with Friederici's argumentation, however, is that she assigned subcategorized prepositions among syntactic prepositions. Not all linguists accept this classification. According to an alternative view, subcategorized prepositions are lexically selected by the verb and they are theta-role assigners, though the type of the theta-role assigned is not transparent (e.g., Neeleman, 1997). If true, Friederici's stimuli were not well chosen to test for dissociations between 'syntactic' and 'semantic' prepositions; instead, they examined the availability of lexical prepositions with different degrees of semantic transparency.

An in-depth single case study of prepositions in aphasia was reported by Druks (1991). She described the performance of a Hebrew speaking agrammatic patient (SL) whose spontaneous speech was entirely devoid of prepositions. The availability of prepositions was tested in a number of single word and sentence level tasks, including comprehension, production, and grammatical judgement of prepositional sentences. Among the materials, Druks included meaningful, subcategorized and syntactic prepositions. She found that the patient's comprehension of (meaningful) prepositions in sentence-picture-matching was not impaired. In contrast, production of prepositions was severely impaired, but less so on single word than sentence level. Overall, meaningful prepositions were somewhat better preserved than meaningless prepositions. Druks concluded that meaningfulness of a preposition facilitates production in structured tasks (but not in spontaneous speech). What Druks' study also demonstrated is that the availability of prepositions can differ in different tasks. Although prepositions were completely absent in the patient's spontaneous speech, she was able to correctly produce *some* prepositions in the structured tasks. Druks' study is also one of few that found large differences between comprehension and production of prepositions.

Lexicality

Bennis, Prins, and Vermeulen (1983) re-examined Friederici's theory on the basis of the linguistic criteria of the Extended Standard Theory (Chomsky, 1972; Jackendoff,

1972) that distinguishes between prepositions that are lexically inserted (lexical prepositions) and prepositions whose insertion depends on the syntactic configuration of the sentence (syntactic prepositions). Among the lexical prepositions they included spatial and subcategorized prepositions and among the syntactic prepositions, the syntactic *of* and dative *to*. Broca's aphasic patients (speakers of Dutch) were found to be better at producing lexical prepositions than syntactic prepositions in a sentence completion task[16]. The opposite pattern was found for Wernicke's aphasic patients. The majority of errors made by Broca's and Wernicke's patients were within-category substitutions. Bennis et al. argued that Broca's aphasic patients have a deficit in syntax-based processing with relatively well preserved lexical processing, and Wernicke's aphasic patients present with the opposite pattern of impairment. Thus, Bennis et al.'s data suggest that lexicality of a preposition affects its availability in aphasia.

A potential problem of the Bennis et al. study is related to the classification of the dative *to* which remains controversial to date. Some argue, and this is the position of Bennis et al., that the dative *to* is a meaningless, purely case assigning preposition. However, according to an alternative view the dative *to* is lexical and meaningful (see discussion in 1.2). If this view is correct, the dative *to* was wrongly included among the syntactic prepositions, which would make the conclusion invalid.

Phonological properties

That the phonological properties of prepositions could determine their availability was implied in Kean's theory of agrammatism (1977; 1979). Druks' (1991) study of a Hebrew speaking agrammatic patient (SL) suggests that Kean's claim might be in the right direction. Hebrew provides an excellent testing ground because it has longer, free standing prepositions and very short, unstressed prepositions that are cliticized to their complement nouns. Both these and the free standing prepositions can be pronominalized by inflecting them for person, number and gender. Examples are given in (18).

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[16] Bennis et al. also carried out a grammaticality judgment task, which is not reported here. The reason is that this task focused on the examination of different types of sentences rather than different subcategories of prepositions.

(18)   *Bound prepositions*   *in obligatory cliticized form*

le- 'to'   →   le-London 'to London'

be- 'in'   →   be-London 'in London'

Bound prepositions   *in pronominalized form*

be- 'in'   →   banu 'in us'

le 'to'   →   li 'to me'

mi- 'from'   →   mimeni 'from me'

Free preposition   *in pronominalized form*

lifney 'in front of'   →   lefanenu 'in front of us'

shel 'of'   →   sheli, shelxa 'mine, yours'

Druks made some interesting observations. First, the isolated production (repetition) of bound prepositions that always require cliticization to the following noun was very difficult for the patient. Second, while the patient never used (non-pronominalized) prepositions in connected speech, Druks found some instances of pronominalized prepositions in connected speech, and in some of the structured tasks (reading, writing to dictation, sentence completion) the patient preferred to produce a pronominalized preposition rather than the bare one, and made such substitution errors (to demonstrate that she knew which preposition was required). Druks explained this phenomenon in terms of phonology. The pronominalization of prepositions added length and stress to the preposition. Therefore, the patient was better able to produce *sheli* 'of me → mine' or *mimeni* 'from me' but not *shel* 'of' or *mi-* 'from' in sentence completion. Of course, pronominalization also added meaning to the preposition. However, some free standing prepositions convey meaning on their own (e.g., *lifney* 'in front of'), and yet, the patient produced only pronominalized prepositions in speech (e.g., *lefanenu* 'in front of us'). This shows that the patient preferred to produce longer prepositions. Nevertheless, Druks maintained that length is not the only factor to account for the problems aphasic patients have with prepositions. Instead, at least for this patient, she proposed that multiple factors contribute to the impairment/ preservation of prepositions, among them their length and meaningfulness.

Frequency

Kreindler and Mihăilescu's (1970) is the only study that compared the production of prepositions in the speech of aphasic patients and non-brain-damaged control participants. Large samples of connected speech of 10 Romanian speaking aphasic patients with expressive and/or receptive aphasia and 10 control participants were compared. Kreindler and Mihăilescu found that prepositions constituted on average 13.1% of all words in the speech of the controls. They used 33 different preposition types with an average of 17 preposition types per individual speaker (with a range of 14 to 24). The patient group produced an average of 9.5% prepositions. They used 23 different preposition types with an individual range of 7 to 16. More revealing than the percentage of prepositions correctly produced was the frequency of the prepositions produced by the aphasic patients and controls. Kreindler and Mihăilescu determined the frequency of a preposition by its occurrence in the controls' speech. The authors found that those prepositions that occurred frequently in the controls' speech were also used frequently by the aphasic patients. The most frequent prepositions in the speech of the controls were *de* 'by, of', *la* 'at, to, by', and *pe* 'on, upon' (see Kreindler & Mihăilescu, 1970, Table 2, p. 278). These prepositions were well preserved even in the speech of the most severely impaired patients. In turn, the prepositions that were used infrequently by the controls were absent from the patients' speech. Kreindler and Mihăilescu's results thus suggest that frequency of use of prepositions has an effect on their availability in aphasic patients.

Among the best preserved prepositions were prepositions with syntactic function, possibly, according to Kreindler and Mihăilescu, because of their frequent occurrence in the speech of healthy speakers. Syntactic prepositions are of high frequency in other languages too. For example, in Francis and Kučera's database (1982) *of*, *to*, and *by* are among the 22 most frequent words in (written) English[17]. If frequency indeed has an effect, syntactic prepositions are at an advantage. The problem, however, is that it is (almost) impossible to disentangle the effects of frequency differences and function of a preposition. This becomes clear in Table 1 which gives the average frequency of a sample of syntactic, polysemic and non-

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[17] Unfortunately, Francis and Kučera's frequency database (as well as the CELEX database mentioned below) does not distinguish the different usages of polysemic prepositions. Hence, the frequency value given for a preposition token such as *of* is most likely the sum of the individual frequencies of its different usages (e.g., as syntactic and subcategorized preposition). Only the frequency of the infinitival *to* is listed separately from its other usages (e.g., as meaningful and subcategorized preposition).

polysemic prepositions in English (those that were used in the present study). The frequency values stand for the number of times English prepositions occur in a corpus of 1.014.000 written words of English (Francis & Kucera, 1982) and a corpus of 17.900.000 spoken and written English words (CELEX database by Baayen, Piepenbrock, & Gulikers, 1995). The table shows that syntactic prepositions are the most frequent ones, polysemic prepositions are of medium frequency, and non-polysemic spatial and temporal prepositions are of the lowest frequency in English.

Table 1: Average frequency of a sample of syntactic, polysemic, and non-polysemic prepositions in English

Frequency values	syntactic	polysemic	non-polysemic (spatial/temporal)
Francis & Kučera	25729	8687	433
CELEX	540085	135781	7591

Therefore, because frequency of use and subcategory of a preposition coincide, it is difficult to decide whether the preservation of syntactic prepositions is due to an effect of prepositional subcategory or frequency.

Structural parameters

The effects of the structural context in which a preposition appears, and the extent to which the choice of a preposition is constrained by the context are considered in this section.

Government

Grodzinsky (1988) used the linguistic construct of government to explain the selective deficit for different subcategories of prepositions. Government determines the degree of the relationship between the verb and the PP (e.g., Chomsky, 1981). The relation is intrinsic in the case of arguments, and accidental in the case of adjuncts. Ungoverned PPs (adjuncts) are always optional. Their deletion from the sentence does not result in ungrammaticality (e.g., *it was raining [on Sunday]*). Governed PPs (arguments) are mostly obligatory (e.g., *Sue relies [on her friend]*), though some governed PPs are optional (e.g., *Adam stole £10 [from the old man]*). Optional arguments are part of the verb phrase and, when realized, they are governed

(Grimshaw, 1990). PPs that are headed by subcategorized prepositions and particles are always governed and obligatory (e.g., *Sue relies ~~[on her friend]~~, *Sue filled ~~[in the form]~~*). Most meaningful prepositions, however, can be either governed obligatory arguments (e.g., *the key is [in the pocket])*, governed optional arguments (e.g., *she sent a postcard [from Spain]*) or ungoverned optional adjuncts of the verb (e.g. *the team played hockey [in the hall]*).

Grodzinsky suggested that prepositions that are governed by the verb are impaired because governed terminal nodes are deleted from the syntactic tree, while prepositions that are ungoverned by the verb are spared. Unfortunately, Grodzinsky does not provide justification for this claim. It could be argued, however, that this performance pattern is expected in agrammatic aphasic patients with underlying syntactic impairments. A possible reason is that governed prepositions are intrinsically embedded in the sentence structure and ungoverned prepositions are only loosely related to the sentence structure. A syntactic deficit would, therefore, affect the ability to parse close syntactic relationships more than loose syntactic relationships.

Grodzinsky compared the syntactic passive *by* (ungoverned) with subcategorized prepositions (either governed optional as in the lexical passive *the boy is interested [in the girl]* or governed obligatory as in the subcategorized active *the boy counts [on the girl]*) in a grammaticality judgment task conducted in English. Broca's aphasic patients made more errors when they were required to detect ungrammaticality in sentences with governed prepositions (lexical passive and subcategorized active) than in sentences with ungoverned prepositions (syntactic passive).

There are several problems with this study: (i) the empirical evidence in support of the theory was weak because it was present only in the ungrammatical sentences, not in the grammatical ones; (ii) the distinction between governed and ungoverned prepositions is confounded with another distinction between idiomatic (subcategorized prepositions) and non-idiomatic prepositions (the passive *by*); (iii) the selective advantage found for ungoverned prepositions was not replicated with other word types: in Thompson et al.'s study agrammatic aphasic patients produced more verb arguments than verb adjuncts in connected speech (Thompson, Shapiro, Tait, Jacobs, & Schneider, 1996); (iv) the notion of government has been given up by current linguistic theories (e.g., Chomsky, 1993; 1995).

A few subsequent studies re-examined the influence of government on the availability of prepositions in aphasia. Some supported Grodzinsky's conclusion, while others failed to find evidence for it. Lonzi and Luzzatti (1995) tested two Italian speaking agrammatic patients' ability to complete sentences missing either governed subcategorized and spatial prepositions or ungoverned spatial preposition and the passive *by*. While one patient was severely impaired on all types of prepositions, the second patient was significantly more impaired on governed than ungoverned prepositions. As the authors included governed *and* ungoverned spatial prepositions in their materials, they avoided the confounding effect present in Grodzinsky's original study. Tesak and Hummer (1994) analysed the production of prepositions in the spontaneous speech of a group of German speaking agrammatic Broca's aphasic patients. By classifying the prepositions correctly produced/omitted into governed and ungoverned, in contrast to Lonzi and Luzzatti, they did not find an advantage for ungoverned prepositions. On the contrary, they found governed prepositions to be omitted less frequently than ungoverned prepositions, though the difference was small. Similarly, Druks (1991) tested the effect of government in an agrammatic patient (SL) in Hebrew. She included meaningful governed prepositions (spatial prepositions, dative *to*) and meaningful ungoverned prepositions (spatial and temporal prepositions). Thus, as Lonzi and Luzzatti, she tested the effect of government within the same type of preposition. She found no difference in the production of governed or ungoverned meaningful prepositions. The data show that true effects of government have been found in one patient only so far (Lonzi & Luzzatti, 1995).

Recoverability

Lonzi and colleagues (Lonzi, Luzzatti, & Vitolo, 2007) account for the problems agrammatic aphasic patients have with prepositions in terms of Optimality Theory (e.g., Prince & Smolensky, 1993). The claim is that the pronunciation of grammatical morphemes in aphasia is regulated by the same principles as in healthy speakers. However, in the case of aphasia, these principles are re-ranked. This affects in particular the Telegraph Constraint (see e.g., Chomsky, 1981; Pesetsky, 1998), which maintains that function words are not to be pronounced. This results in the omission of grammatical morphemes (this includes, according to Lonzi et al., all types of prepositions), and what is omitted and what is maintained is constrained by the

Recoverability Condition. According to the Recoverability Condition, grammatical morphemes must be pronounced unless their deletion can be recovered by a local antecedent (i.e., a verb, according to Lonzi and colleagues). This divides prepositions into recoverable prepositions which are predicted to be omitted and unrecoverable prepositions which are predicted to be preserved. Subcategorized prepositions, for example, are specified by the verb and hence, if omitted, their identity can be recovered from the context. Some spatial prepositions (e.g., *put your hands under/on/over the table*), in contrast, are underspecified by the verb, and, hence, if omitted, cannot be recovered from the context. Other spatial prepositions, according to Lonzi et al., are however recoverable due to extra-linguistic reasons (e.g., *the boy is pouring the water from a vase*)[18].

Lonzi et al. (2007), working in Italian, compared the availability of recoverable prepositions such as spatial prepositions (*the boy is pouring water from a vase*), subcategorized prepositions (*the tent belongs to a boy*), and prepositions in adjectival passives (*he has been intrigued by the scene*) with that of unrecoverable prepositions such as spatial prepositions (*the boy is reading a book on a deck-chair*), 'other theta-role assigning' prepositions (e.g., *the girl ties the parcel with a string*), and prepositions in syntactic passives (both with action verbs as in *the dog is trained by a boy* and psychological verbs as in *the dog is loved by a boy*) in sentence completion and grammaticality judgement in four agrammatic Broca's aphasic patients. No difference in performance on the different sentence types was found in grammaticality judgment due to good overall performance. However, Lonzi et al. found that recoverable prepositions were more often omitted (and substituted[19]) than unrecoverable prepositions in production. This was also true for homophonic prepositions in different functions (e.g., adjectival passives and syntactic passives). These results were compatible with the overuse of the Telegraph Constraint in conjunction with the Recoverability Condition by the patients.

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[18] Of course, the boy could also pour the water *into* a vase. However, it must be assumed that Lonzi et al. specified the spatial situation well enough with pictures and/or sentence frames thus ruling out any other prepositions than *from* as correct response.

[19] Both omissions and substitution errors were taken as evidence for the effects of recoverability (although the account clearly favours omission errors) because the authors found a correlation between omission and substitution errors in agrammatic speech: (recoverable) prepositions that were more likely to be omitted in connected speech were also prone to substitution errors while (unrecoverable) prepositions that were less likely to be omitted were also less prone to substitution errors in Broca's aphasia.

Spatial prepositions were an exception in so far that the majority of patients had problems with both recoverable and unrecoverable spatial prepositions. This is however problematic for Lonzi et al.'s account because it requires additional stipulation in the form of a *'supplementary licensing condition'* (p. 291). Lonzi et al. argued that *all* spatial prepositions are recoverable from the context due to *'the obligatoriness of location for any material action'* (p. 291). Therefore, *all* spatial prepositions are prone to omission[20].

The need for an extra stipulation for spatial prepositions weakens Lonzi et al.'s account and it loses clarity in that it is not evident whether recoverability is a grammatical or a pragmatic parameter. It seems that, in the case of non-spatial prepositions, recoverability functions as a grammatical principle because the verb acts as local antecedent for (recoverable) prepositions and determines their identity. For spatial prepositions, however, recoverability appears to be a pragmatic principle.

Moreover, Lonzi et al.'s claim that recoverability is achievable only by *lexical* antecedents (i.e., the verb) is questionable. According to them, for example, the passive *by*-phrase is unrecoverable because it is not linked to a verb. What Lonzi et al. do not consider is that the *by*-phrase might be recoverable by sentence structure.

Finally, it should be noted that the categorisation of the prepositions of Lonzi and colleagues largely overlaps with Grodzinsky's, albeit on different grounds. While Grodzinsky distinguished governed and ungoverned prepositions, Lonzi et al. differentiate between prepositions that are recoverable by a local antecedent (and also governed) and those that are unrecoverable (and also ungoverned). Thus, all recoverable stimuli are also governed and all unrecoverable stimuli are also ungoverned (as far as the English translations allow judging[21]). Therefore, the effects of government and recoverability were not disentangled.

In relation to spatial prepositions, the two theories make different claims. According to Grodzinsky, only *governed* spatial prepositions are impaired. Lonzi et

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[20] Lonzi et al. noted that the patients tended to produce within-category substitutions for spatial prepositions which was interpreted by saying that the '*representation of the relevant thematic grid is preserved*' (p. 289). This is expected considering the '*obligatoriness of location'* that constrains the choice of substitute prepositions to a spatial preposition but does not specify the precise location of the action.

[21] Lonzi and colleagues did not clarify the status of the stimuli in terms of government in their paper. However, the English translations suggest that all recoverable prepositions are also (governed) arguments (optional: *the boy is pouring the water from a vase;* obligatory: *the tent belongs to a boy*) and all unrecoverable prepositions are (ungoverned) adjuncts (e.g., *the boy is reading a book on a deck-chair)*.

al., however, initially argued that *some* spatial prepositions are recoverable (due to extra-linguistic reasons), and, therefore, more prone to omission, and other spatial prepositions are unrecoverable, and, therefore, less prone to omission. This remains similar to the distinction in Grodzinsky (1988). In their interpretation of the results, however, Lonzi and colleagues reconsidered their position and argued that *all* spatial prepositions are recoverable, and therefore, prone to omission. This is incompatible with Grodzinsky's account but it also undermines the recoverability distinction.

In most likelihood, Lonzi and colleagues did not consider government to be an important linguistic construct (though see Lonzi & Luzzatti, 1995), and, therefore, did not consider it important to control their stimuli for effects of government. In all eventualities, Lonzi and colleagues' data do not convincingly support the recoverability account *and* cannot reject Grodzinsky's argument/adjunct distinction.

Constraint on lexical search

A somewhat similar idea was formulated by Wales and Kinsella (1981). They attributed the selective impairment of different types of prepositions to a difference in the constraints on lexical search for distinct prepositions. The authors compared the production of nouns, verbs and prepositions in a group of English speaking Broca's aphasic patients. Prepositions consisted of meaningful and subcategorized prepositions (which were not analysed separately)[22] and particles. Particles were either adjacent or non-adjacent to the verb. They used a sentence completion task in which the sentences were controlled for the number of possible options to complete them grammatically. Three levels of constraints with respect to the potential choice of words were identified: one word only (high constraint), two or three words (intermediate constraint), and more than three words (low constraint). The effects of grammatical class were significant. The Broca's aphasic patients performed best on non-adjacent particles followed by nouns, adjacent particles and verbs and they performed poorest on prepositions. The advantage of nouns over prepositions was interpreted as evidence for a syntactic deficit, despite the relatively good performance on particles and poor performance on verbs. Post hoc, no difference was found between spatial and subcategorized prepositions. The effects of level of

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[22] The authors did not clearly specify the types of prepositions used in their study. Only in their discussion is there some evidence that the prepositions included were spatial (i.e., *being in hospital*) and subcategorized prepositions (i.e., *believing in God*) (p. 306).

constraint were not significant. However, the post hoc analysis of the levels of constraints employed by spatial (i.e., 'local') and subcategorized (i.e., 'grammatical') prepositions revealed that '*the likelihood of a preposition with a 'grammatical' function being correct is relatively higher with high constraint […] whereas the level of constraint seems to have little effect on 'local' function. This effect with 'grammatical' function prepositions is what would be expected if the higher constraint is restricting the options in lexical search by syntactic means.*' (Wales & Kinsella, 1981, p. 306). Wales and Kinsella's findings suggest that different degrees of constraints are intrinsically related to different subcategories of prepositions. If true, it may be hypothesized that, if aphasic patients are indeed sensitive to the benefits of structural or lexical constraints on certain types of prepositions, then prepositions which are relatively highly constrained should be better preserved than those whose choice is relatively little constrained. Under this proposal subcategorized prepositions and syntactic prepositions are at an advantage because their identity is inherently constrained by the preceding verb or a certain syntactic configuration. In contrast, meaningful prepositions are at a disadvantage because their identity is less constrained and mostly depends on the semantic *and* syntactic analysis of the entire sentence.

Summary

Research into prepositions has been united in the assumption that prepositions are a heterogeneous class and that different types of prepositions can be affected by selective deficits. However, there is no consensus yet about (i) which type(s) of prepositions are prone to impairment and which type(s) resist language breakdown and (ii) about the parameter(s) that determine the availability of different types of prepositions in aphasia. That (ii) is not a consequence of (i) can be seen in studies which accounted differently for the same data. Grodzinsky (1988) and Friederici (1982), for example, both examined the availability of idiomatic (subcategorized) and non-idiomatic (passive *by*, spatial) prepositions with similar results. Yet, their interpretations of the data could not be more different. Similarly, Lonzi and colleagues analysed the availability of recoverable versus unrecoverable prepositions. Their distinction overlaps with Grodzinsky's governed/ungoverned divide of prepositions, and they obtained similar results as Grodzinsky but account for the data differently.

The parameters identified so far and the predictions they make on the availability of different types of prepositions in mostly Broca's aphasia are summarized in Table 2.

Table 2: The parameters identified by previous research and the predictions they make with respect to the availability of different types of prepositions in aphasia

Lexical parameters	Predictions
Meaningfulness	meaningful prepositions spared meaningless prepositions impaired
Lexicality	lexical prepositions spared syntactic prepositions impaired
Phonological properties	longer prepositions spared shorter prepositions impaired
Frequency	high frequency prepositions spared low frequency prepositions impaired
Structural parameters	**Predictions**
Government	ungoverned prepositions spared governed prepositions impaired
Recoverability	unrecoverable prepositions spared recoverable prepositions impaired
Constraint on lexical search	highly constrained prepositions spared poorly constrained prepositions impaired

These parameters were the basis for the formulation of the hypotheses of the present study. In the following section, the objectives and hypotheses of the present study are outlined.

2.3   THE PRESENT STUDY

Methodological issues

While the previous body of work is a good starting point for the present study, what can be learnt from it is limited for a number of reasons. First of all, some of the studies only partially addressed the preposition deficit because they focused on *one* type of preposition only. Although other studies acknowledged the heterogeneous status of prepositions, none of them included in their investigation *all* types of prepositions. Many previous studies used only small numbers of exemplars for each subcategory of prepositions (e.g., Friederici, 1982; Grodzinsky, 1988) and some employed faulty methodology (e.g., Kemmerer, 2005, see 4.5). Other studies made theoretical claims without providing their own empirical evidence (e.g., Kean, 1977;

1979; Ouhalla, 1993; Rizzi, 1985) (which, of course, does not mean that those claims were incorrect). The majority of previous studies focused on clinical syndromes and their typical (and expected) patterns of performance in relation to prepositions and, consequently, they presented group data only. Individual differences in performance, therefore, could not be considered (e.g., Bennis et al., 1983; Friederici, 1982; Grodzinsky, 1988). Some studies assumed that only Broca's aphasic patients have grammatical morpheme deficits, and, hence, they studied only this patient group (e.g., Grodzinsky, 1988; Tesak & Hummer, 1994; Zurif, Caramazza, & Myerson, 1972). For example, in Grodzinsky's study, although data of fluent patients was collected, it was used as control data and was not discussed. Most previous studies did not provide background data other than clinical diagnoses (e.g., Bennis et al., 1983; Friederici, 1982; Grodzinsky, 1988; Kemmerer, 2005). Hence, we do not know much about the patients' language behaviour and we cannot compare the preposition deficits found in the experimental tasks with performance in spontaneous speech, or performance on prepositions with performance on other word types, or with other cognitive skills. Most importantly, some studies used in their experiments incorrectly classified prepositions. Friederici (1982), for example, classified subcategorized prepositions as syntactic prepositions, despite the fact that some linguists consider them to be lexically selected by the verb and theta-role assigners (e.g., Neeleman, 1997). As a consequence of these methodological shortcomings, our present knowledge about the extent of the preposition deficit in different types of aphasia and individual patients, and the form it takes is limited and much more so than our knowledge about other word classes such as verbs and verb inflections, for example.

To improve upon the variable and at times conflicting evidence available in previous studies, the present study used more sophisticated methodologies. Data were derived from a number of (relatively) unstructured (i.e., connected speech) and structured tasks in production (i.e., sentence completion, description of spatial situations from pictures), comprehension (i.e., word/sentence-picture-matching, sentence-picture-verification, acting out), and grammaticality judgment (i.e., of single sentences, of contrastive sentence pairs, and forced choice grammaticality judgment). Performance in production, comprehension and grammaticality judgment was compared in order to detect similarities/differences across modalities and tasks. The tasks employed larger sets of materials in terms of the number of subcategories and number of exemplars in each subcategory. Four subcategories of prepositions

were tested (meaningful, subcategorized, syntactic prepositions, particles) and the assignment of prepositions to their category was carefully done in line with current linguistic knowledge. Further, for each patient a large body of background data was obtained that allowed relating performance on prepositions to performance on other grammatical classes and other cognitive skills. For example, it was crucial (i) to investigate the availability of verbs because verbs and prepositions share syntactic properties such as case and theta-role assignment, (ii) to find out if patients have visual and/or spatial deficits because intact spatial processing may be important for the production and comprehension of spatial prepositions; and (iii) to find out if the patients have syntactic comprehension deficits because previous studies have suggested a relationship between syntactic comprehension abilities and the processing of grammatical morphemes, including (at least some types of) prepositions.

Objectives

The literature review has shown that our knowledge about prepositions and their impairments is limited. Although most aphasic patients presented with preposition impairments (e.g., Bennis et al., 1983; Friederici, 1981; 1982), some did not (e.g., Kemmerer & Tranel, 2003). For some aphasic patients the preposition deficit manifested across modalities (e.g., Friederici, 1981; 1982; Kemmerer & Tranel, 2003), while in others some but not all modalities were impaired (e.g., Druks, 1991). Some previous studies found an association between preposition deficits and types of aphasia (e.g., Bennis et al., 1983; Friederici, 1981; 1982), while others did not (e.g., Kemmerer & Tranel, 2003). Some previous studies reported different error types for patients of different forms of aphasia (e.g., Friederici, 1981; 1982), while others did not (e.g., Bennis et al., 1983; Leikin, 2002).

The objective of the present study was to find out the extent of the impairment of prepositions in Broca's and anomic aphasic patients, whether or not there is a relationship between production and comprehension of prepositions, whether or not deficits are linked to diagnostic category, and what types of errors are made. The present study also re-evaluated the parameters that were identified in past studies to account for the impairment/preservation of prepositions. Five previous parameters (a subset of those summarized in Table 2) were re-examined. Table 3 below displays the parameters tested (meaningfulness, lexicality, phonology, frequency and

government), the predictions they make with respect to the different types of prepositions, and the subcategories of prepositions that were used for their re-evaluation. Since the present study used more subcategories of prepositions and more exemplars of each type, it is in a better position than the original studies were to assess the validity of their parameters and predictions. For example, in order to find out the effects of meaning (parameter I (i), in Table 3), instead of confining the comparison to spatial versus subcategorized prepositions as Friederici (1982) did, the availability of a wide range of meaningful prepositions (spatial, temporal, benefactor, instrumental, source, goal, etc.) was compared with a range of meaningless (and truly syntactic) prepositions (the infinitival *to*, the syntactic *of*). This better tested the contrast between meaningful and syntactic prepositions. Similarly, more types of governed and ungoverned prepositions (spatial, temporal, benefactor, instrumental, source, goal, etc.) with more exemplars than in Grodzinsky's (1988) study were used. More importantly, testing the parameters of Friederici, Bennis et al., and Grodzinsky was improved upon by eliminating the confounding factors present in their comparisons. For example, in order to test the effects of meaningfulness (parameter I (i)), subcategorized prepositions were excluded from among the syntactic prepositions because they may be lexically selected and may assign a theta-role (even if the theta-role assigned is opaque, e.g., Neeleman, 1997), and, therefore, are very different from true syntactic prepositions. This better tested the contrast between meaningful and syntactic prepositions (which Friederici (1982) aimed at but failed to test). It also made the test applicable to Rizzi's (1985) and Ouhalla's (1993) theories. Furthermore, in order to ensure that the only difference between the two types of prepositions is meaningfulness (and not *also* lexicality), a second comparison was added for testing the same parameter (parameter I (ii)): instead of comparing meaningful lexical and (meaningless) syntactic prepositions, the effects of meaningfulness were explored within *one* subcategory by contrasting meaningful lexical with meaningless *lexical* prepositions (i.e., subcategorized prepositions and particles[23]), which is the same contrast that Friederici (1982) actually carried out.

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[23] Not all linguists agree that subcategorized prepositions are lexical (but see e.g., Neeleman, 1997) and that all particles are meaningless (but see e.g., Lindstromberg, 1997). Subcategorized prepositions and particles are grouped together here because they are both idiomatic. Admittedly, some particles are meaningful and these are less idiomatic.

Table 3: Parameters, predictions and prepositional subcategories

	Parameters	Source	Predictions made…	Comparisons
I	meaningfulness	Friederici/ Rizzi/ Ouhalla	meaningful > meaningless prepositions	(i) spatial, temporal, 'other theta-role assigning' prepositions *vs.* infinitival *to*, syntactic *of* (ii) spatial, temporal, 'other theta-role assigning' prepositions *vs.* subcategorized prepositions, particles
II	lexicality	Bennis et al.	lexical > syntactic prepositions	subcategorized prepositions, particles *vs.* infinitival *to*, syntactic *of*
III	phonology	Kean, Druks	stressed and longer > unstressed and shorter prepositions	bisyllabic prepositions *vs.* monosyllabic prepositions
IV	frequency	Kreindler & Mihăilescu	high frequency > medium frequency > low frequency prepositions	syntactic *of*, infinitival *to vs.* polysemic prepositions *vs.* non-polysemic spatial and temporal prepositions
V	government	Grodzinsky	ungoverned (adjunct) prepositions > governed (argument) prepositions	ungoverned meaningful prepositions *vs.* governed meaningful prepositions

In order to test the effects of lexicality, Bennis et al.'s comparison of lexical and syntactic prepositions (parameter II) was corrected by comparing *meaningless* lexical (i.e., subcategorized prepositions and particles, see footnote 23) and *meaningless* syntactic prepositions. This made the comparison more balanced in so far that no meaningful prepositions were included among the lexical prepositions, as it was in the original study. To further modify Bennis et al.'s comparison, in our materials the dative *to* was re-classified as a lexical preposition (following e.g., Levin, 1993). The effects of phonology were tested by comparing performance on bisyllabic and monosyllabic prepositions (parameter III). In order to test the effects of frequency as in Kreindler and Mihăilescu's parameter (IV) frequency ratings were taken from the CELEX frequency database (Baayen et al., 1995) (rather than from samples of control data), and the preposition tokens used were classified into high, medium, and low frequency prepositions. Finally, the test of the effects of linguistic government (parameter V) was also modified. Instead of comparing the passive *by* with subcategorized prepositions, as in Grodzinsky (1988), government was explored within one subcategory by contrasting governed and ungoverned meaningful prepositions.

Hypotheses

Previous studies put forward different hypotheses to explain the preposition deficit in aphasia. The present study will test these hypotheses in conjunction with traditional views on aphasia in light of the performance patterns of four Broca's aphasic patients and one anomic aphasic patient.

According to the traditional view, Broca's aphasic patients are assumed to have an underlying syntactic impairment (which was shown to result in the omission or substitution of grammatical morphemes, simplification of sentence structure, paucity of verbs, and asyntactic comprehension) (e.g., Berndt & Caramazza, 1980; Menn & Obler, 1990) and anomic aphasic patients, an underlying lexical impairment (which was shown to have little impact on the availability of grammatical morphemes or sentence structure in general) (e.g., Kay & Ellis, 1987). Because of these fundamentally different underlying impairments (and if we consider prepositions to be grammatical morphemes, as all previous studies of aphasia did) (i) Broca's aphasic patients are expected to perform poorly on prepositions, while the anomic aphasic patient should not show marked difficulties with prepositions. If preposition deficits should be present (even in anomia), then the different nature of their impairments predicts that the two groups of patients perform differently: (ii) Broca's aphasic patients are expected to be most impaired on syntactic prepositions and the anomic aphasic patient, on lexical prepositions (see e.g., Friederici, 1982; Bennis et al., 1983, and parameters I (i) and II in Table 3). Having syntactic deficits predicts that (iii) Broca's aphasic patients are more impaired on governed prepositions than ungoverned prepositions (e.g., Grodzinsky, 1988, and parameter V), while the structural relation between a preposition and the verb should have no effect on the performance of the anomic aphasic patient. Since it has also been claimed that Broca's aphasic patients have underlying phonological impairments (Kean, 1977; 1979), (iv) they are expected to be affected by the length of a preposition. The length of a preposition should have no effect on the anomic aphasic patient (see parameter III). As neither Broca's nor anomic aphasic patients have severe semantic deficits, (v) meaningfulness of a preposition should be beneficial for both patient types (see parameter I (ii)). Finally, as lexical access is known to be influenced by frequency (see e.g., Forster & Chambers, 1973; Segui, Mehler, Frauenfelder, & Morton, 1982) and as anomic aphasic patients are assumed to have lexical impairments, (vi)

frequency of a preposition is predicted to affect their performance, while it should have no effect on the performance of Broca's aphasic patients (see parameter IV).

However, the review of research into prepositions has also shown that these parameters and the predictions they make about expected performance patterns based on the traditional views of aphasia might be overstated. For example, it has been repeatedly found that the preposition deficit is not confined to Broca's aphasic patients, but occurs in patients of all types of aphasia (see e.g., Bennis et al., 1983, for Broca's and Wernicke's aphasia; Goodglass et al., 1970, for conduction and global aphasia; Kemmerer, 2005, for transcortical motor aphasia; Leikin, 2002, for transcortical sensory aphasia; Smith, 1974, for anomic aphasia). This finding contradicts hypothesis (i) and suggests that preposition impairments are not confined to Broca's aphasia and, by implication, to syntactic impairments (which, in turn, is also in contradiction to the expected difference in performance patterns for Broca's and anomic aphasic patients as hypothesized in (ii) and (iii)). This appears to be supported by the prevalence of within-category substitution errors in Broca's aphasia that has been reported in more recent studies (e.g., Bennis et al., 1983; Froud, 2001b; Kemmerer & Tranel, 2000; Leikin, 2002; Lonzi et al., 2007; Morton & Patterson, 1987) because within-category substitution errors indicate preserved syntactic knowledge for the grammatical class of the category in question and preserved parsing (see e.g., Friederici, 1981, who argued for preserved syntactic knowledge on the basis of within-category substitution errors in Wernicke's aphasic patients; see also Bennis et al., 1983). These considerations may imply that the source of the preposition deficit is not syntactic in nature not only in the anomic but also in the Broca's aphasic patients. Therefore, the finding of preposition deficits in anomic (and Wernicke's) aphasic patients that per definition have intact syntax and the finding of within-category substitution errors in Broca's aphasic patients that per definition have impaired syntax suggest that (vii) the preposition deficit in Broca's and anomic aphasia is not due to failure of syntactic operations, but due to failure to *select* the correct preposition at a level *past* syntax. The preposition deficit might be located post syntactically where '*phonological factors […] interact with syntactic ones*' as it has been suggested as early as 1981 by Wales and Kinsella (p. 306). Such a process is late vocabulary insertion at spell-out (e.g., Halle & Marantz, 1993) – an operation between syntax and phonology which links syntactic representations with

phonological representations. If this mapping process is disrupted, mismatches might occur which would surface as within-category substitution errors.

As will be shown in Chapter 6, a disruption of late vocabulary insertion at spell-out is able to explain the occurrence of (similar) preposition deficits in patients of different clinical profiles; selective impairments/preservations of different types of prepositions; and the prevalence of within-category substitution errors. In contrast, other hypotheses fail to account for some or all of these empirical findings.

Chapter 3: Case descriptions

This chapter provides information about the patients (their diagnostic categories, lesions, performance in the neuropsychological background tests, and characteristics of their spontaneous speech), and the control participants that participated in the study.

3.1 THE PARTICIPANTS[24]

The patients

Table 4 gives information about the patients' clinical diagnosis on the Boston Diagnostic Aphasia Examination (BDAE, Kaplan, Goodglass, & Weintraub, 1983), aetiology, time post onset, and lesion site, if available. The full diagnostic profiles of the patients on the BDAE are in Appendix I, and scan images, if available, are in Appendix II. Samples of connected speech for each patient are in Appendix III (the speech data are from description of the *Cat and Fish Story* (for pictures see Appendix IV) and are treated according to the guidelines explicated in 3.3).

Table 4: Information about patients' clinical diagnosis and aetiology

	clinical diagnosis	aetiology	onset of disease	lesion site
BG	predominately Broca's aphasia	haemorrhage	02/2000	no pathological findings evident
DC	predominately Broca's aphasia	haemorrhage	06/2002	not available
DOR	predominately Broca's aphasia	Vascular	1987	fronto-temporo-parieto-occipital extending subcortically, left
EW	predominately Broca's aphasia	haematoma	03/2000	fronto-temporal (involving insula), left and fronto-occipital, right
TH	predominately anomic aphasia	hypoglycemia	03/2001	not available

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[24] Information re ethics: Aphasic and control participants gave their written consent to participate in the study, and, in case of the aphasic participants, to look at their medical reports in relation to their brain injury and to have access to their brain scans, if available. Participants were informed that their participation is strictly voluntary, that, should they decide so, they can withdraw from participating at any time without giving any reason, and that all data is treated confidentially.

Control participants

Five healthy participants with no history of cognitive or language impairments acted as control participants. The control participants and the patients were matched pair-wise for age and years of education. Demographic information about the patients and control participants is given in Table 5. In addition to controls, four students of UCL, whose mother tongue was English, carried out stimulus ratings of the materials of the present study.

Table 5: Demographical information about patients and matched control participants

patient	age	years of education	sex	matched control	age	years of education	sex
BG	53	15	F	**SS**	57	17	F
DC	54	20.5	M	**GC**	57	20	M
DOR	62	9.5	M	**DGR**	62	15	M
EW	64	16	M	**WM**	65	17	M
TH	36	14	F	**CM**	36	20	F
mean	**53.8**	**15**	**-**	**mean**	**55.4**	**17.8**	**-**

Case descriptions

BG

BG is a 53 years old, right handed woman who, prior to her brain damage, was a manager at a London Council. BG was born in Poland. When she was 10 years old, her family moved to England. She was educated in England to a degree level, worked as a clerk in a London council, and was an active member of a union representing employees in court. Thus, it can safely be concluded that, premorbidly, her English was of high standard. In February 2000, following a history of inflammation of the spinal cord (in 1997) and of the optic nerve (in 1998), BG suffered a subarachnoid haemorrhage. An angiogram carried out then indicated a left middle cerebral artery aneurysm, which was clipped in March 2000. A post-operative CT scan was normal indicating little structural brain damage following the operation. However, post-operatively, BG suffered from pain in and weakness of the right hand and from right lower facial weakness and aphasia.

In a speech and language assessment following the operation, BG was described as an excellent communicator with good comprehension at single word level. Her language was described as non-fluent consisting of mostly single word utterances. Object naming was very impaired but she responded well to phonemic cues. She was able to read concrete words only and copy names of objects. She was diagnosed as agrammatic Broca's aphasic patient. Eight years following the haemorrhage, her language has recovered to a large extent which is reflected in her mixed profile on the BDAE now. BG is still rated as Broca's aphasic patient in terms of articulatory agility, paraphasia, word finding, and auditory comprehension and her speech is still characterized by agrammatic features such as omissions/substitutions of grammatical morphemes. However, her phrase length, melodic line and repetition are in line with anomic aphasia. Her use of grammatical form is better than that of typical Broca's aphasic patients but still not within the normal range. The assessment on the Boston Naming Test (BNT, Kaplan, Goodglass, & Weintraub, 1978) revealed good object naming (92% correct). BG is fully mobile. She lives with her husband and two teenage children.

DC

DC is a 54 years old, right handed man who, prior to the stroke, worked as a teacher. DC suffered a subarachnoid haemorrhage in June 2002. In July 2002, he underwent craniotomy in order to clip the left middle cerebral artery. A couple of days later another aneurysm was clipped (no information about lesion site). The haemorrhage left him with severe language problems without dysarthria.

Six years post onset, DC presents with a mixed, predominately Broca's aphasic patient's profile on the BDAE. In line with this diagnosis, he has auditory comprehension deficits and his speech is non-fluent due to severe word finding difficulties, and agrammatic; his sentences are syntactically simple and characterized by omissions/substitutions of grammatical morphemes. However, his BDAE scores on phrase length, articulatory agility, repetition, and melodic line are more in line with anomic aphasia. His melodic line was rated as good because he does not speak in one-word-utterances and is able to use prosody appropriately to convey meaning which he cannot express syntactically. If, for example, DC fails to produce a question, he will produce a simple matrix sentence and indicate the question by adequate intonation. DC also produces many paraphasias and his body part

identification and comprehension of commands is poorer than what is expected of both Broca's aphasic and anomic aphasic patients. He has severe difficulties in naming objects in the BNT (40% correct). An interesting feature of DC's speech is his preference to use proper names where common nouns and pronouns would be more appropriate (see in particular Appendix III), possibly due to what Goldstein (1948) called loss of abstract attitude. DC receives speech and language therapy at UCL's Acquired Communication Disorders Clinic. His language problems and general health situation lead to much frustrations and anger. He is fully mobile and lives on his own.

DOR

DOR is a 61 years old, right handed man. Prior to his illness, DOR worked as an administrator in an export-import firm. In 1986, at the age of 41, he noticed numbness on his right side and word-finding difficulties in writing. By 1987, DOR was suffering from seizures and showed signs of aphasia, dyslexia, and dysgraphia and was diagnosed with cerebral vasculitis. In 1993, he suffered a seizure that resulted in severe comprehension problems. In 2007, a structural scan was obtained as part of parallel research project by the Wellcome Trust Centre for Neuroimaging, UCL. The brain scan showed a large left hemisphere lesion involving the frontal, parietal, temporal, and occipital lobes extending subcortically. The cerebellum of both hemispheres is spared. The right hemisphere was found unaffected. The scan images are in Appendix II.

DOR presents with a mixed diagnostic profile on the BDAE. Subtests tapping semantic and lexical knowledge identified him as Broca's aphasic patient, but his scores on utterance length, melodic line, and articulatory agility were better than that of typical Broca's aphasic patients because, like DC, DOR does not speak in one-word-utterances and is able to use prosody appropriately to convey meaning which he cannot express syntactically. His object naming is severely impaired (40% correct on the BNT), and he is severely dyslexic and dysgraphic. His speech is non-fluent and agrammatic but not dysarthric.

EW

EW is 63 years old. Prior to his brain injury, EW was a professional photographer. He speaks English as a mother tongue and was fluent in French, Spanish and spoke

some Greek. In March 2000, he was involved in a road accident (riding a bicycle, wearing no helmet) in which he contracted a severe traumatic brain injury (Glasgow Coma Scale 6 on site). A recent brain scan (in 2007), carried out at as part of a parallel research project by the Wellcome Trust Centre for Neuroimaging, UCL, confirms damage to both left and right hemispheres. An extensive frontal lesion is evident involving the anterior parts of the superior, middle and inferior frontal gyri of the left hemisphere. The frontal lesion extends ventrally into the medial orbito-frontal cortex and laterally and posteriorly into the insula. The left temporal lesion involves the anterior temporal pole (middle and inferior temporal gyri). The primary auditory cortex appears to be spared. There is evidence of occipital damage on the right hemisphere due to a larger posterior horn of the lateral ventricle on the right and a right medial frontal contusion. The scan images are in Appendix II.

EW's large lesion caused severe expressive aphasia, dyspraxia and dysarthria. Initial language assessments reported moderate difficulties in understanding complex sentences and severe difficulty in speaking. Production was reduced to *yes* and *no* responses, that were not always reliable, and EW had difficulty to initiate conversation out of context. He was nevertheless described as a good communicator using drawing, gestures and single word writing. At this time he was diagnosed as Broca's aphasic patient with agrammatic speech. Eight years post onset, EW is still Broca's aphasic on the BDAE, though his excellent repetition skills are more in line with anomic aphasia. His language behaviour also shows features of transcortical motor aphasia as he produces very little self-initiated speech and more speech in structured tasks. While EW's spoken language has somewhat recovered, agrammatism is still evident in EW written sentence production, according to his speech and language therapist. Naming objects in the BNT is poor (58% correct). EW has the tendency to ambidexterity. He wears a hearing aid.

TH

TH is a 36 years old, right handed woman who, prior to her brain injury, worked in IT. TH has a family history of diabetes and in 1994 she was diagnosed with diabetes type II. In March 2001, she suffered an episode of severe hypoglycaemia which led to diffuse brain damage (no lesion information available). Following the brain injury, TH became epileptic. She suffers from both tonic and clonic seizures approximately once a month and minor fits approximately once a week. The brain injury left TH

with severe memory problems and fluent aphasia. Due to her severe epilepsy she receives care for 24 hours a day. The carers supervise her management of diabetes as TH has difficulty to recall the number of units of injections each day due to her memory problems. She has three children who live nearby with her ex-husband who visit her every day.

An initial report by TH's speech and language therapist described her communication disability as complex and worsened by her memory problems. TH used many stereotypical phrases, had severe word-finding difficulties and she made syntactic and semantic errors in both speech and writing. Sentence reading was effortful. TH showed lack of confidence in communicating with people and she tended to turn to her carers to answer on her behalf. However, recent treatment at the UCL's Acquired Communication Disorders Clinic has increased her confidence to interact with people in daily life. Seven years post onset, her rich variety of grammatical constructions, melodic line, phrase length, word finding difficulties, severely impaired oral object naming (10% correct on BNT) and well persevered repetition abilities classify her as an anomic aphasic on the BDAE. TH however also presents with occasional paragrammatism and many paraphasias in her spoken language and moderately impaired auditory comprehension. These features are more typical for Wernicke's aphasia.

3.2   BACKGROUND TESTING

Background tests included the subtest *cube analysis* from the Visual Object and Space Perception Battery (VOSP, Warrington, 1991), copying of the Rey Complex Figure (Rey, 1941; Osterrieth, 1944; see also Corwin & Bylsma, 1993, for a translation), the (three picture version of the) Pyramids and Palm Tree Test (PPT, Howard & Patterson, 1992), the Object and Action Naming Battery (OANB, Druks & Masterson, 2000), and the Noun and Verb Comprehension Test (NVCT, Masterson & Druks, unpublished). The NVCT is a word-picture-verification task consisting of 74 object and 74 action pictures, a subset of the items in the OANB. Each picture is presented (i) with the target word, (ii) with a semantically related word, and (iii) with an unrelated word. Participants have to decide if the picture and word match. The Syntactic Comprehension Test (SCT, Froud & Druks, unpublished), which examines the comprehension of semantically reversible active, passive and subject and object cleft sentences in a sentence-picture-matching task

was also administered. Some sentences (e.g., *the ball is kicking the boy*) and pictures (e.g., of a ball kicking a boy) described impossible situations (see Table 6b). In this task, participants had to match one of two pictures to an aurally presented sentence. Finally, for each aphasic and control participant samples of connected speech from picture description (*Cat and Fish Story*) and spontaneous speech were recorded and transcribed (see Appendix III for connected speech examples of each patient from description of the *Cat and Fish Story*).

The subtest of the VOSP and the copying of the Rey Complex Figure were administered to find out if the patients have visual and/or spatial deficits. Intact spatial processing may be important for the use and comprehension of spatial prepositions. The PPT was carried out in order to find out if the patients had conceptual-semantic deficits. The OANB and NVCT were administered in order to detect disproportionate verb deficits. It is important to investigate the availability of verbs for a study of prepositions as verbs and prepositions share syntactic properties such as case and theta-role assignment. The SCT examines the syntactic comprehension abilities of the patients. It is important to find out if the patients had syntactic comprehension deficits because past studies have suggested a relationship between syntactic comprehension abilities and the processing of grammatical morphemes, including (at least some types of) prepositions (e.g., Caramazza & Zurif, 1976; Zurif, 1980). Finally, the analysis of connected speech concentrates on the characteristics of the patients' speech in terms of fluency, grammaticality, and presence/absence of verbs and grammatical morphemes.

Results of the background tasks

The results of cube analysis, the copying of the Rey Complex Figure, the PPT, OANB, and NVCT are summarized in Table 6a. Results of the SCT are given in Table 6b.

All patients performed within the normal range in copying the Rey Complex Figure. Counting cubes arranged in blocks was within the norm for all aphasic individuals with the exception of EW. Unfortunately, the tests used in the present study were not sensitive enough to determine if EW's difficulty is confined to three-dimensional space only or arises from a general impairment of spatial processing. On the PPT all patients, with the exception of TH, performed within the normal range. In the OANB, accuracy in object naming ranged from 30% to 99%, and in action

naming from 40% to 95%. Three patients (BG, DC, and DOR) were better at naming object pictures than action pictures, but the difference was significant only for DC. TH was better at naming action pictures, and EW did not show a difference. In the NVCT, all patients performed relatively well in the unrelated and target conditions but four patients (BG, DC, DOR, and TH) made many errors in the semantically related condition. Four patients (BG, DC, DOR, and TH) performed better at noun comprehension than verb comprehension, but the difference was significant again only for DC. Noun and verb comprehension was better preserved than object and action naming for three patients (DC, DOR, and TH). BG and EW performed relatively well in both modalities.

In syntactic comprehension, BG and EW performed relatively well on all sentence types with an accuracy of at least 90% correct. EW's performance only declined on object cleft sentences. TH, the anomic patient, also did not present with severe syntactic comprehension deficits. However, she made some errors on object cleft and impossible passive sentences. The latter could be attributed to her severe semantic (and/or memory) difficulties. Object cleft sentences, on the other hand, are difficult for some healthy speakers too (Clough, 2007). In contrast, DC and DOR presented with severe syntactic comprehension difficulties on passives and object cleft sentences. Their accuracy scores ranged from 90% to 10% correct. Surprisingly, performance on semantically possible passives was below chance for both patients (10% correct) while semantically impossible passives that have the same syntactic structure were better comprehended (DC 60% correct; DOR 90% correct).

Table 6a: Summary of results (scores/percentages correct) of background tasks for individual patients

	cube test	copy of Rey Complex Figure	normal range	Pyramids and Palm Tree Test	normal range	Object and Action Naming Battery objects	actions	difference	Noun-Verb-Comprehension-Test nouns target	relat	unrel	verbs target	relat	unrel	difference nouns – verbs (relat. cond)
BG	9/10	36	32+/-2 under 60 yrs.	52		99%	95%	n.s.	100%	92%	100%	100%	85%	100%	n.s.
DC	10/10	36	32+/-2 under 60 yrs.	49		69%	48%	$(\chi^2(1) = [9.08], p = .002)$	100%	82%	100%	99%	66%	100%	$(\chi^2(1) = [5.10], p = .019)$
DOR	9/10	32	28+/-3 over 60 yrs.	49	49-52	77%	69%	n.s.	95%	96%	100%	95%	89%	100%	n.s.
EW	1/10	36		50		92%	92%	n.s.	97%	96%	100%	97%	99%	99%	n.s.
TH	9/10	36	32+/-2 under 60 yrs.	35		30%	40%	n.s.	93%	72%	97%	92%	64%	97%	n.s.

Table 6b: Summary of results (percentages correct) of the *Syntactic Comprehension Test* for individual patients

Syntactic Comprehension Test

	reversible sentences					irreversible sentences					filler sentences
	actives	passives	truncated actives	subject cleft	object cleft	active possible	active impossible	passive possible	passive impossible	truncated passives	sentences with prepositions
Example	The man is lifting the woman.	The woman is being lifted by the man.	The cook is carrying somebody.	It is the cat that is licking the dog.	It is the cat that the dog is licking.	The boy is kicking the ball.	The ball is kicking the boy.	The ball is being kicked by the boy.	The boy is being kicked by the ball.	The bear is being kicked.	The apple is in the box.
Target picture											
Distracter picture											
BG	100%	100%	100%	100%	100%	100%	100%	100%	90%	90%	100%
DC	70%	15%	90%	80%	30%	80%	90%	10%	60%	50%	83%
DOR	70%	45%	60%	60%	60%	60%	80%	10%	90%	50%	80%
EW	100%	95%	90%	100%	70%	100%	100%	100%	90%	100%	93%
TH	95%	95%	100%	100%	85%	100%	100%	100%	70%	90%	93%

3.3   SPONTANEOUS SPEECH AND PICTURE DESCRIPTION

The objective of the speech analyses was to compare the characteristics of the patients' and controls' speech in terms of the number of utterances and words produced as well as the quality of speech such as fluency, grammaticality, complexity of grammatical structures and the presence/absence of lexical and grammatical morphemes. Spontaneous speech samples, which were obtained from conversation about the participant's activities in daily life, were restricted to no more than 300 words. This allowed a quantitatively equivalent comparison between the patients and controls. There was no word limit in description of the *Cat and Fish Story*. This comparison was expected to reveal differences in the quantity of speech produced in response to the same pictures.

Method of speech analysis

For each aphasic and control participant samples of connected speech from picture description (*Cat and Fish Story*) and spontaneous speech were collected and treated following the procedures in Berndt, Wayland, Rochon, Saffran, and Schwartz (2000) and Druks and Carroll (2005). First, all non-narrative words such as repetitions, echolalias, coordinating conjunctions, and stereotypical phrases were deleted. Then, the speech samples were divided into utterances on the basis of semantic, syntactic and prosodic considerations. In the analysis of the speech samples of the patients and the controls a number of considerations were followed. Some of these considerations were only relevant for the controls' speech samples. An example of connected speech of each patient from picture description is in Appendix III. The pictures of the *Cat and Fish Story* are in Appendix IV. Tables A to F (see below) are in Appendix V.

For each participant, the number of utterances was counted and the proportions of grammatical, ungrammatical, and utterances that are grammatical only out of context and the mean length of utterance (MLU) were calculated. Grammatical utterances were analysed for complexity as reflected in the length of the longest grammatical utterance (LGU) and the number of embeddings. The proportion of embeddings was calculated in relation to the total number of grammatical utterances. Utterances whose meaning or structure could not be unambiguously interpreted were discarded from analysis (e.g.,

BG: *I work like whole (cold?) face/the other one I wanna swell/different coin, different face/it's maybe decision not actually count*; DC: *by friends is all four of us is fantastic*; EW: *I picked up little bits of me and ghost*). 5% to 18% of all utterances of a patient's speech sample fell into this category. Ungrammatical utterances with recoverable meaning and structure were included in the analysis. Ellipses (e.g., *and so does the cat* in *they are all looking very happy and so does the cat)* were not considered separate utterances but analysed together with the sentence they refer to. Parentheses (e.g., *there is also a mouse who is looking with pleasure – as far as I can see – at the apples and the potatoes*) were also analysed together with the utterance in which they were embedded. There were only few ellipses and parentheses and they were all produced by the controls. Tables A (for spontaneous speech) and B (for description of the *Cat and Fish Story*) list the number of utterances, the MLU, the LGU, the proportions of grammatical and ungrammatical utterances, and those that are ungrammatical within the context but grammatical out of context and the proportion of embeddings for each participant.

All words produced in an utterance were classified according to grammatical class and counted. The proportion of *correctly* produced lexical verb tokens, copula verbs, common noun tokens, proper noun tokens, pronoun tokens, determiner tokens, preposition tokens, and other word tokens was calculated in relation to the total number of narrative words. The proportion of auxiliaries and modal verbs produced was calculated by dividing the number of auxiliaries and modal verb tokens by the total number of lexical verb tokens and auxiliaries and modal verb tokens. The proportion of plural nouns was calculated by dividing the total number of plural noun tokens by total number of common and proper noun tokens. The proportion of word types was calculated by dividing word types by word tokens. For example, the number of different verbs used was divided by the number of all verbs used. Finally, the production of collocations such as film titles (e.g., *Lord of the Rings*) was scored as single proper noun. Tables C (for spontaneous speech) and D (for description of the *Cat and Fish Story*) give information about each participant's proportion of correctly produced verbs, nouns, pronouns, prepositions, determiners, and words of other word classes. Tables A, B, C, and D also provide the normal range for each category, calculated by the performance of the control participants.

The total number of free and bound grammatical morphemes and lexical words omitted, substituted or wrongly inserted in speech by aphasic and control participants was counted too. For example, if the patient produced **the man rush to the fish and chip shop* all words apart from *rush* were included in the count of correctly produced words and *rush* was counted as *omission of an auxiliary and the progressive marker*. Ungrammatical utterances were analysed for omissions and substitutions using the *minimal reconstruction procedure* (Leheckova, 2001; Menn & Obler, 1990). For example, DC produced *Phil* in response to a picture of a man. His intention was to name this man, so his one-word-utterance could be interpreted as *[This man is called] Phil*, *[Let's call this man] Phil*, or *[This is] Phil. This is Phil*, being the least complex utterance, was selected as the intended one. Omissions were judged as either acceptable within the context (because under certain conditions omissions are permissible in natural speech) or ungrammatical. Diary-drop, for example, is a common phenomenon in speech which involves the legal omission of a pronoun (see e.g., Haegeman, 1990). Diary-drop is, however, subject to three constraints, that is, it is only acceptable to omit a pronoun in *sentence-initial* position of a *matrix sentence* whose identity is *recoverable from discourse* (e.g., *can't remember; must have been the cat*). There are also instances of legal preposition omissions in natural speech (e.g., *Mr. Smith is busy [with] lighting the candles trying to create a good atmosphere; [at] that time I was working for Shell*). Similarly, pragmatic omissions are permissible if they are set in a proper context and express the meaning of a sentence (e.g., *not at counselling* in *I don't work anymore… not at counselling*). Therefore, if an omission could be analysed as diary-drop, legal preposition omission or pragmatic omission, the utterance was scored as grammatical. There were only few acceptable omissions and they were all produced by the controls. Finally, violations of Standard English that are permissible in colloquial speech were scored as grammatical (e.g., double negation). Tables E (for spontaneous speech) and F (for description of the *Cat and Fish Story*) list the number of substitutions, insertions and omissions of verbs and verb inflections, nouns, pronouns, prepositions, and determiners for each participant.

The performance of individual aphasic patients was compared to that of the control group in terms of proportions and numbers of words/utterances produced. Aphasic

performance was considered to differ from the controls if it was outside the normal range. For word/utterance numbers the normal range was the range of the number of words/utterances produced by the controls. Proportions were considered out of range if they were two standard deviations above/below the controls' means of proportions (see also Webster, Franklin, & Howard, 2007).

Results of speech analysis

At least 95% of all utterances of the control participants were grammatical (see Tables A and B in Appendix V). Their sentences were long with many embeddings. The number of utterances produced by the controls varied. The number of utterances produced by individual patients also varied and was below the normal range for EW only. The patients produced many more ungrammatical utterances than the controls and their grammatical sentences were shorter (see LGU) and less complex. In picture description, the number of embeddings produced by the patients was within the controls' range. However, the quality of the embeddings differed greatly in that controls used different types of embeddings (e.g., reduced/full relative clauses) introduced by a variety of complementizers (*which, that, because, while, thus,* etc.) while the patients' speech was largely confined to reduced relative clauses of the structure *There is an X doing Y.* In both speech contexts, the Broca's aphasic patients also had a reduced MLU and produced more ungrammatical than grammatical utterances. The anomic patient's MLU score was within the norm and she produced more grammatical than ungrammatical utterances, albeit below the norm.

The number of words produced by the patients in picture naming is lower than that of the controls but below the controls' range only for EW and DOR (see Tables C and D in Appendix V). The proportions of words of different word classes are also different in the two groups. Three patients (BG, DC, and DOR) have reduced proportions of lexical verbs. EW and TH are different in that their proportions of verbs are well within the norm (and even above the norm for EW in picture description). TH's proportion of nouns, however, is reduced. This is in contrast to BG and DOR who show higher proportion of nouns in the context of too few verbs. EW is different again as his noun proportion is above the normal range (in the context of many verbs). DC's proportion of

noun tokens is reduced in spontaneous speech but within the norm in picture description. DC preferred the use of many proper nouns which also led to a reduction of his common noun score. With respect to proportions of pronouns, patients did not differ much from the controls. In spontaneous speech BG's and TH's pronoun proportions were slightly above the norm and DC's slightly below it, and so was EW's in picture description. Preposition impairments became apparent in picture description but not so much in spontaneous speech. DOR was the only one whose use of prepositions was below the norm in both speech tasks. DC and EW produced fewer prepositions than the control group only in picture description. The number of determiners was reduced in DOR's, EW's and TH's spontaneous speech but within the norm in picture description.

As for errors, the controls made only few omission, insertion and substitution errors (n = 5, for both tasks). In contrast, many errors were made by the patients (see Tables E and F in Appendix V). Overall, the Broca's aphasic patients made more errors than the anomic patient (see Table 7).

Table 7: Number of omissions (O), insertions (I) and substitution errors (S) of bound and free morphemes for each patient

	Bound morphemes			Free morphemes			Total
	O	I	S	O	I	S	
BG	19	2	14	62	9	18	**124**
DC	3	1	8	82	14	27	**135**
DOR	4	0	20	73	10	38	**145**
EW	2	0	4	47	4	6	**63**
TH	0	0	6	7	7	2	**22**

The majority of the Broca's aphasic patients' errors were omissions. Free morphemes were more susceptible to omissions; they were less likely to be substituted or wrongly inserted. Bound morphemes, in contrast, were more likely to be substituted than omitted or wrongly inserted. The anomic patient produced an equal number of errors per type. Yet, omissions (and wrong insertions) were more likely to occur in the case of free morphemes, and she mostly made substitution errors on bound morphemes.

Summary of the background tests

The background tests and speech analyses confirmed the initial diagnoses made for the patients. For BG, DC, DOR, and EW typical features of Broca's aphasia were found. These are non-fluent, effortful speech (DC, DOR, and EW); with agrammatic features such as omissions/substitutions of grammatical morphemes and a reduced use of verbs in connected speech (BG, DC, and DOR); verb deficits in production and comprehension in structured tasks, and comprehension deficits for syntactically complex sentences (DC and DOR).

BG and EW are high-level Broca's aphasic patients. Their performance across background tasks was only mild-to-moderately impaired and their language is relatively well recovered: BG's speech, although still agrammatic, is relatively fluent and EW's speech, although still non-fluent, is not overtly agrammatic anymore. EW's test results show that only few features of agrammatism are still present. First, he has no selective verb impairment (contra BG, DC, and DOR), that is, his proportion of verbs (and nouns) in spoken language was similar to and even sometimes higher than that of the controls which indicates that his speech consisted of mainly content words. Picture naming was only mildly impaired with no difference between nouns and verbs. Second, EW was only impaired in the production of free grammatical morphemes; bound morphemes (e.g., verb inflections) tended to be spared (contra BG, DOR). Third, syntactic comprehension was intact (contra DC, DOR).

TH's language behaviour is different from that of the Broca's type patients. Her speech was fluent and lacking in nouns (and determiners) while she used many verbs. TH's object and action naming was severely impaired, more so for objects. These features confirm the initial diagnosis of anomic aphasia. However, TH also showed features of Wernicke's aphasia in that she had moderate semantic difficulties in single word comprehension tasks and her speech was sometimes paragrammatic manifested in overuse of grammatical morphemes and by sentence break-offs and sentence blends.

In the next chapter the methodology of the study is described. The tasks used to test the availability of different prepositions in different modalities are outlined and the results are presented along with short discussions of the findings.

Chapter 4: Experimental studies

In this chapter the tasks used to test the availability of different types of prepositions in different modalities are described and the results are presented and discussed.

Ten tasks were administered. They probed the production (in description of spatial situations, connected speech, and sentence completion), comprehension (in word/sentence-picture-matching, sentence-picture-verification and acting out) and grammaticality judgment (in grammaticality judgment of single sentences, contrastive sentence pairs and forced choice grammaticality judgment) of prepositions. Four categories of prepositions – meaningful (spatial and temporal and prepositions assigning theta-roles other than spatial and temporal, henceforth 'other theta-role assigning' prepositions), subcategorized, and syntactic prepositions and particles – and 21 different preposition tokens were targeted in the study. Multi-word prepositions (e.g., *ahead of*) were excluded. Table 8 lists the preposition tokens, their subcategory, the theta-roles they assign, the tasks in which they were used, and the number of times they were probed in each task.

4.1   METHODOLOGICAL CONSIDERATIONS

Five aphasic patients and five controls participated in the study. Control participants were asked to carry out only those tasks that posed some demand on healthy speakers (i.e., sentence completion, grammaticality judgment and acting out). On the remaining tasks controls' performance was expected to be at ceiling, and, therefore, these tasks were not administered to them.

In the tasks using sound presentation, stimulus sentences were spoken by a female native speaker of English in a slowed down but still natural rate and were recorded using Audacity (http://audacity.sourceforge.net/). All computerized experiments were programmed using Visual Basics (Microsoft) and presented on a laptop PC. Instructions for all tasks as well as lists of stimuli are in Appendix VI.

Table 8: The prepositions (their types, the special features associated with them, and the theta-roles assigned by them) used in the experimental tasks and the number of times they were probed in each task

Preposition tokens	Prepositional subcategories	Theta-role assigned and other linguistic properties	Production		Comprehension			Grammaticality judgment
			Sentence completion	Description of spatial situations	Word/ sentence-picture-matching	Sentence-picture-verification	Acting out	
above	spatial	locational	6	6	6	6	6	-
after	temporal	open interval	6	-	6	-	-	-
at	spatial	locational	6	-	-	-	-	6
	temporal	closed interval	6	-	-	-	-	6
	subcategorized		6	-	-	-	-	6
around	spatial	locational	-	6	6	6	6	-
before	temporal	open interval	6	-	-	-	-	-
behind	spatial	locational	6	6	6	6	6	-
beside	spatial	locational	-	6	6	-	6	-
between	spatial	locational	-	6	6	6	6	-
by	'other theta-role assigning' preposition	agent (passive)	6	-	-	-	-	-
	'other theta-role assigning' preposition	instrument, manner, animate source	6	-	-	-	-	-
for	temporal	closed interval	6	-	-	-	-	6
	'other theta-role assigning' preposition	benefactor	6	-	-	-	-	6
	subcategorized		6	-	-	-	-	6
from	spatial	directional	6	-	-	-	6	6
	temporal	open interval	6	-	-	-	-	6
	'other theta-role assigning' preposition	animate source	6	-	-	-	-	6
	subcategorized		6	-	-	-	-	6

in	spatial	locational	3	6	6	6	6	6	1
	temporal	closed interval	6	–	–	–	–	–	6
		subcategorized	6	–	–	–	–	–	6
	particle	attached/resultative (n = 3), attached/ non-resultative (n = 3)	6	–	–	–	–	–	–
		not attached/ resultative (n = 3), not attached/ non-resultative (n = 3)	6	–	–	–	–	–	6
into	spatial	directional	3	–	–	–	–	6	2
of	syntactic	derived (n = 12), not derived (n = 12)	24	–	–	–	–	–	24
		subcategorized	6	–	–	–	–	–	6
on	spatial	locational	3	6	6	6	6	6	–
	temporal	closed interval	6	–	–	–	–	–	6
		subcategorized	6	–	–	–	–	–	6
	particle	attached/ resultative (n = 3), attached/ non-resultative (n = 3)	6	–	–	–	–	–	–
		not attached/ resultative (n = 3), not attached/ non-resultative (n = 3)	6	–	–	–	–	–	6
onto	spatial	directional	3	–	–	–	–	6	2
since	temporal	open interval	6	–	–	–	–	–	–
to	spatial	directional	6	6	6	6	6	–	6
	temporal	open interval	6	–	–	–	–	–	6
	'other theta-role assigning' preposition	recipient	6	–	–	–	–	–	6
		subcategorized	6	–	–	–	–	–	6
	infinitival	bare infinitival (n=12), purpose infinitival (n = 12)	24	–	–	–	–	–	24
under	spatial	locational	6	6	6	6	6	6	–
until	temporal	open interval	6	–	–	–	–	–	–
with	'other theta-role assigning' preposition	instrument (n = 6), comitative (n = 6), degree/manner (n = 3), substance (n = 3)	18	–	–	–	–	–	–
		subcategorized	6	–	–	–	–	–	–
TOTAL			**276**	**54**	**54**	**42**	**54**	**66**	**179**

4.1.1   Scoring of the data

For the control participants accuracy and latencies/reaction times were recorded. The reason for collecting latencies/reaction times is that controls are likely to perform at ceiling in the test battery and only latency/reaction time data might be able to detect differences in task and stimulus complexity. As it will be seen, latency/reaction time data of the controls were not revealing. Since the interpretation of latencies and reaction times of aphasic patients is complex (D. Howard, p.c.), for the patients, only accuracy data are reported.

Accuracy

In the production tasks, *no responses*, substitutions, and alternative responses were considered as errors. Alternative responses are grammatical non-target responses often including adverbials instead of prepositions (e.g., *she will arrive home late [at] night → she will arrive home late [this/tomorrow/in the] night*). Responding with synonymous prepositions, however, was not considered an error. A preposition was considered synonymous, if at least three of the four students involved in the stimulus rating used the target and its synonym interchangeably. This was the case for eight target prepositions (*above → above/over, behind → behind/after, besides ↔ next to, into → in/into, onto → on/onto, under → under/below/underneath*, (spatial) *to → to/towards,* and (temporal) *to → to/until*). First responses only entered analysis.

Reaction times and latencies

Only the control participants' reaction times and latencies were analysed. In timed sentence completion, latencies of target responses, target responses with recognizable phonological distortions, and multi-word responses that contained the target entered the analysis. Alternative (non-target) responses, albeit grammatically acceptable, were excluded from the latency analysis. In the grammaticality judgment tasks, reaction times of target responses only entered the analysis. 0.02% of the reaction time and latency data was discarded due to inaccuracy of responses and 0.004% due to technical problems.

4.1.2 Statistical methods

In tasks that tested the availability of spatial prepositions (description of spatial situations, word/sentence-picture-matching, sentence-picture-verification, acting out) individual patients' results were analysed descriptively. The reason is that non-brain-damaged people perform at ceiling on these tasks, and, therefore, it is impossible to carry out *meaningful* statistical comparisons between patients and controls.

Data from the tasks that tested all subcategories of prepositions (sentence completion and grammaticality judgment tasks) were used to test the predictions specific parameters make about differential impairments of subcategories of prepositions. For this purpose, logistic regression of single case data with linear contrasts was applied. Log odds ratios were used rather than raw proportions correct.

The following two examples illustrate the statistical procedure used to test for a linear trend which was used to identify whether a predicted order of impairment has been obtained in the data or not. Friederici (1982) identified the parameter *meaningfulness* to influence the availability of prepositions in Broca's aphasia. She predicted that Broca's aphasic patients perform better on meaningful (e.g., spatial, temporal, and 'other theta-role assigning' prepositions) than meaningless prepositions (e.g., syntactic *of,* infinitival *to)*. The prediction was tested using PROC LOGISTIC procedure in SAS 9.1 statistical software by performing a contrast where the log odds ratios involving meaningful prepositions were given coefficients of 2 and the log odds ratios involving meaningless prepositions were given coefficients of -3. The results showed whether or not the data 'behaved' as predicted, that is, whether there were indeed significantly more errors made on meaningless prepositions than meaningful prepositions. Using logistic regression of single case data with linear contrasts also allowed the comparison of more than two different variables. For example, Kreindler and Mihăilescu (1970) identified the parameter *frequency* to influence a patient's availability of prepositions. It was suggested that aphasic patients perform better on high frequency than medium frequency prepositions, and performance on low frequency prepositions is the poorest. The prediction was tested by performing a contrast where the log odds ratios involving high frequency prepositions were given coefficients of 3, the log odds ratios involving medium frequency prepositions were given coefficients of -1, and the log odds ratios involving low frequency prepositions were given coefficients of -2. The results showed whether or not there were significantly more errors made on low

frequency prepositions than medium frequency prepositions and high frequency prepositions. The last example also illustrates one of the main advantages of logistic regression. Instead of using (at least) three 2×2 tests of proportions of errors to compare differences between the categories – a strategy which suffers from the disadvantage of increasing the likelihood of getting significant differences by chance – only one statistical test per prediction of performance and participant was run. Moreover, to reduce the likelihood of reporting differences that are significant by chance, the alpha level was set at $p = .01$ to correct for multiple comparisons. Consequently, only comparisons that revealed a difference of p $\leq$ .01 were considered significant; comparisons that revealed a difference of p > .01 and $\leq$ .05 were considered trends.

The data of the control participants were initially analysed using confidence intervals, and only entered logistic regression, if the confidence intervals indicated significant differences between subcategories.

In the rest of the Methods chapter, first, tasks that tested spatial prepositions (description of spatial situations, word/sentence-picture-matching, sentence-picture-verification, acting out), second, the analysis of prepositions produced in connected speech, and, finally, the tasks that probed all subcategories of prepositions (sentence completion and the three grammaticality judgment tasks) are described. The results of these latter tasks were analysed with the aim to test the validity of the predictions previous parameters make in relation to selective impairments of different subcategories of prepositions.

4.2 TASKS PROBING SPATIAL PREPOSITIONS

Spatial prepositions were tested in production (description of spatial situations) and comprehension (word/sentence-picture-matching, sentence-picture-verification and acting out). The objective of these tasks was to determine whether the production and/or comprehension of spatial prepositions are impaired and if the degree of impairment differs across different spatial prepositions.

4.2.1   Production tasks

Description of spatial situations

Description of spatial situations was tested in free and prompted task presentations. Prompted description of spatial situations was administered to those patients who failed to carry out the free description task. The reason was that free production may be difficult not because the preposition cannot be accessed but because initiating and producing a sentence is difficult.

Materials

54 pictures to elicit the spatial prepositions *above, around, behind, beside, between, in, on, to,* and *under* six times each were used (see Table 8). Each picture depicted two or three objects that were in spatial relation to each other. One of the objects was coloured. The task was to describe the picture using a single sentence starting with the coloured object's name. Since none of the participants had a problem in distinguishing between the coloured and uncoloured parts of the picture, there was no element of ambiguity in the task.

Procedure

In the free version, pictures were presented in the centre of a computer screen. Recording started when the picture appeared. Once a response was made, the experimenter stopped the trial by pressing the *stop* button on the screen (see Figure 1).
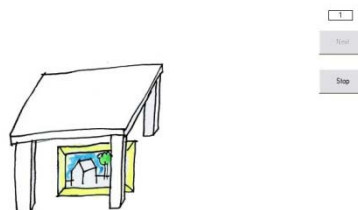
Figure 1: Display of a screen for the free version of description of spatial situations.

The procedure in the prompted version of the task was similar with the exception that 1000ms following the appearance of the picture, patients were prompted with the

written, and 1000ms later, with the spoken initial part of the sentence (consisting of the subject and the verb). Participants were then required to complete the sentence with a prepositional phrase or just a preposition (see Figure 2).

Figure 2: Display of a screen for the prompted version of description of spatial situations.

Stimuli were presented in three blocks with 18 items in each block. Each target preposition was elicited twice within each block. The pictures were arranged in a pre-determined semi-random order, so that the same preposition was not elicited one after the other. Nine practice trials were also included to familiarize the participants with the task. During practice trials feedback was given.

Results and interim discussion

Three patients (BG, EW, and TH) carried out the free version of the task and two patients (DC and DOR), the prompted version. Table 9 summarizes the number of correct prepositions produced, the number of omissions and substitutions and the substitutions made per target.

   BG, TH, and EW made few errors. In contrast, DC and DOR made errors on more than half of the items. Most errors were within-category substitution errors. Only DOR omitted prepositions, but, nevertheless, the vast majority of his errors too were within-category substitutions. Different prepositions were prone to errors in different patients: DC was unable to describe pictures depicting the spatial relation of *beside* and DOR was unable to retrieve *behind* and *to*. *Behind* was the most vulnerable preposition for BG, *between* for EW, and *above* for TH. TH, the anomic patient, had often more difficulty to retrieve the object names than the prepositions in a picture.

Table 9: Patients' performance in description of spatial situations

Free description of spatial situations

	correct responses (n=54)	no. of errors			substitutions
		omissions	across-category substitutions	within-category substitution	
BG	46 (85%)	0	1	7	behind → around, in, verb in → through, through on → in, in to → between
EW	37 (69%)	3	2	12	above → on around → next to, neologism behind → verb beside → in front of between → beside, beside, beside, in the middle of, in the middle of in → from, under on → in to → away from
TH	44 (82%)	1	0	9	above → on top, on top of, on top of behind → over, through between → beside, in the middle of in → over, through

Prompted description of spatial situations

	correct responses (n=54)	omissions	across-category substitutions	within-category substitution	substitutions
DC	20 (37%)	0	5	29	above → behind, behind, adjective around → on, on, noun behind → in, on, under, under beside → above, behind, behind, behind, past, through between → in, in, in, on, adjective in → above, around, behind, on, under on → above, above to → around, from, in, in under → in, verb
DOR	18 (33%)	9	8	19	above → in, on, on, on around → noun behind → beside, beside, in, adverb, DP beside → 'side-by-side', 'side-by-side', behind, on between → above, on, adjective on → in, in to → in, with, adverb, adverb under → beside, in, on, on

None of the patients performed perfectly and there was no difference in accuracy between the Broca's aphasic and the anomic aphasic patients: BG, EW, and TH, the anomic patient, performed relatively well, while DC and DOR made many errors.

Past studies that tested the production of spatial prepositions in picture description tasks also found them to be impaired (e.g., Friederici, 1981; Kemmerer & Tranel 2000, 2003; Leikin, 2002; Tranel & Kemmerer, 2004).

All patients produced more substitution errors than omissions. The majority of the substitutions were within category. This form of error demonstrates sensitivity to the grammatical class of the word required. The majority of patients in Tranel and Kemmerer's study (2004) also produced more within-category substitution errors than omissions, and, in Kemmerer and Tranel (2000) this error pattern was found in a patient with a severe preposition deficit. Many substitution errors and few omissions were also reported by Leikin (2002) for a group of Broca's, Wernicke's, and transcortical sensory aphasic patients. In contrast, Friederici (1981) found that Broca's aphasic patients made more omissions than substitution errors and in their substitution errors grammatical class was not maintained.

Although little is known to date about the featural make-up of prepositions (apart from the better understood contrast in terms of semantic complexity between locational and directional prepositions), the nature of the erroneous responses made by the patients indicates a great deal of knowledge about the semantic properties of spatial prepositions. Within-category substitutions often differed only in one or two features from the target's meaning and mostly the meaning of the target was entailed in the substitute's meaning (see e.g., Leikin, 2002, who also reports within-subcategory substitution errors). Table 10 gives the classification of the within-category substitution errors into within- and across-*sub*category substitution errors (of the total number of within-category substitution errors). It shows that features such as [PLACE] and [PATH] were maintained in 86% of all within-subcategory substitution errors (while fewer instances were found in which features were added or omitted). In these cases, therefore, patients tended to retain the [PATH]/[PLACE] feature specification of the target but they substituted the values attached to the prepositions (e.g., *to* [(PLACE), PATH, endpoint] → *from* [(PLACE), PATH, beginning]). This will be further discussed in Chapter 6.

Synonymous prepositions were also produced by the less impaired patients (BG, EW, and TH). Such responses demonstrate access to a variety of spatial prepositions, and sensitivity to the subtle differences in the meaning of spatial prepositions.

Table 10: Error classification: within- and across-subcategory substitutions with examples (% of all within-category substitution errors)

Within-subcategory substitutions			Across-subcategory substitution
Features maintained	**Features added**	**Features omitted**	
[PLACE] ↔ [PLACE] [(PLACE), PATH] ↔ [(PLACE), PATH]	[PLACE] → [(PLACE), PATH]	[(PLACE), PATH] → [PLACE]	
Percentage			
86	9	4	1
Examples			
above → on top of/on on → above between → beside/in in → on to → away from/from	in → through beside → past, through in → from behind → through	to → in, between	to → with

4.2.2   Comprehension tasks

The comprehension of spatial prepositions was explored in four tasks: word/sentence-picture-matching, sentence-picture-verification and acting out of prepositions and prepositional sentences.

Word-picture-matching and sentence-picture-matching

It was expected that only very impaired patients would make errors on these relatively simple tasks. The two versions of the task pose different demands. It was anticipated that the word condition might be more difficult than the sentence condition because it requires the comprehension of the preposition without reference to a context.

Materials

Nine spatial prepositions (*above, around, behind, beside, between, in, on, to, under*) were tested in these tasks (see Table 8). Each preposition was probed six times and was accompanied by four pictures, the target and three distracter pictures that described spatial relations other than the target. In order to distinguish subject and landmark, the object representing the subject was coloured, while the landmark was in black and white. In the word-picture-matching task, participants heard the bare preposition and in the sentence-picture-matching, the preposition was embedded in a sentence.

Procedure

Participants were presented with four pictures on the screen (see Figure 3). The position of the target picture was semi-randomised to ensure that a particular position was employed not more than three times in a row. 1000ms after the appearance of the four pictures, a spoken sentence or word was heard. Participants were required to decide which of the four pictures matched the spoken stimulus by pointing at the matching picture using a touch screen. Once a picture was selected, or if participants did not respond within 10 seconds[25], the squares went blank and a new trial started. The stimuli were presented in a fixed semi-random order in three blocks of 18 items each. Each preposition occurred twice within a block but never consecutively. Nine practise trials were administered prior to the experiment. During practice trials feedback was given.

The flowers are growing around the girl.
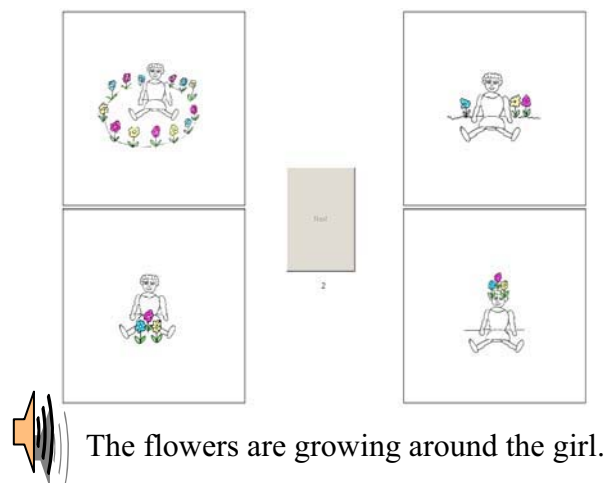
Figure 3: Screen of a trial in the sentence-picture-matching task.

Results

Table 11 gives the number of correct responses, the number of *no responses,* and the number of erroneous responses.

In word-picture-matching, three patients (BG, EW, and TH) made relatively few errors, while DC and DOR made many errors. While all patients tended to make erroneous responses, all of EW's errors were *no responses*. Different prepositions were error-prone in different patients. *To* was most error-prone for EW, *behind* for TH, *beside* for DC, and *in* for DOR.

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[25] A time window of 10 seconds was introduced to the comprehension and grammaticality judgment tasks in order to elicit fast responses from those patients who are hesitant in making a decision and to overcome working memory limitations.

In sentence-picture-matching, BG performed flawlessly (see Table 11). EW and TH also performed well. DC was very hesitant in responding and therefore made more *no responses* (due to timeouts) than erroneous responses. *Beside* was most error-prone for DC. DOR also made more *no responses* than erroneous responses. *Behind* was most error-prone for DOR.

A comparison of numbers of correct responses in the two tasks showed that performance did not differ in the two versions of the task for any of the patients. What differed, however, were the types of errors made by DC and DOR the two tasks. While the majority of errors of both patients were erroneous responses in the word version, there were more *no response*s in the sentence version. It is possible that DC and DOR, who are the most impaired patients in the group, cannot process sentences when the time window is short (10 seconds).

Table 11: Patients' performance in word- and sentence-picture-matching

	Word-picture-matching			Sentence-picture-matching		
	correct responses (n=54)	no. of *no responses*	no. of erroneous responses	correct responses (n=54)	no. of *no responses*	no. of erroneous responses
BG	53 (98%)	0	1	54 (100%)	0	0
DC	35 (65%)	2	17	36 (67%)	11	7
DOR	33 (61%)	8	13	36 (67%)	12	6
EW	47 (87%)	7	0	52 (96%)	1	1
TH	47 (87%)	1	6	52 (96%)	1	1

The results of word/sentence-picture-matching are discussed together with the results of sentence-picture-verification.

Sentence-picture-verification

In this task, a trial consisted of one picture and a sentence, and patients had to say if the sentence correctly described the picture. The lack of opportunity for comparison may render this task more difficult than sentence-picture-matching.

Materials

Seven spatial prepositions (*above, around, behind, between, in, on, under*) were targeted (see Table 8). Each preposition appeared six times in the matching condition and twelve times in the non-matching condition. There were two non-matching

conditions. For half of the items the spatial arrangement of the picture differed from the situation described by the preposition in the sentence, and in the other half, one of the objects in the picture differed from one of the nouns in the sentence[26] (see Figure 4). In total 126 sentence-picture pairs were presented.

The doll is sitting **between** the teddy and the box. The doll is sitting **on** the teddy and the box.

*The doll is sitting **on** the teddy and the box. *The doll is sitting **between** the teddy and the box.

*The **shoe** is sitting between the teddy and the box. *The **ball** is sitting on the teddy and the box.

Figure 4: Example of pictures and sentences for matching and non-matching conditions contrasting *between* and *on*[27].

Procedure

On button press by the experimenter, a picture appeared on the screen. 800ms later two brackets appeared signaling the imminent appearance of the written sentence after another 200ms. Participants were required to decide as quickly and accurately as possible whether or not the sentence matched the picture by pressing a *yes* (z-key) or *no* (m-key) button. Stimuli were organized in two blocks of 32 and two blocks of 31 items. Items within blocks were presented in a pre-determined semi-random order. There were no more than three matching and three non-matching conditions, and three identical prepositions in a row. In each block, a third of the target sentences matched the picture and two thirds did not. There was a time limit of 10 seconds following stimulus presentation in which a response was expected, otherwise the screen went blank. If patients had difficulties reading the sentences, the experimenter read them aloud. A practice block with 19 items was administered prior to testing to

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[26] An initial version of the task did not include the non-matching condition with object (noun) distracters. BG and EW were initially tested on this version. Due to their good overall performance in this task and their good noun comprehension scores in the NVCT, the new and larger version of the sentence-picture-verification tasks was not administered to them.

[27] When *between* was probed, three objects must be present, unlike in pictures representing other prepositions. In order to make the pictures comparable, an additional object (not always necessary for the situation) was added to those pictures that were used as contrasts to *between* items.

familiarize participants with the task. Feedback was given. A trial was scored correct if the matching *and* the two non-matching conditions were responded to correctly (n = 42).

Results and interim discussion

Table 12 shows the patients' accuracy scores for all trials and for each condition separately and the number of errors made per type.

Two patients performed relatively well (BG and EW), while three patients made many errors (TH, DOR and DC). For none of the patients there was a difference in the number of errors across the matching and non-matching (preposition and noun distracter) conditions.

All patients but DOR made more erroneous responses than omission errors. *Under* was the most error-prone preposition for DC, *on* for DOR, *above* for EW, and *in* for TH.

Table 12: Patients' performance in sentence-picture-verification

	no. of trials correct (n = 42)	no. of matching trials correct (n = 42)	no. of non-matching trials correct (n = 42)		no. of errors		
			preposition distracters	noun distracters	omissions	erroneous responses	
BG	40 (95%)	40	42	-	0	2
DC	6 (14%)	25	16	24	26	35
DOR	26 (62%)	29	26	35	23	13
EW	37 (88%)	40	39	-	0	5
TH	27 (64%)	35	36	37	8	10

The sentence-picture-verification task that tested the comprehension of spatial prepositions revealed mild (BG and EW), moderate (DOR and TH), and severe (DC) impairments with an accuracy ranging from 95% to 14%. Even in the very simple word/sentence-picture-matching tasks, each patient made at least some errors, and some patients made many errors with an accuracy ranging from 100% to 61%. Thus, it may be concluded that comprehension of spatial prepositions is not spared in most of the patients of the present study. Previous studies that used similar tasks also

found the comprehension of prepositions impaired (e.g., Friederici, 1981; Friederici et al., 1982; Goodglass et al., 1970; Kemmerer, 2005; Kemmerer & Tranel, 2000; 2003; Kolk & Friederici, 1985; Saffran, Schwartz, & Marin, 1980b; Schwartz, Saffran, & Marin, 1980; Tranel & Kemmerer, 2004).

Sentence-picture-verification was more difficult than word/sentence-picture-matching for DC and TH. Other patients did not show large differences in performance between the tasks (BG's performance was consistently good across tasks). There have been only two previous studies that also tested verification of spatial prepositions in aphasia and compared it to other comprehension tasks: Kemmerer and Tranel's (2003) and Tranel and Kemmerer's (2004). They found either no difference between word/sentence-picture-matching and sentence-picture-verification (similarly to most patients in the present study) or better performance in the verification task (contrary to DC and TH). That sentence-picture-verification caused much difficulty for some patients of the present study is at odds with the fact that in this task there was a high chance (50%) to make the correct decision while in word/sentence-picture-matching the chance was lower (25%). It seems that the lack of opportunity for comparison rendered the verification task difficult. There are other potential factors that might have caused this task to be difficult. For example, in word/sentence-picture-matching, the correct response was always presented to the patients, that is, the patients knew that one of the four pictures presented was always correct. Hence, the patients might be inclined to make a response more readily in word/sentence-picture-matching than in sentence-picture-verification. This would imply more omissions (due to time-out errors) in sentence-picture-verification than in word/sentence-picture-matching, which was indeed found for DC and TH. Another reason for the relative difficulty of the verification task is that in this task (in the non-matching conditions) not only the choice of preposition was manipulated but also the subject of the spatial relation. Indeed, DC was better on matching trials than non-matching trials showing that the detection of two different types of violations was difficult for him.

Despite their deficits, patients made more erroneous responses than *no responses*. This is in line with previous studies such as Friederici and colleague's (1982) and indicates that the semantics of the prepositional system was not completely lost to them.

Acting out of prepositions and prepositional sentences

This task tested the comprehension and acting out the verbal demand of spatial prepositions in two conditions. In one condition participants had to act out prepositional sentences and in the second condition, single prepositions. Performance in the sentence condition was compared to that of the word condition. It was predicted that the word condition would be more difficult than the sentence condition as it required the comprehension of a preposition without a context. The sentence condition also allowed observing the effects of semantic reversibility in most sentences, though this was not possible in sentences with *in* and *from*.

Materials

A set of objects was used for acting out the commands. The landmarks were two boxes, two mugs, and two baskets, and the subjects were two coins, two paper cards, and two plastic bananas. Eleven spatial prepositions were targeted (*above, around, behind, beside, between, from, in, into, on, onto, under*; see Table 8). Each preposition was probed three times in both the sentence and word condition. There were 33 items in each condition.

Procedure

Participants were asked to manipulate the objects in front of them according to the sentences or words heard, presented in three blocks. The first block required the manipulation of a pair of bananas and two baskets, the second block used a pair of cards and two mugs, and the third block, two coins and two boxes. Within a block, the objects were arranged in front of the participants with one object inside the landmark and the other (identical) object outside the landmark (see Figure 5). This arrangement was the basic position from which each trial started. This was necessary in order to test the acting out of the preposition *from*.

Figure 5: Basic positions for each block in acting out of prepositions and prepositional sentences.

In the sentence condition participants were presented with a sentence such as *Take the banana from the basket!* or *Put the coin in the box!*. In the word condition, they heard a single preposition only (i.e., *from/in*)[28]. The two ways of presentation were mixed within each block. Each block contained 22 trials. Each preposition was presented twice within a block, once as a single word and once in a sentence. Within blocks, the same preposition was never presented in a row. 18 practice trials were administered prior to testing proper. During practice, the comprehension of the object names (*basket, banana, mug, card, box, coin*) and the verbs used (*put, take, move, is*) was checked and feedback was provided. In the case of *behind*, the perspective the participant chose in acting out was taken into consideration[29].

Results and interim discussion

Table 13 lists the number of correct responses made in each condition by each participant and the number of errors and substitutions made per target.

The controls scored at ceiling. They always acted out the sentences (e.g., *the coin is above the box*) by using the appropriate objects (*coin* and *box*) in the functions specified by the sentence (e.g. the coin was used as subject and the box as landmark) and they followed this convention in the word condition too.

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[28] Acting out single prepositions appears to be an artificial and difficult task. However, control participants had no difficulties, and scoring in this condition was more lenient in that only accuracy of the spatial relationship was scored (e.g., *cup in cup/card in cup* were both scored as correct).

[29] De Renzi and Vignolo (1962) found that non-brain-damaged participants responded in two different ways to a command such as *put the paper behind the mug*. They either choose to arrange the tokens interpreting *behind* from their perspective or from the experimenter's perspective. Hence, responses in the present study were analysed for consistency. In the present study, all control participants acted out *behind* from their own perspective and were consistent.

Table 13: Results of patient and control group in acting out of prepositions and prepositional sentences

	no. of correct responses in…		% correct in total	no. of errors	substitutions in both conditions
	sentence condition (n=33)	word condition (n=33)			
BG	30	32	94	4	above → on, on, on under → into
DC	8	14	33	44	around → in behind → in, in, on beside → in, in, in, in, in front of between → in, in, in front of, in front of, behind from → in, in into → beside, around on → in, in, in, in onto → in, in, into, in front of, over above → in, in, in, in front of under → in, in, beside
DOR	25	19	67	22	behind → on beside → behind, between, between, between, between from → in, in into → on on → in, in, in, in onto → into, into, into above → around, on, on, under
EW	31	31	94	2	on →in onto → under
TH	29	33	94	4	beside → in front of above → on
control group	165/165	165/165	100	0	-

Three patients (BG, EW, and TH) made only few errors. DOR and DC, in contrast, made many errors. The patients did not show a difference between the two conditions in terms of error numbers. The majority of errors were incorrect responses. Only the more impaired patients (DC and DOR) failed to respond at times. *Beside* was most error-prone for DOR and *beside, between, onto* and *over* were very error-prone for DC. *In* was the preferred substitute for DOR and DC. In the sentence condition, some patients (DC, EW, and TH) exchanged the functions of subject and landmark (i.e., *the coin is above the box* acted out as *box above coin/coin below box*) or used landmarks only (i.e., *the coin is above the box* acted out as *box above box)*. In the word condition all patients at times swapped the functions of subject and landmark and/or used landmarks only to act out the preposition targets.

This form of response, while legal, was never made by the controls who performed perfectly in this task.

There are only few previous studies that tested spatial prepositions in an acting out paradigm and all, like the present study, found acting out of spatial situations to be impaired (Leikin, 2002; Mack, 1981; Morton & Patterson, 1987; Smith, 1974).

In contrast to the controls, patients not only had difficulty in acting out the target prepositions but also in maintaining the roles of subject and landmark. In the sentence condition this caused errors, which, contrary to the prediction, made this condition more difficult than the single word condition for some patients. Morton and Patterson (1987) also reported reversals of the theta-roles of subject and landmark in an aphasic patient using a similar task. Reversal errors in acting out suggest that the syntactic comprehension deficit with respect to agent-patient relations in sentences may extend to subject-landmark relations in simple active prepositional sentences. DC, for example, made many role-reversal errors on semantically reversible sentences in the syntactic comprehension task (see SCT in 3.2) and in acting out prepositional sentences in this task (see also Kolk & Friederici, 1985; Schwartz, Saffran, & Marin, 1980). This however does not mean that there is a necessary link between the two because DOR made many role-reversal errors in the syntactic comprehension task but not in acting out the prepositional sentences and EW and TH showed the opposite pattern. It is possible that, in addition to the impairment of prepositions, some patients' performance in acting out is affected by '*a deficit in organizing a response to a complex stimulus situation, i.e., an executive deficit*' (Mack, 1981, p.90).

The production and comprehension of spatial prepositions

Spatial prepositions were shown to be impaired even in relatively simple tasks in each individual patient. Figure 6 shows that BG, DOR, and EW were more impaired in production than comprehension of spatial prepositions. This is in line with previous research (Druks, 1991; Friederici, 1981; Kemmerer & Tranel, 2000 (patient 1978JB); Leikin, 2002; Tranel & Kemmerer, 2004 (except patients 1726 and 1962)). DC and TH, in contrast, were more impaired in the sentence-picture-verification task than in the production of spatial prepositions. This shows that production is not necessarily more impaired than comprehension. A few patients in previous studies (Kemmerer & Tranel, 2000 (patient 1688PG); Kemmerer & Tranel, 2003 (patient

JP); Tranel & Kemmerer, 2004 (patients 1726 and 1962)) also showed no difference in production and comprehension of spatial prepositions.
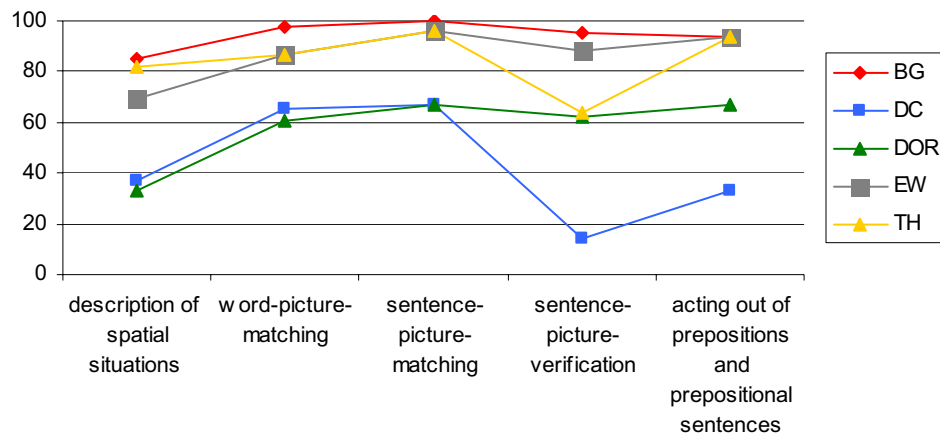
Figure 6: Production and comprehension of spatial prepositions in individual patients.

On the basis of what is known from previous reports, comprehension of spatial prepositions was expected to be better preserved than production: twelve studies have been found which tested the comprehension of prepositions (Druks, 1991; Friederici, 1981; Friederici et al., 1982; Goodglass et al., 1970; Kemmerer & Tranel, 2000; 2003; Kemmerer, 2005; Leikin, 2002; Mack, 1981; Morton & Patterson, 1987; Smith, 1974; Tranel & Kemmerer, 2004). Seven of them also tested production (Druks, 1991; Friederici, 1981; Friederici et al., 1982; Kemmerer & Tranel, 2000; 2003; Morton & Patterson, 1987; Tranel & Kemmerer, 2004). Together they report data of 112 aphasic patients. Only two of these patients scored at ceiling in comprehension[30] (Druks, 1991; Kemmerer & Tranel, 2003). However, it seems that only Druks' patient presents a true dissociation of spared comprehension and impaired production of spatial prepositions while Kemmerer and Tranel's patient does not. The reason is that the patient reported by Kemmerer and Tranel performed well not only in comprehension tasks but also in picture description (93% correct) and comprehension was at ceiling in only one of two comprehension tasks (when matching one of three given prepositions to a picture) but around 94% correct in the other (when matching one of three pictures to a given preposition). Druks' patient, in

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[30] It is possible that there are more patients like Druks' and Kemmerer and Tranel's in the previous literature, however, they remain unknown because most previous studies did not consider single case data.

contrast, scored at ceiling in comprehension (sentence-picture-matching) and around 13% correct in production of spatial prepositions (in response to a prepositional situation). There is however a problem with Druks' findings: she administered only one (relatively simple) comprehension task to her patient (sentence-picture-matching, which is almost identical to the one used in the present study). In the present study, BG also scored at ceiling in this task, however, she revealed subtle comprehension impairments in word-picture-matching (98% correct) and sentence-picture-verification (95% correct). It may therefore be concluded that subtle comprehension deficits for spatial prepositions may remain undetected if comprehension is not tested extensively.

When considering spatial prepositions, visuo-spatial processing impairments need to be ruled out in order to exclude the possibility that visuo-spatial deficits are the underlying cause of the language deficits. Two tests of visuo-spatial processing – copying the Rey Complex Figure (e.g., Rey, 1941) and counting cubes in different spatial arrangements were administered (VOSP; Warrington, 1991, see 3.2). All patients performed at ceiling in both tasks, only EW had difficulty in the latter task. Nevertheless, EW did as well as BG on spatial prepositions and better than DC, DOR, and TH, whose visuo-spatial processing was intact. The findings of Tranel and Kemmerer were similar. They reported patients with severe deficits for spatial prepositions in production and comprehension without deficits in visuo-spatial processing (patient JB in Kemmerer & Tranel, 2000; patient RR in Kemmerer & Tranel, 2003; all patients of study 2 in Tranel & Kemmerer, 2004) and patients with impaired visuo-spatial processing with no preposition deficits (patient PG in Kemmerer & Tranel, 2000). This shows that language deficits for spatial prepositions and visuo-spatial deficits are independent and that the patients' deficit for spatial prepositions is most likely of linguistic origin.

4.3   PREPOSITIONS IN CONNECTED SPEECH

Description of pictures specifically designed to elicit prepositions

The use of prepositions in connected speech was explored in picture description. A set of nine pictures was designed for the purposes of this study to elicit a large number and variety of prepositions (*Preposition House Pictures*). The pictures depicted peculiar spatial situations (e.g., a man in a cupboard, fish in the bathtub) with the purpose to increase the likelihood that participants will comment on those

spatial situations and consequently produce prepositions. Speech was transcribed and treated in the same way as spontaneous speech and speech from description of the *Cat and Fish Story* (see 3.3) but the analysis here focused on the presence/absence of (obligatory) prepositions. This allowed the comparison of the number and type of prepositions used by the patients and control participants. The use of prepositions and lexical verbs (because they share the role of case and theta-role assignment) was also compared. The pictures used to elicit the prepositions are reproduced in Appendix VII.

Results and interim discussion

Table A in Appendix VIII displays the number of utterances produced by the patients, their mean length of utterance (MLU) and longest grammatical utterance (LGU), the proportions of grammatical sentences and embeddings produced, and the proportions of ungrammatical utterances and those that are ungrammatical within the context but grammatical out of context. Table B in Appendix VIII lists the proportions of narrative words produced correctly in each word class for the patients. Table C in Appendix VIII gives the number of omissions of words in obligatory contexts, and the number of insertions and substitution errors for individual participants. Appendix IX lists the proportions of prepositions produced per subcategory for each patient. Table 14 gives a summary of the proportions of prepositions and lexical verbs correctly produced in obligatory context by the aphasic patients and controls in description of the *Preposition House Pictures* (the proportions of lexical verbs and prepositions were calculated with respect to the total number of narrative words produced). The performance of individual aphasic patients was compared to that of the control group. The performance of the patients was considered to differ significantly from the controls if it was outside the normal range. For words/utterances the normal range was derived from the range of words/utterances produced by the controls and for proportions it was based on two standard deviations above and below the controls' means of proportions. The normal range is presented throughout the tables in Appendices VIII and IX and in Table 14.

The controls produced a proportion of prepositions within a range of .12 to .17. Only BG's production of preposition tokens and types was within the norm. The remaining four patients' proportions of preposition tokens were below normal (see Table B in Appendix VIII). DC and EW produced few preposition tokens overall but

made use of many different preposition types. The controls as a group made only one error on prepositions (a substitution error, see Table C in Appendix VIII). The patients, in contrast, made many errors. The Broca's aphasic patients made many omission (n = 42) and fewer substitution (n = 11) and insertion errors (n = 4). All substitution errors were within category and subcategory. The anomic patient (TH) produced more substitution errors (n = 5) than omissions (n = 2) and insertions (n = 2). Her substitution errors were always within category and almost always within subcategory.

Controls produced all types of subcategories of prepositions in describing the *Preposition House Pictures*, however, the vast majority of all prepositions produced were spatial prepositions (see Figure 7 and Appendix IX). BG's and TH's distributions of subcategories produced were similar to that of the control group. The remaining three patients also produced many spatial prepositions. Some of these patients however produced significantly more temporal prepositions (DC, EW), and particles (DC, DOR), and fewer syntactic prepositions (DOR, EW) and 'other theta-role assigning' prepositions (DC) than the controls.
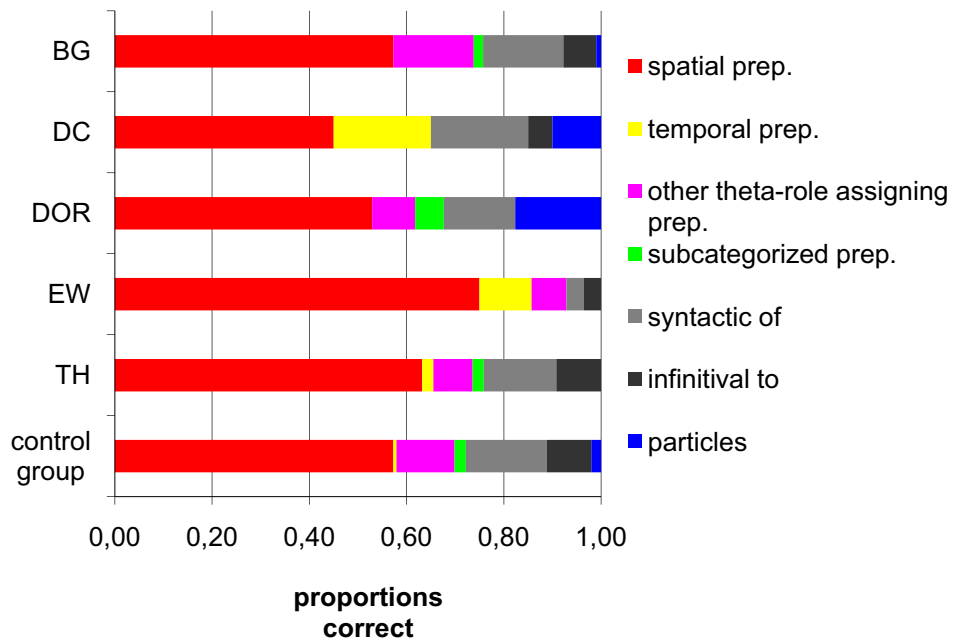
Figure 7: Proportions of subcategories of prepositions for each patient and the control group in description of the *Preposition House Pictures*.

The use of prepositions was compared to that of verbs. The comparison showed no consistent relationship between the availability of the two (see Table 14). BG had a preposition proportion within the normal range but a reduced proportion of verbs, EW and TH were mildly impaired in producing prepositions but not verbs, and DC and DOR were severely impaired in producing both prepositions and verbs.

Table 14: Summary of the usage of prepositions and verbs by patients and controls in description of the *Preposition House Pictures*

	No. of narrative words	Prop. of prepositions correctly produced	Prop. of lexical verbs correctly produced
BG	878	.12	.07
DC	649	.03	.04
DOR	452	.08	.04
EW	546	.10	.11
TH	887	.10	.13
normal range	**614-2476**[a]	**.12-.17**[b]	**.08-.14**[b]

[a] The range of words produced by the controls.
[b] For proportions, the normal range was calculated as two standard deviations below and above the controls' mean.

The results show that prepositions, while impaired, are not totally absent from the connected speech of the patients. This can be compared to the only previous study that also analysed the production of prepositions in connected speech of aphasic and control participants. Kreindler and Mihăilescu (1970) also found a reduced number of prepositions (a proportion of .095) in patients in comparison to a mean proportion of .13 produced by controls showing that the patients used fewer prepositions in comparison to the controls. There are however also reports of single cases of patients who never used prepositions in connected speech (Druks, 1991; Smith, 1974). The present study also showed that patients and controls not only differ in the number of prepositions correctly produced in connected speech but also in the types of subcategories produced.

The quality of errors made by the patients was in accordance with the widely-acknowledged traditional observation that non-fluent patients predominately omit and fluent patients substitute function words including some prepositions. Most of the substitution errors were within-category and within-subcategory substitutions and thus revealed much preserved knowledge about prepositions and their functions.

Possible links between verbs and prepositions were explored because they have in common the syntactic properties of theta-role and case assignment. Similarities in their impairment would suggest that they are likely to be caused by case and/or theta-role assignment; differences, on the other hand, would indicate that impairments of either word class are not due to their mutual syntactic properties. The lack of a link as found in the present study suggests that the deficits for prepositions and verbs are unrelated. A few previous studies also compared the use of prepositions and verbs. Kemmerer and Tranel (2003) studied two aphasic patients' production and comprehension of action verbs and spatial prepositions. The Broca's aphasic patient presented with poor performance on verbs and relatively good performance on prepositions. His lesion included the left frontal operculum. The second patient, whose lesion spread over Wernicke's area and who probably had mixed aphasia[31], exhibited the opposite pattern: good performance on verbs but poor performance on prepositions. The two patients with different lesion sites and different language behaviours led the authors to suggest that action verbs and spatial prepositions are processed in (at least partially) independent neural networks that can be impaired independently. Their conclusion, however, might be far-fetched, because the dissociation in the data was not clear-cut. First of all, the dissociation only occurred in comprehension while in production both verbs and prepositions were very impaired in both patients. Second, evidence for a double dissociation was weak even in comprehension: one patient presented a clear-cut single dissociation (63% of the verbs and 98% of the prepositions correctly comprehended); however, the second patient was also impaired on the better preserved category (81% of the verbs and 60% of the prepositions correctly comprehended).

Interestingly, their conclusion in a subsequent paper, a replication of the 2003 study, was very different. In this study, the production and comprehension of spatial prepositions was investigated in a large group of brain-damaged participants, only some of them aphasic. The six patients with the severest problems in producing and comprehending spatial prepositions were all aphasic and had lesions in the left inferior prefrontal and parietal region. All six patients were also severely impaired in producing verbs in action picture naming. The overlapping lesion sites and similar

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[31] In a later study by Kemmerer (2005) a patient is described (subject 3) who, from the background description, most likely is identical with the patient tested in Kemmerer and Tranel (2003). In the 2005 paper, this patient is described as initially global aphasic, but at the time of testing he displayed predominantly anomic aphasia with agrammatism, that is, most likely a mixed form of aphasia.

problems in relation to verbs and prepositions suggested to the authors that '*there is substantial commonality in the neural systems required for operating verbs and spatial prepositions*' (Tranel & Kemmerer, 2004, p. 744).

While the focus of these studies was on the neuro-anatomical relationship between verbs and prepositions, the data also contribute to the understanding of the linguistic relationship between verbs and prepositions. The conflicting results in the two studies show that we still do not fully understand the relationship between verb and preposition processing. The present study, however, offers further evidence for the position that the preservation/impairment of verbs and prepositions is not related.

4.4. TASKS PROBING ALL SUBCATEGORIES OF PREPOSITIONS

4.4.1   Production tasks

Sentence completion

Sentence completion is the only production task that allowed the testing of all subcategories of prepositions. The objective of this task was to find out if the availability of different subcategories of prepositions differed and to identify the parameters that determine the selective preservation/impairment of different subcategories of prepositions: are the parameters suggested in previous research and the predictions they make able to explain the performance pattern of the patients in the present study? The five parameters predicted that (I) meaningfulness of prepositions (Friederici, 1982; Ouhalla, 1993; Rizzi, 1985), (II) the lexical status of prepositions (Bennis et al., 1983), (III) the phonological properties of prepositions (Druks, 1991; Kean, 1977; 1979), (IV) the frequency of occurrence of prepositions (Kreindler & Mihãilescu, 1970), or (V) government (Grodzinsky, 1988) influence their availability. The parameters, their predictions, and the subcategories of prepositions used in the present study to explore them are outlined in Table 3 in Chapter 2 and are repeated here in Table 15.

Table 15: Parameters, predictions and prepositional subcategories used for the comparisons

	Parameters	Source	Predictions	Comparisons
I	meaningfulness	Friederici/ Ouhalla/Rizzi	meaningful > meaningless prepositions	(i) spatial, temporal, 'other theta-role assigning' prepositions *vs.* infinitival *to*, syntactic *of* (ii) spatial, temporal, 'other theta-role assigning' prepositions *vs.* subcategorized prepositions, particles
II	lexicality	Bennis et al.	lexical > syntactic prepositions	subcategorized prepositions, particles *vs.* infinitival *to*, syntactic *of*
III	phonology	Druks, Kean	stressed and longer > unstressed and shorter prepositions	bisyllabic prepositions *vs.* monosyllabic prepositions
IV	frequency	Kreindler & Mihăilescu	high frequency > medium frequency > low frequency prepositions	syntactic *of*, infinitival *to* *vs.* polysemic prepositions *vs.* non-polysemic spatial and temporal prepositions
V	government	Grodzinsky	ungoverned (adjunct) prepositions > governed (argument) prepositions	ungoverned meaningful prepositions *vs.* governed meaningful prepositions

Materials

The prepositions in the study were of either one syllable (n = 234) or two syllables (n = 42). Table 8 lists all prepositions, their subcategories, their specific features and the meaning they convey, and the number of times they are probed in the sentence completion task. The following six functions of prepositions were included:

(i) Spatial and (ii) temporal prepositions

Five prepositions with homophonic spatial and temporal meanings (*at, from, in, on, to*), five (predominately) spatial prepositions (*above, behind, into, onto, under*), and five (predominately) temporal prepositions (*after, before, for, since, until*) were included in the task. Spatial and temporal prepositions were controlled for complexity of features. Distinctions were made between spatial prepositions of place (i.e., locational prepositions such as *above, at, behind, in, on, under*) and of direction (i.e., directional prepositions such as *from, into, onto, to*), and between temporal prepositions that encode a closed time interval (a time interval with a beginning and

an end, i.e., *at, for, in, on)*, and an open time interval (a time interval with either a beginning or end, i.e., *after, before, from, to, since, until*). There were 48 sentence frames eliciting spatial prepositions and 60 eliciting temporal prepositions.

(iii) Prepositions assigning theta-roles other than spatial or temporal (i.e., 'other theta-role assigning' prepositions)

Five prepositions (*by, for, from, to, with*) were included. They assign theta-roles of benefactor (*for the baby*), recipient (*to his father*), instrument (*he unscrewed the glass with his hand/by hand.*), manner (*by accident, with care*), substance (*with sand*), animate source (*from John, this book is by Steven Pinker*), comitative (*with a friend*) or agent (*the book was written by Steven Pinker)*[32]. There were 48 sentence frames eliciting prepositions assigning these theta-roles.

(iv) Prepositions subcategorized by the verb

Five prepositions that are homophonic with spatial/temporal prepositions (*at, from, in, on, to*), one temporal (*for*) and two non-spatial prepositions (*of, with*) were included. There were 48 sentence frames eliciting subcategorized prepositions.

(v) Syntactic prepositions *of* and *to*

Of-constructions such as *a glass of wine* and *of*-constructions in which the first DP is morphologically derived from a verb (*the translation of the book*) were included. There were 24 such sentence frames eliciting the syntactic preposition *of*, 12 of each type. Bare infinitival constructions in which *to* does not contribute to the meaning of the sentence (*Tom intends to marry soon*) and *in order to* infinitival constructions in which *to* assigns the theta-role of purpose (*Bill went on a diet to lose some weight*) were also included[33]. 24 sentence frames, 12 of each type, elicited the availability of the infinitival *to*.

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[32] The dative *to* (recipient) and the passive *by* are included here. The reason is given in Chapter 1 under *An overview of the prepositions included in the present study*.

[33] The reason for including both types of syntactic *of* and infinitival *to* is to control for the fact that both syntactic prepositions can alter their degree of meaningfulness. This enables to investigate whether patients are sensitive to the differential degree of meaning of syntactic prepositions, and whether it can account for potential differences in aphasic performance (i.e., if meaningfulness facilitates the availability of prepositions then the *in order to* infinitival should be better preserved than the bare infinitival).

(vi) Particles

Two particles (*on, in*), homophonic with spatial and temporal prepositions, were included. They were used both as non-resultative (e.g., *pass on a tradition*) and resultative particles (e.g., *turn on the radio*), six times each[34]. Each sentence frame eliciting a particle was presented twice, once with the particle and verb being separated by the object (*he turned the radio on*) and once with the particle attached to the verb (*he turned on the radio*). There were 24 sentence frames, 12 of each type, eliciting particles.

The preparation of the materials

For each preposition a sentence was constructed which required the insertion of a preposition. Some target sentences needed the provision of context or a picture in order to elicit the target. In 193 cases the presentation of the sentence frame sufficed for eliciting the missing target, in 26[35] trials the sentence frame was accompanied by a picture, and in 57 trials it was introduced by a context sentence. Sentences were presented in written form and a line (in the un-timed version) or box (in the timed version) indicated the position of the missing preposition (see (19) for examples of all types of stimuli with target sentences in italics).

(19)   no context: *John left _____ Wednesday*.

context: John is a very active child. *He cannot sit still _____ the table[36]*.

picture: *The book is _____ the table*.

All sentence frames were presented to four students of UCL, whose mother tongue was English, for completion. A sentence was included in the test battery only if at least three out of four students provided the target preposition. The sentences were

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[34] Again, the reason for including resultative and non-resultative particles is to control for the differential degrees of meaningfulness of particles.

[35] 25 spatial prepositions and one preposition assigning the theta-role of animate source (*this book is by Jane Austen)* constitute to this number.

[36] This sentence frame can be correctly completed by more than one preposition (e.g., *at, under, on*). However, all students involved in the stimulus rating (see below) provided the same target preposition (*at*), possibly, because it is the most plausible choice. Therefore, the sentence frame was included in the materials. This procedure was followed for all sentence frames with multiple choices.

presented in predetermined semi-randomized order with no more than three homophonic prepositions in a row.

The 276 target sentences were administered in six individual blocks with 46 target sentences per block. The same sentence eliciting a particle either in a position attached to the verb or not attached to the verb did not occur within a block. A practice block with 14 practice sentences was presented to familiarize participants with the task. During practice trials feedback was given.

Procedure

The task was administered to both patients and controls. The patients were given unlimited time but the controls were allowed only a limited time window for responding. It was expected that under this condition differences between the different subcategories of prepositions could be detected for the controls.

For the patients, stimuli were presented in a fixed semi-randomized order using PowerPoint. Written sentence frames were shown on the screen. Pictures were presented above the sentences (see Figure 8a). Each sentence was read by the participants or, if necessary, by the experimenter. Patients could ask for the sentence to be repeated. Participants were required to complete the sentences by producing the missing target words. The written sentence frame was continuously available on the screen and there was no time limit to complete the sentence.
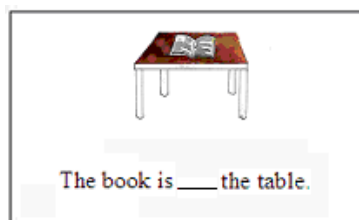
Figure 8a: A screen during un-timed sentence completion.

For the controls, sentences were displayed horizontally in three parts on the screen. On top, the first part of the sentence preceding the preposition was presented. In the middle the place marker of the preposition was displayed as an empty box and underneath it, the part of the sentence following the preposition was presented (see Figure 8b). Pictures accompanying the sentences were displayed above the sentence in the upper half of the screen.
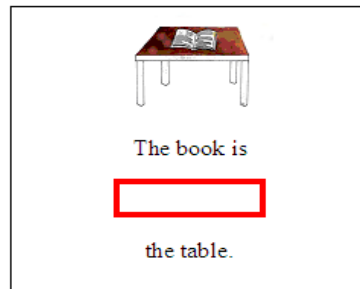
Figure 8b: A screen during timed sentence completion.

If a picture accompanied the sentence, the picture appeared first. 1000ms later the sentence frame was displayed. If no picture was involved, the sentence frame appeared 1000ms after beginning of the trial. 1000ms later, the sentence part preceding the preposition was read aloud and highlighted by a coloured frame. Then the gap position was highlighted and remained so for 1500ms until the trial had finished. The part of the sentence following the preposition was presented only in writing. Participants were required to complete the sentence while the gap was highlighted. Once time had expired the screen went blank and the next trial was activated on button press by the experimenter.

Recording started at the end of the oral presentation of the sentence part that preceded the preposition and lasted until the trial was finished. Spoken responses were analysed for latency and accuracy. The *latency of interest* for analysis was the time between the end of the oral presentation and the production of the target word by the control participant. Responses made after closure of the time window were scored as *no response* errors.

Results and interim discussion

Tables A in Appendix X (for controls) and B in Appendix X (for patients) give the number of correct responses (and mean latencies for controls) in total (second column), the proportions of correct responses (and mean latencies for controls) for subcategories of prepositions (columns three until nine), for the phonology contrast (columns 10 and 11), for the frequency contrast (columns 12-14), and for the government contrast (columns 15 and 16). Figures A and B in Appendix X present the confidence intervals for the controls' accuracy and latency data. Table 16a gives the patients' and control group's number of errors made in each error type. Figure 9 illustrates the individual patient's results with respect to the five parameters tested.

Table 16b summarizes the parameters significantly supported and rejected by the patients and controls.

The control participants made few errors (range 90-97% correct) and responded fast (range 386-1203ms). Confidence intervals showed that performance across subcategories of prepositions did not vary (see Figures A and B in Appendix X). They produced more *no responses* (due to time-outs) than substitution errors and the majority of substitutions were within category (see Table 16a).

Some patients made only few errors (BG: 23%, EW: 24%) while others made many (TH: 45%, DC: 66%, DOR: 82%). The majority of errors were within-category substitutions. Only DOR produced an equal number of *no responses* and within-category substitutions. This, however, must be considered with caution due to DOR's tendency to perseverate on four prepositions, *by*, *from*, *before*, and *for*, which could account for the high number of within-category substitution errors. DOR's behaviour illustrates the general inclination of the patients to use certain prepositions as substitutes for others. BG used *of* and *in* as replacement prepositions, TH also preferred *in* as a substitute, and DC's used mostly *for*, *from*, and *on*.

Table 16a: Summary of the numbers of errors in each type for individual patients and the control group in sentence completion

	Number of errors		
	no responses	**across-category substitutions**	**within-category substitutions**
BG	3	7	54
DC	17	43	122
DOR	104	13	110
EW	12	10	45
TH	24	19	81
control group	54	1	36

Only a few parameters were shown to affect the patients' performance: syntactic prepositions were produced more accurately than meaningless lexical prepositions (i.e., subcategorized prepositions and particles, see footnote 23) (parameter II: BG: [Wald χ^2 = 10.47, df=1, p = .001]; TH: [Wald χ^2 = 10.44, df=1, p = .001]; EW: trend [Wald χ^2 = 5.27, df=1, p = .02]). Syntactic prepositions were also better preserved than meaningful lexical prepositions (parameter I (i): BG: trend [Wald χ^2 = 4.93, df=1, p = .03]), however, meaningful lexical prepositions were better preserved than meaningless lexical prepositions (i.e., subcategorized prepositions and particles)

(parameter I (ii): BG: trend [Wald χ^2 = 6.07, df=1, p = .014]; DOR: trend [Wald χ^2 = 5.00, df=1, p = .025]). DOR's performance was also significantly influenced by government in that he performed better when a meaningful preposition was governed by the verb (parameter V: [Wald χ^2 = 10.98, df=1, p = .0009]). Lastly, BG tended to be better at high frequency prepositions than medium frequency and low frequency prepositions (parameter IV: trend [Wald χ^2 = 4.00, df=1, p = .05]). None of the other parameters explained the patients' performance patterns (see Figure 9).
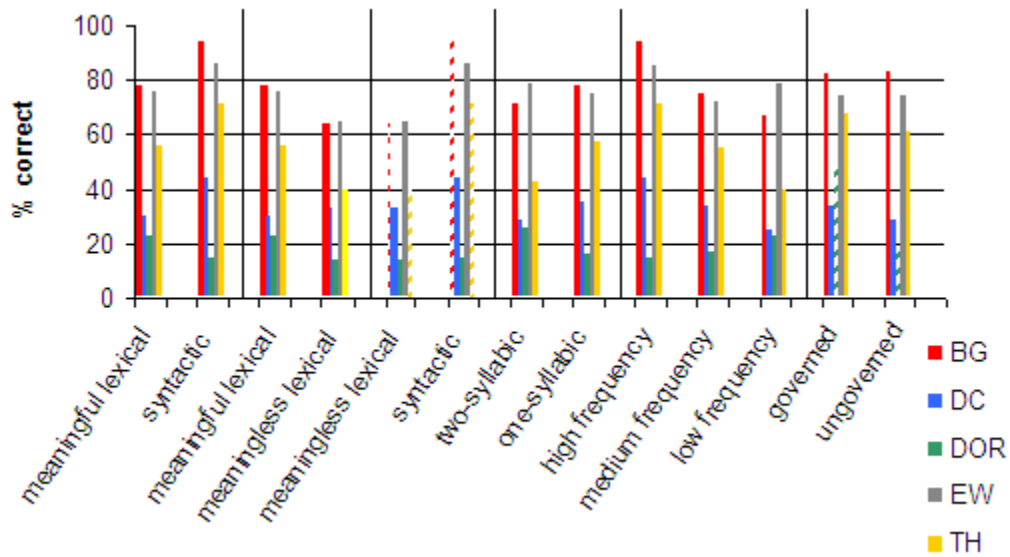
Figure 9: Individual patient's results in sentence completion with respect to the five parameters tested (marked with stripes are significant results of p $^{<}/_{=}$ .01).

Table 16b: Summary of the results for testing the parameters for each patient and the control group in sentence completion

	Parameters derived from previous aphasia research					
	(I)		**(II)**	**(III)**	**(IV)**	**(V)**
	meaningfulness		lexicality	phonology	frequency	government
	(i)	(ii)				
sentence completion						
BG	–	–	↔	–	–	–
DC	–	–	–	–	–	–
DOR	–	–	–	–	–	↔
EW	–	–	–	–	–	–
TH	–	–	+	–	–	–
control group – (timed) sentence completion						
accuracy data	–	–	–	–	–	–
latency data	–	–	–	–	–	–

+ parameter significantly supported
↔ parameter significantly rejected
– represents a parameter that is not significantly supported/rejected

The control group responded fast and accurately and their performance was not influenced by any of the parameters. Patients' performance was impaired, with accuracy scores ranging from 18% to 77%. Past studies that tested the availability of prepositions in sentence completion also found impairments (e.g., Bennis et al., 1983; Druks, 1991; Friederici, 1981; 1982; Friederici et al., 1982; Lonzi et al., 2007; Wales & Kinsella, 1981). Results also show that different subcategories of prepositions were not equally affected. Most importantly and contrary to expectations, the statistical comparisons and/or informal comparisons of the patients' proportions correct on each subcategory of preposition (see Table B in Appendix X) showed that a disproportionate deficit for subcategorized and syntactic prepositions was not found. In fact, BG (against prediction) and TH, the anomic patient, (according to prediction) performed best on prepositions that play a syntactic role only in the sentence (which led to a significant difference when testing parameter II). This also shows that the performance pattern of the anomic patient did not differ from that of the Broca's aphasic patient. Two other patients (DC and EW) performed best on syntactic and subcategorized prepositions (albeit this did not lead to

significant differences when testing parameters I and II). Only DOR, the patient with the severest impairment in preposition production, performed (non-significantly) better on meaningful prepositions than meaningless (subcategorized and syntactic) prepositions. Overall, none of the parameters correctly predicted the Broca's aphasic patients' performance and only two of them – lexicality and government – had some effect in that they were rejected by the patient data. Lexicality also had an effect on the anomic aphasic patient and it was in line with the prediction. A detailed discussion of the patients' performance in relation to the five parameters is in 5.1.

All five patients made more substitution than omission errors. Only a few previous studies carried out error analyses (in sentence completion) and they report variable results. Friederici (1981; 1982) found more omission than substitution errors for Broca's aphasic patients and the errors were often across category. The opposite pattern was observed for Wernicke's aphasic patients. In contrast, Bennis et al. (1983) found that the majority of errors of Broca's and Wernicke's aphasic patients were within-category substitutions. The results of the present and Bennis et al.'s study show that patients, both mildly and severely impaired, make less severe errors than previously reported. The production of many within-category substitution errors indicates that patients have knowledge about the linguistic and semantic properties of prepositions.

4.4.2   Grammaticality judgment tasks

Three tasks – grammaticality judgment of single sentences, contrastive grammaticality judgment of sentence pairs, and forced choice grammaticality judgment – explored the ability to judge the grammaticality of sentence (the task design is a replication of Friedmann and Grodzinsky's, 1997). It was expected that forced choice grammaticality judgment would be the most difficult judgment task because in this task participants were presented with a sentence frame and a number of target choices. The objective of the tasks was to find out if grammaticality judgment of sentences with different subcategories of prepositions would differ and to identify the parameters that determine the selective preservation/impairment of subcategories of prepositions. The comparisons of interest were the same as for sentence completion described in 4.4.1 and summarized in Table 15. As no speech production was involved in grammaticality judgment, parameter III about the

phonological properties of a preposition was not tested. Sentences testing particles were only presented once with the verb and the particle being separated by the noun.

Materials

The three grammaticality judgment tasks employed the same stimuli. 179 sentences, a subset of the sentences in the sentence completion task were included in the grammaticality judgment tasks. Items in the sentence completion task that required a picture (n = 26) were removed. 250 sentences were left. In order to further reduce the number of items, 24 non-polysemic temporal prepositions, 29 'other theta-role assigning' prepositions, six subcategorized prepositions, and 12 sentences eliciting a particle in a construction in which the particle is attached to the verb were also removed. 179 sentences remained. The prepositions used in the tasks are listed in Table 8.

Grammatical violations consisted of wrongly selected prepositions. For grammaticality judgment of single sentences and sentence pairs, for each of the 179 sentences an ungrammatical sentence was created which differed from the grammatical sentence only in the preposition used. The erroneous prepositions were randomly selected from the prepositions used in the task. Particle violations were created by substitution with another particle. As only two particles were tested, additional particles (that were not included in this study) were used in the ungrammatical sentences (e.g., *out, up*). The final stimulus set consisted of 358 sentences, 179 grammatical sentences and 179 ungrammatical structures.

For forced choice grammaticality judgment, for each of the 179 sentences two distracter prepositions were randomly selected from the prepositions used in the task.

Procedure

Grammaticality judgment of single sentences

The 358 test sentences were distributed over eight blocks with 45 items in six and 44 items in two blocks. The number of grammatical and ungrammatical sentences in each block was between 20 and 24. The grammatical and ungrammatical version of a sentence never occurred within the same block. Within blocks, all sentences were arranged in a pre-determined semi-random order with no more than three grammatical or ungrammatical sentences consecutively. A block of 28 practice sentences was also administered and feedback was given.

Participants were presented with a sentence in the upper half of the screen. After a delay of 1000ms the sentence was read aloud and highlighted by a coloured frame. After spoken presentation of the sentence *yes?* and *no?* buttons were activated and participants were asked to judge the grammaticality of the sentence by pressing one of the buttons using a touch screen (see Figure 10). Pressing one of the buttons triggered the appearance of a blank screen displaying only the *next* button. Pressing *next* started a new trial. There was a time limit of 10 seconds in which a response had to be made, otherwise the screen went blank.
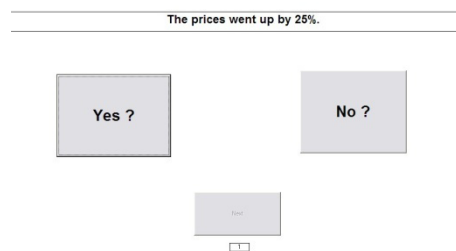
Figure 10: Display of a screen for grammaticality judgment of single sentences.

Responses were analysed for accuracy (for patients and control group) and reaction times (for control group). The recording of reaction time started when spoken sentence presentation was finished and was terminated on button press.

Contrastive grammaticality judgment of sentence pairs

The 179 sentence pairs were presented in three blocks with 45 trials and one block with 44 trials. Presentation was in a pre-determined semi-random order with no more than three grammatical/ungrammatical sentences consecutively in the same position. A block of 14 practice sentences was also administered prior to testing proper and feedback was given.

Participants were presented with two identical sentences that differed only in the prepositions used and they had to select the grammatical sentence. The first sentence of a pair was presented in the upper half of the screen. After a delay of 1000ms the sentence was read aloud and highlighted by a coloured frame. Another 1000ms later, the second sentence appeared in the lower half of the screen. 1000ms later, the sentence was read aloud and highlighted. At this stage, the response buttons were

activated. The buttons, placed underneath each sentence, were labeled with *good?* (see Figure 11).
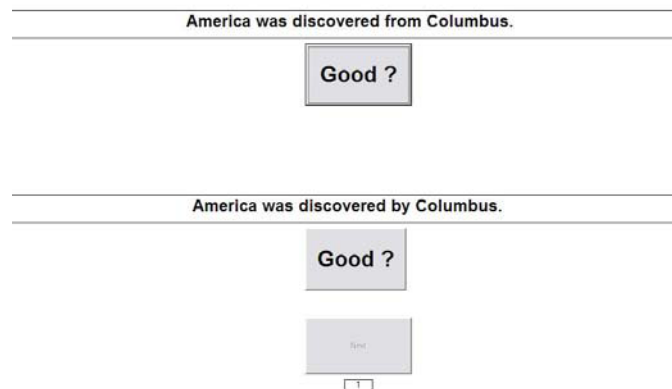
Figure 11: Display of a screen for contrastive grammaticality judgment of sentence pairs.

Participants selected a sentence by pressing the corresponding *good?* button using the touch screen. Selecting one of the sentences triggered the appearance of a blank screen displaying only the *next* button. Pressing *next* started a new trial. After a time limit of 10 seconds, if no response was made, the screen went blank. Responses were analysed for accuracy (for patients and control group) and for the control group, reaction time was recorded from termination of spoken presentation of the second sentence until a button was pressed.

Forced choice grammaticality judgment

In the forced choice task, the 179 sentence pairs were presented in three blocks with 45 trials and one block with 44 trials. Presentation was in a pre-determined semi-random order with no more than three target prepositions consecutively in the same position. A block of 14 practice sentences was also administered prior to testing proper and feedback was given.

Participants were presented with a sentence frame with a missing preposition and a choice of three prepositions only one of which correctly completed the sentence frame. The task was to select the preposition that correctly completed the sentence. The sentence frame was presented in the upper centre of the screen. The missing word was represented by a line. 1000ms following the appearance of the written sentence, it was read out aloud and highlighted by a coloured frame. For the spoken presentation of the sentence frames, the target words have been cut out from the

sound wave and a gap has been inserted lasting for 2s. Those 2s were a 0.5s silence followed by a 1s sine noise of 330Hz and an amplitude of 0.5. Finally, there was another 0.5s silence before the sentence continued. On the lower part of the screen, three buttons were displayed each reading *this one?*. 1000ms following the spoken sentence presentation, the first preposition that may complete the gap appeared in writing above the leftmost button, and 1000ms later it was read aloud. 1000ms later, the second preposition appeared above the middle button followed by its spoken presentation. 1000ms later the same procedure applied to the third preposition (see Figure 12).

All *this one?* buttons became activated once the third preposition was presented aurally. Participants responded by pressing the corresponding *this one?* button using a touch screen. Once a selection was made, a blank screen appeared displaying a *next* button. Pressing *next* triggered a new trial to start. There was a time limit of 10 seconds in which participants had to respond, otherwise the screen went blank.
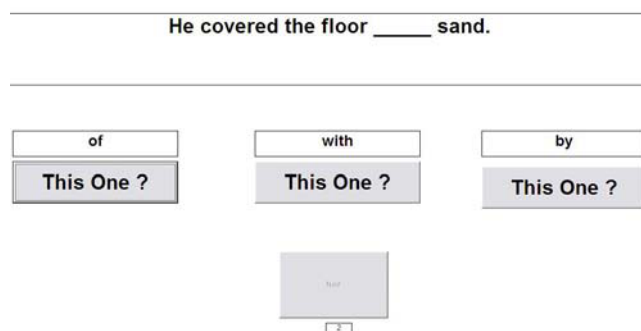
Figure 12: Display of a screen for forced choice grammaticality judgment.

Responses were analysed for accuracy (for patients and control group) and reaction times (for control group) which were recorded following spoken presentation of the third preposition until a *this one?* button was pressed.

Results and interim discussion

Appendix XI summarizes the results for grammaticality judgment of single sentences, Appendix XII for contrastive grammaticality judgment of sentence pairs and Appendix XIII for forced choice grammaticality judgment. Tables A (for controls) and B (for patients) in Appendices XI to XIII give the number of correct responses (and mean reaction times for controls) in total (column two), the

proportions of correct responses (and mean reaction times for controls) for subcategories of prepositions (columns three until nine), for the frequency contrast (columns 10-12), and for the government contrast (columns 13 and 14)[37]. Figures A and B in Appendices XI to XIII present the confidence intervals on the controls' accuracy and reaction time data. Table 17a gives the patients' and control participants' number of errors in each error type for each grammaticality judgment task. Table 17b summarizes the parameters significantly supported and rejected by the patients and controls across all grammaticality judgment tasks.

The control participants made few errors across the grammaticality judgment tasks (individual range 98-100% correct) and responded fast (individual range 503-1675ms). Confidence intervals on the controls' accuracy and reaction time data revealed that performance across the subcategories of prepositions did not differ.

Patients' performance was generally good, though not errorless: BG made only a few errors across tasks (accuracy ranged from 92-98% correct) while most patients made many errors in some but not all tasks (DC's accuracy ranged from 72-91% correct, DOR's from 39-90% correct, EW's from 55-92% correct, and TH's from 77-89% correct). The majority of errors were made in forced choice grammaticality judgment. Only DC and TH made as many errors in grammaticality judgment of single sentences as in forced choice grammaticality judgment. The majority of errors made by the patients across tasks were erroneous responses. However, more *no responses* than erroneous responses were made by BG, DC, and EW in force choice grammaticality judgment and by DC in contrastive grammaticality judgment of sentence pairs.

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[37] In grammaticality judgment of single sentences the number of correct responses is given separately for the grammatical and ungrammatical condition (columns two and three), and, consequently, the column setting is deferred accordingly.

Table 17a: Summary of the numbers of errors in each type for individual patients and the control group for each grammaticality judgment task

	BG	DC	DOR	EW	TH	control group
Grammaticality judgment of single sentences						
No responses	7	16	9	4	23	0
Erroneous responses	7	79	59	25	58	15
Contrastive grammaticality judgment of sentence pairs						
No responses	1	11	5	0	1	0
Erroneous responses	2	6	13	16	19	3
Forced choice grammaticality judgment						
No responses	13	35	15	74	8	1
Erroneous responses	1	15	95	6	29	3

Only some of the parameters could account for the performance patterns of the patients. In forced choice grammaticality judgment, DOR performed significantly better on meaningful and meaningless lexical prepositions (i.e., subcategorized prepositions and particles, see footnote 23) than syntactic prepositions (parameter I (i): [Wald χ^2 = 7.70, df=1, p = .006] and parameter II: [Wald χ^2 = 7.88 df=1, p = .005]). DOR's performance was not influenced by meaningfulness itself as he did not show significant differences (or trends) for contrast (ii) of parameter I. This is in contrast to BG, DC, and TH who performed better on meaningful than meaningless lexical prepositions (i.e., subcategorized prepositions and particles) in grammaticality judgment of single sentences (parameter I (ii): DC: [Wald χ^2 = 7.41, df=1, p = .007]; TH: [Wald χ^2 = 13.8, df=1, p = .0002]), and forced choice grammaticality judgment (parameter I (ii): TH: [Wald χ^2 = 9.68, df=1, p = .002]; BG: trend [Wald χ^2 = 6.46, df=1, p = .011]). It is also in contrast to EW and TH who performed better on syntactic than meaningless lexical prepositions (i.e., subcategorized prepositions and particles) in contrastive grammaticality judgment of sentence pairs (parameter II: EW: trend [Wald χ^2 = 4.19, df=1, p = .04]), and grammaticality judgment of single sentences (parameter II: TH: trend [Wald χ^2 = 4.90, df=1, p = .03]).

DC, DOR, and TH showed a negative frequency effect (parameter IV) in forced choice grammaticality judgment (DOR: trend [Wald χ^2 = 4.98, df=1, p = .03][38]), in contrastive grammaticality judgment of sentence pairs (DOR: [Wald χ^2 = 6.62, df=1,

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[38] Statistical calculations on DOR's original data were impossible due to ceiling effects for one of the three categories (low frequency prepositions). In this case, an error was added (to avoid ceiling performance) in order to carry out the statistical analysis. After doing so, the comparison approached significance.

p = .01]; DC: trend [Wald χ^2 = 4.93, df=1, p = .03[39]), and in grammaticality judgment of single sentences (TH: trend [Wald χ^2 = 3.85, df=1, p = .05]).

Table 17b: Summary of the results for testing the parameters for each patient and the control group across all grammaticality judgment tasks

	Parameters derived from previous aphasia research				
	(I)		**(II)**	**(IV)**	**(V)**
	meaningfulness		*lexicality*	*frequency*	*government*
	(i)	(ii)			
BG	–	–	–	–	–
DC	–	+	–	–	–
DOR	+	–	+	↔	–
EW	–	–	–	–	–
TH	–	+	–	–	–
control group					
accuracy data	–	–	–	–	–
reaction time data	–	–	–	–	–

+ parameter significantly supported
↔ parameter significantly rejected
– represents a parameter that is not significantly supported/rejected

The control group responded fast and accurately across tasks and their performance was not influenced by any of the parameters predicted. Judging the grammaticality of sentences with violations created by substitution of the correct preposition is impaired in the patients, however, performance across grammaticality judgment tasks differed and the impairment was evident mainly in forced choice grammaticality judgment. Forced choice grammaticality judgment of sentences with preposition violations, as far as I am aware, was only tested in one previous study – in Kemmerer's (2005). Kemmerer tested the judgment of temporal prepositions with this task in two Broca's aphasic patients, one mixed patient, and one transcortical motor patient. The Broca's aphasic patients performed well (90% and 97% correct, respectively) while the transcortical motor aphasic patient was moderately (78% correct), and the mixed aphasic patient, severely impaired (35% correct). Three

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[39] DC performed at ceiling on low frequency prepositions. In order to be able to carry out a statistical comparison, the procedure described in footnote 38 was applied.

previous studies have probed grammaticality judgment of single sentences (Friederici, 1982; Grodzinsky, 1988; Lonzi et al., 2007). Accuracy of (agrammatic) Broca's aphasic patients ranged from 68% to 92% across studies and for fluent/Wernicke's aphasic patients from 58% to 82%. Contrastive grammaticality judgment of sentence pairs with preposition violations was used in only two previous studies – in Druks' (1991) and Goodglass et al.'s (1970). Performance was correct around 85% for the Broca's aphasic patients in both studies, and 89% for the group of anomic patients in Goodglass et al. In these past studies, as in the present study, forced choice grammaticality judgment and grammaticality judgment of single sentences revealed moderate-to-severe impairments in some but not all patients, while contrastive grammaticality judgment of sentence pairs was found mildly impaired across patients. It might be argued that forced choice grammaticality judgment is most demanding because there is less chance to respond correctly due to more choices to select from. It has however been observed in the different comprehension tasks of the present study that some patients may benefit from a larger choice of stimuli (see also Salis & Edwards, 2006, who found that a large choice of pictures did not negatively affect patient performance in sentence comprehension). Therefore, it is possible that task presentation rather than the number of response choices contributed to the difficulties patients had with forced choice grammaticality judgment; perhaps, because the response choices were not presented in sentences (as in the other judgment tasks) but in isolation. Because of the time restrictions, patients could not insert each preposition in the sentence frame and 'try out' the grammaticality of the sentences (which was often attempted by the patients during trials and seemed the preferred strategy to make a choice). This might be the reason why forced choice grammaticality judgment was a difficult task and revealed subtle deficits in grammaticality judgment that other versions of the task could not detect.

Some patients' performance patterns could be predicted by some of the parameters. Grammaticality judgment was influenced, as predicted, by the parameters of meaningfulness (DC, DOR, and TH) and lexicality (DOR) and contrary to prediction by the frequency parameter (DOR). A detailed discussion of the patients' performance in relation to the five different parameters is in 5.1.

Lastly, patients made overall more erroneous responses than *no responses*, however, with an increasing number of choices, the number of *no responses*

increased. Only one of the few previous studies that used grammaticality judgement analysed error types. Druks (1991), similarly to the majority of the patients in the present study, reported more erroneous responses (80%) than *no responses* (20%) in grammaticality judgement of contrastive sentence pairs.

The processing of different types of prepositions in production and grammaticality judgment

While for the majority of patients production of prepositions was more difficult than grammaticality judgment (BG, DC, and TH) for other patients, forced choice grammaticality judgment was more demanding than production (EW) or equally difficult (DOR). This shows that grammaticality judgment *per se* is not necessarily less impaired than production in Broca's aphasia (but see Friederici, 1982; Linebarger et al., 1983; Lonzi et al., 2007).

Some performance patterns were consistent across modalities and across subcategories of prepositions: syntactic prepositions were among the best preserved prepositional subcategory for BG, DC, EW and TH in production and grammaticality judgment and BG and TH produced syntactic prepositions with significantly more accuracy than meaningless lexical prepositions (i.e., subcategorized prepositions and particles, see footnote 23). DOR, in contrast, was consistently better at meaningful lexical prepositions than syntactic prepositions across tasks, and in forced choice grammaticality judgment, the difference between meaningful (and meaningless) lexical and syntactic prepositions was significant. Some patterns, however, were evident in one modality only. DOR, for example, was significantly better at producing governed than ungoverned prepositions only in sentence completion (see Figure 13). He also showed a reversed frequency effect in contrastive grammaticality judgment of sentence pairs (and most likely in forced choice grammaticality judgment[40]) but not in sentence completion and grammaticality judgment of single sentences (see Figure 14).

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[40] The difference between high, medium and low frequency prepositions in forced choice grammaticality judgment was most likely also significant. However, as mentioned in footnote 38, due to ceiling performance a statistical comparison on the original data was not possible.
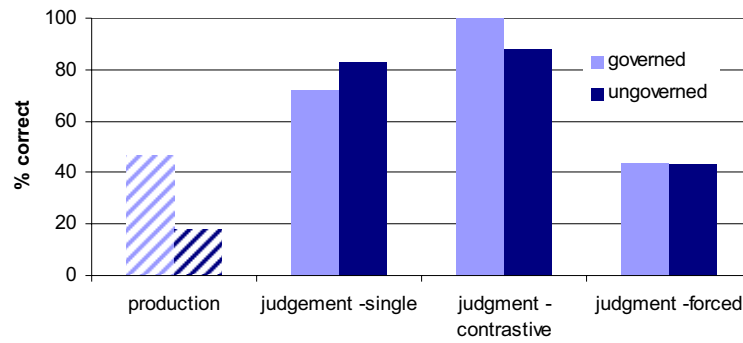
Figure 13: Accuracy scores for the governed-ungoverned contrast across tasks for DOR (marked with stripes are significant results of p $^</_=$ .01).
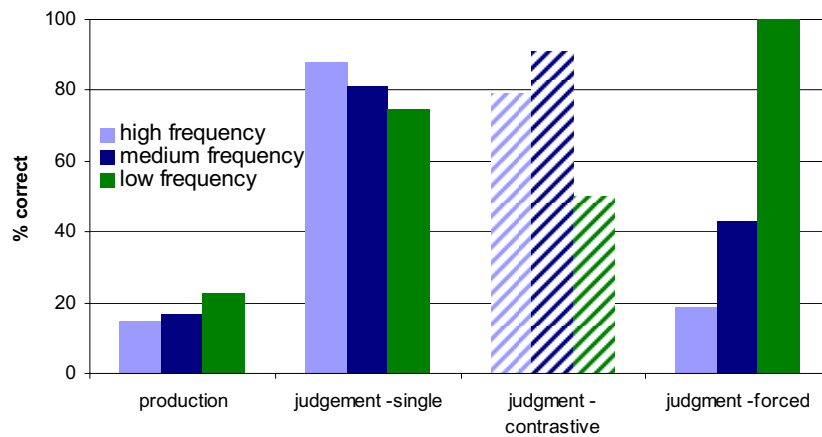
Figure 14: Accuracy scores for the frequency contrast across tasks for DOR (marked with stripes are significant results of p $^</_=$ .01).

Lastly, one of the main findings of the present study – the relative preservation of syntactic prepositions in the majority of the patients – deserves some discussion. The relative preservation of syntactic prepositions in the present study rules out a disproportionate deficit for the group of meaningless prepositions as found previously (e.g., Friederici, 1982). There are other studies that did not find differences between meaningful and meaningless prepositions. Wales and Kinsella (1981) tested the production of prepositions in sentence completion in six Broca's aphasic patients. Although prepositions were very impaired, post hoc, no difference was found between spatial and subcategorized prepositions. Lonzi and Luzzatti (1995) found that for one of their patients in their study, the difference was not between meaningful (spatial) and meaningless (subcategorized) prepositions but between governed (subcategorized and spatial prepositions) and ungoverned

prepositions (spatial prepositions, passive *by*), that is, between arguments and adjuncts. Bennis and colleagues (1983) found a difference between lexical (spatial and subcategorized) and syntactic prepositions (syntactic *of*, dative *to*). Broca's aphasic patients were better at producing the lexical than syntactic prepositions and Wernicke's aphasic patients showed the opposite pattern. Thus, the performance of the patients did not distinguish between (meaningful) spatial and (meaningless) subcategorized prepositions, and the (possibly meaningful) dative *to* and the (meaningless) syntactic *of*. However, in contrast to Bennis et al., in the present study a strong advantage for *syntactic* prepositions but not for meaningless prepositions in general was found across patients of different clinical profiles. This is because subcategorized prepositions (which are sometimes analysed as meaningless lexical prepositions and at other times as meaningless syntactic prepositions) were found more impaired than meaningful lexical and syntactic prepositions (i.e., the syntactic *of* and the infinitival *to*) in some tasks and for some patients (BG, DC, and TH). In Chapter 5, section 5.2, possible reasons for the dissociation between syntactic and subcategorized prepositions and the selective preservation of syntactic prepositions will be discussed.

4.5   OTHER COMPARISONS

The comparisons discussed in this section were not the focus of the present study; however, they are of interest as they contribute to the understanding of the nature of the preposition deficit.

These comparisons investigated the availability of subtypes of prepositions within the same subcategory with different linguistic properties. First, within the subcategory of meaningful prepositions, spatial and temporal prepositions were compared. Second, the availability of meaningful prepositions that differ in semantic complexity was compared. For example, if we assume that all spatial prepositions have in common the semantic feature of [PLACE] then spatial prepositions of direction must have the feature of [PATH] in addition. The presence of an additional feature may render directional prepositions more complex. Third, the availability of syntactic prepositions with different degrees of meaningfulness was compared. Some usages of the infinitival *to*, for example, convey the meaning of purpose, while other usages are meaningless. Fourth, the availability of resultative and non-resultative particles in different positions in the sentence was compared because, as already

indicated, the two differ in terms of their meaninglessness, among other things. Finally, the availability of homophonic prepositions with different functions was explored.

Spatial and temporal prepositions

Kemmerer (2005) studied two Broca's, one mixed, and one transcortical motor aphasic patients' comprehension of spatial and temporal prepositions. The two Broca's aphasic patients were better at comprehending temporal prepositions while the two remaining patients were better at comprehending spatial prepositions. Kemmerer's findings show that the distinction between preserved and impaired prepositions might go beyond meaningfulness, suggesting that a more fine-grained division may be needed to take into account the different theta-roles a preposition assigns. Moreover, which meaning is (un)impaired can be different in different patients.

The design of the present study allowed the re-evaluation of Kemmerer's claim (2005) that the different functions of meaningful prepositions can be selectively impaired in aphasia. 48 spatial and 60 temporal prepositions were included in sentence completion and 23 spatial and 36 temporal prepositions in each grammaticality judgment task. Tables A (for controls) and B (for patients) in Appendix XIV give the proportions of correct responses (and mean latencies/reaction times for controls) for spatial prepositions and temporal prepositions separately for each of the tasks. Figures A and B in Appendix XIV present the confidence intervals on the controls' accuracy and latency/reaction time data.

The controls' accuracy and latencies/reaction times for spatial and temporal prepositions did not differ. Using logistic regression of single case data with linear contrasts also revealed that none of the patients supported the prediction because in most patients there was none or only a small difference in production and grammaticality judgment of spatial and temporal prepositions. For EW and TH the differences approached significance. For EW there was an advantage of spatial prepositions in forced choice grammaticality judgment ([Wald χ^2 = 4.48, (df=1), p = .03]), while for TH the difference was in favour of temporal prepositions ([Wald χ^2 = 5.11, (df=1), p = .02]) in grammaticality judgment of single sentences.

Thus, the difference was neither large nor was it present across tasks (in fact, in sentence completion TH showed an advantage for spatial prepositions). The small

differences and the inconsistent performance patterns suggest that the patients were not influenced by the distinct meanings of spatial and temporal prepositions. Moreover, it could be that the difference found between the two types of prepositions in Kemmerer's study was task-induced. This is because the mode of elicitation used for spatial and temporal prepositions was different: when probing spatial prepositions in a forced choice sentence completion task, pictures were used. Participants had to compare three given prepositions (and a sentence frame) with the spatial situation in the picture. Choosing the correct preposition was to be carried out by word-picture matching: any of the provided prepositions would have resulted in a grammatical sentence but only one of them also matched the picture. When probing temporal prepositions using the same task, no pictures were used. In order to select the temporal preposition that correctly completes a given sentence frame from a choice of three, a decision had to be made on language level. Moreover, only the insertion of the target prepositions resulted in a grammatical sentence. Thus, the tasks used to assess the knowledge of spatial and temporal prepositions were different, and, therefore, the comparison was not made between temporal and spatial prepositions but between two very different task demands. The findings and conclusions of Kemmerer's study, therefore, are questionable. Thus, to date there is no good evidence for a difference in the availability of spatial and temporal prepositions.

More and less complex prepositions

Meaningful prepositions divide into semantically less and more complex prepositions. The semantic complexity of prepositions is measured here by the featural make-up of prepositions. The examples below illustrate a possible featural make-up of some spatial and temporal prepositions. This featural composition of prepositions is by no means generally accepted by all linguists, and, as will be pointed out in Chapter 6, the details of this are not fully worked out for most prepositions.

Spatial prepositions are subdivided into prepositions of place/location on the one hand, and movement/direction, on the other (e.g., Svenonius, 2004; 2007). Similarly, temporal prepositions are subdivided into those specifying a closed interval of time and those that indicate an open interval of time (e.g., Pullum & Huddleston, 2002). An open interval implies duration (which can have a beginning (*from* 9 o'clock) and/or an end (*until* 9 o'clock)) while a closed interval denotes a specific point in

time with a beginning and an end but no perceived duration (e.g., *at* 9 o'clock). The main difference between the two subtypes could therefore be characterized by the presence/absence of the feature [PATH] for spatial prepositions (e.g., *into* is specified as denoting [PATH] in addition to [PLACE] and *in* only represents [PLACE]), and [DURATION] for temporal prepositions (e.g., being an open interval prepositions *after* denotes [DURATION, BEGINNING], *before* denotes [DURATION, END], and *during* denotes [DURATION, BEGINNING, END], while *at* being a closed time interval preposition denotes [BEGINNING, END] but not [DURATION]). It is possible that the presence of an additional semantic feature such as [PATH] or [DURATION] renders a preposition semantically more complex.

In order to test the effects of semantic complexity, the materials of the present study were controlled for complexity of spatial and temporal prepositions. 54 semantically less complex and 54 semantically more complex spatial and temporal prepositions were included in sentence completion and 31 semantically less complex and 28 semantically more complex spatial and temporal prepositions in each grammaticality judgment task. Tables C (for controls) and D (for patients) in Appendix XIV give the proportions of correct responses (and mean latencies/reaction times for controls) for semantically less complex prepositions and semantically more complex prepositions separately for each of the tasks. Figures C and D in Appendix XIV present the confidence intervals on the controls' accuracy and latency/reaction time data.

The controls' accuracy and latencies/reaction times for semantically more and less complex prepositions did not differ. Logistic regression of single case data with linear contrasts was used to test the effects of semantic complexity in the patients. For one patient (DOR) in one task (forced choice grammaticality judgment) complexity predicted performance ([Wald χ^2 = 8.339, (df=1), *p* = .004]), in that semantically more complex prepositions were better preserved than less complex prepositions. The difference was not significant in any other patient or task. It may be concluded that semantic complexity of meaningful prepositions is not a relevant factor to influence their availability in this group of patients.

Syntactic prepositions

Linguists distinguish two types of infinitival *to*. The *in order to* infinitival assigns the theta-role of *purpose* while the bare infinitival is meaningless. As the crucial contrast

between the two forms of *to* is in the degree of their meaningfulness, it is possible that those syntactic prepositions with some meaning attached to them would be better preserved than their meaningless counterparts.

In order to test this hypothesis, 12 sentences probing the *in order to* and bare infinitival *to*, respectively, were included in sentence completion and in the grammaticality judgment tasks. Tables E (for controls) and F (for patients) in Appendix XIV give the proportions of correct responses (and mean latencies/reaction times for controls) for the *in order to* infinitival *to* and the bare infinitival *to* separately for each of the tasks. Figures E and F in Appendix XIV present the confidence intervals on the controls' accuracy and latency/reaction time data.

The controls' accuracy and latencies/reaction times for the two types of infinitival *to* did not differ. Using logistic regression of single case data with linear contrasts revealed that for one patient, DC, performance was influenced by meaningfulness of a syntactic preposition, however, in the direction opposite to the predicted. DC was significantly better at producing the bare infinitival *to* than the *in order to* infinitival ([Wald χ^2 = 7.02, (df=1), *p* = .008]). The other patients did not show a difference and for DC too the difference was present only in sentence completion. It seems, therefore, that the degree of meaning attached to the infinitival *to* was irrelevant for the patients in the present study.

Particles

Particles, like syntactic prepositions, vary with respect to their meaninglessness. Resultative particles have maintained traces of their concrete core meaning (usually [PATH], e.g., *throw up the ball*). In contrast, non-resultative particles are less concrete (e.g., *give up hope*). On the basis of previous studies that have identified meaningfulness as the key parameter to influence a preposition's availability (e.g., Friederici, 1982), it is speculated that particles with more concrete meaning would be better preserved than particles with less concrete meaning.

Particles are also distinguished according to their position. A typical characteristic of particles is that they can either be attached to the verb (e.g., *look up the information*) or not (e.g., *look the information up)* (e.g., see Bolinger, 1971; Palmer, 1974). One previous study compared the availability of attached versus non-attached particles. Wales and Kinsella (1981) found that Broca's aphasic patients did significantly better on non-attached particles than attached particles in a sentence

completion task. They suggested several explanations for their finding: (i) that it reflects the order of acquisition of particles from the non-attached position to the attached position (see Visser, 1963), (ii) that it reflects phonological differences between attached particles that are clitics and therefore more vulnerable and non-attached particles that are not clitics and thus more robust and (iii) that the sentence final position of non-attached particles is more salient and, therefore, advantageous for their processing. On the basis of Wales and Kinsella's research, it was expected that in the present study too, non-attached particles would be better preserved than attached particles.

12 particles of each type were included in sentence completion and six particles of each type in each grammaticality judgment type. While resultative and non-resultative particles were contrasted in production and grammaticality judgment, attached and non-attached particles were only compared in production. Tables G (for controls) and H (for patients) in Appendix XIV give the proportions of correct responses (and mean latencies/reaction times for controls) for resultative particles, non-resultative particles, attached particles, and non-attached particles separately for each of the tasks. Figures G and H in Appendix XIV present the confidence intervals for the controls' accuracy and latency/reaction time data.

There was no difference in the controls' accuracy and latencies/reaction times for the different types and positions of particles. Using logistic regression of single case data with linear contrasts revealed that the degree of meaningfulness or the position of a particle did not affect performance significantly in any of the patients either. For three patients there was however a trend: as predicted, BG was better at producing resultative than non-resultative particles ([Wald χ^2 = 5.22, (df=1), p = .02]) and DOR showed the same pattern in forced choice grammaticality judgment ([Wald χ^2 = 4.32, (df=1), p = .04])[41]. EW, in contrast, was sensitive to the position of the particle, however, not in the direction predicted ([Wald χ^2 = 5.43, (df=1), p = .02]). It seems, therefore, that neither the differential degree of meaning nor the position of particles are important factors that influenced the use of particles by the patients in the present study.

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[41] Statistical calculations on DOR's original data were impossible due to ceiling effects for resultative particles. In this case, an error was added (to avoid ceiling performance) in order to carry out the statistical analysis. After doing so, the comparison approached significance.

Performance on polysemic prepositions

Polysemy is a typical feature of the prepositional class. To some extent, the effects of polysemy have been examined in language acquisition; however, the present study is the first to explore its effects in aphasia. Analysing the effects of polysemy is interesting because it allows (i) comparing the performance with respect to the different functions of prepositions with the same phonological form. If differences are found, our confidence in the results is stronger in the case of homophonic prepositions because in their case the difference is only in function, and not form. It also allows (ii) the evaluation of two contrasting views on polysemy: the radical view (e.g., Lakoff, 1987), which claims that the spatial function of polysemic prepositions is the core function and all other functions are derived from it, and the more moderate view (e.g., the principled polysemy model by Tyler & Evans, 2003a), which also claims that each preposition has a central function, however, this function need not be spatial, and additional functions of a preposition are not derived but associated with the central function.

Nine preposition tokens were probed in sentence completion each with at least two (e.g., *by* used as 'other theta-role assigning' preposition and passive *by*) and up to five (e.g., *to* used as spatial, temporal, 'other theta-role assigning', subcategorized, and syntactic preposition) different functions. Results were only descriptively analysed due to small numbers of items. Table 8 presents the polysemic preposition tokens, their functions probed, and the number of times they were probed in sentence completion. Table 18 lists the proportions correct on the multiple functions of polysemic prepositions for each patient.

In relation to (i) it was of interest to find out which function of prepositions (i.e., meaningful, subcategorized, syntactic, particle) fared best with the patients. The number of instances of each preposition function to be used by the five patients was counted (i.e., meaningful: n = 95, subcategorized: n = 40, syntactic: n = 15, and particle: n = 10, see Table 18). For each function, the number of times that this function fared best was counted. These are bolded in the table. For example, two prepositions were used with particle function (*in, on*). Across all patients, there were 10 potential instances in which the patients could have used them better than all other functions. For two patients (DC, DOR), the particle function was among the best preserved functions (20%). In a second example, there were 40 potential instances in

which the patients could have used subcategorized function better than all other functions. In 13 of these the subcategorized function fared best (33%).

Using this form of analysis, it was found that the syntactic function of polysemic prepositions fared best (40%) followed by the meaningful (37%), subcategorized (33%), and the particle function (20%).

In relation to (ii), the same analysis was carried out but this time the different meaningful functions (i.e., spatial, temporal, 'other theta-role assigning') were analysed separately. It was found that the temporal function[42] fared best (53%), followed by the spatial (32%) and 'other theta-role assigning' (28%) function.

Although the merit of this analysis is limited because of the small number of items involved (especially for syntactic prepositions and particles), the results here are in accordance with the larger set of results of the sentence completion task that included also the non-polysemic prepositions: syntactic preposition are better preserved in comparison with other preposition types, and particles are more impaired than other preposition types.

As for the comparison between the two views on polysemy, if data from aphasia are relevant for this debate, the results here do not support the radical view. Lakoff (1987) suggested that the spatial meaning of a polysemic preposition is its core meaning and that all other meanings are derived from it. The finding that the temporal function (as well as the syntactic function) of polysemic prepositions fared similarly or better than the spatial core function is at odds with this assumption.

The evaluation of the moderate view of polysemy is more complex. The reason is that it is an item-specific approach which has not been yet fully worked out (but see Evans & Tyler, 2004a, for a detailed analysis of 'in'; Evans & Tyler, 2004b, for a detailed analysis of 'to' and 'through'; and Tyler & Evans, 2003b; and 2004, for a detailed analysis of 'over'). Nevertheless, the lack of a straightforward advantage for spatial prepositions in the Broca's and anomic aphasic patients in the present study may indicate that a moderate view that does not assume that all non-spatial functions of prepositions are derived from spatial ones is more likely to be the correct one.

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[42] The temporal function of the preposition *to* was well preserved across patients most likely because the production of *to* was facilitated/primed by the presence of *from* in the same sentence (e.g., *The lecture will last from 9am to 11am*). In contrast, *from* was not facilitated/primed by *to*. Notwithstanding, the temporal function fared well (44%) even when *to* was removed from the count.

Table 18: Proportions correct for each patient on the multiple functions of polysemic prepositions (best preserved function per preposition for each patient marked in bold)

		BG	**DC**	**DOR**	**EW**	**TH**
	spatial	0.50	0.17	**0.17**	0.50	**0.33**
at	temporal	**0.83**	0.00	0.00	0.50	0.17
	subcategorized	0.67	**0.33**	0.00	**0.83**	0.00
by	instrument, manner, animate source	0.83	0.00	0.33	0.50	0.17
	passive	**1.00**	**0.67**	0.33	**0.83**	**0.50**
	temporal	**1.00**	0.50	**0.33**	**0.83**	**0.83**
for	benefactor	0.83	0.17	**0.33**	0.50	**0.83**
	subcategorized	0.67	**0.67**	0.00	**0.83**	0.67
	spatial	**0.83**	0.50	0.00	0.50	0.67
from	temporal	**0.83**	0.33	0.00	0.50	0.33
	animate source	0.67	0.33	0.00	0.83	0.67
	subcategorized	0.33	**0.83**	0.00	**1.00**	**0.83**
	spatial	**0.83**	0.00	**0.67**	0.67	**0.83**
in /	temporal	**0.83**	**0.67**	0.00	**1.00**	0.67
into	subcategorized	0.67	0.50	0.00	0.83	0.33
	particle	0.75	0.08	0.25	0.33	0.25
of	subcategorized	**1.00**	**0.67**	0.00	**0.83**	0.17
	syntactic	0.92	0.42	**0.21**	0.79	**0.63**
	spatial	0.50	0.17	0.17	0.83	0.67
on /	temporal	**0.83**	0.17	0.00	0.67	**0.83**
onto	subcategorized	0.33	**0.33**	0.00	**1.00**	**0.83**
	particle	0.58	**0.33**	**0.25**	0.67	0.33
	spatial	**1.00**	0.33	0.33	**1.00**	0.83
	temporal	**1.00**	**0.67**	**1.00**	**1.00**	**1.00**
to	recipient	0.83	0.17	0.17	**1.00**	0.67
	subcategorized	0.83	0.00	0.17	0.50	0.67
	infinitival	0.96	0.46	0.08	0.92	0.79
	comitative	0.67	0.33	0.00	0.67	0.83
	instrumental	**1.00**	0.33	**0.17**	**1.00**	0.33
with	substance	**1.00**	**0.67**	**0.17**	0.67	**1.00**
	degree/manner	0.67	0.00	**0.17**	0.67	0.67
	subcategorized	0.33	0.17	0.00	0.50	0.33

Chapter 5: Interim discussion

In this chapter the results of the present study are discussed in light of parameters identified in previous studies to affect the availability of prepositions in aphasia. The involvement of five parameters – meaningfulness, lexicality, phonology, frequency, and government – and the predictions they make have been explored. The applicability of five more theories with relevance for the preposition impairments in aphasia is also examined. Because none of the previously identified parameters were able to predict the performance pattern of the patients in the present study, new parameter(s) are suggested in order to better capture the data. The chapter ends by arguing against a syntactic impairment being the underlying reason for the patients' preposition deficit.

5.1 SUBCATEGORIES OF PREPOSITIONS: THE RE-EVALUATION OF PREVIOUS PARAMETERS AND PREDICTIONS

One of the aims of this study was to identify the parameters that contribute to the preservation and impairment of prepositions. To achieve this, data from the tasks that allowed testing all prepositional subcategories – sentence completion and grammaticality judgment tasks – were used to test the parameters identified in previous studies to account for the performance patterns of aphasic patients in relation to prepositions (see Table 3 in Chapter 2 for an outline of the parameters).

The first parameter (I) claimed that meaningfulness facilitates the production of prepositions in Broca's aphasia (e.g., Friederici, 1982; Friederici et al., 1982). Since anomic aphasic patients also do not suffer from severe semantic deficits, meaningfulness was expected to be beneficial for them too (hypothesis (v)). In order to test this claim, performance on prepositions with a semantic value, that is, prepositions that assign distinct theta-roles were compared to syntactic prepositions. In a second test of the same parameter, a more constrained contrast was made by comparing lexical prepositions only: lexical prepositions that assign distinct theta-roles were compared to meaningless lexical preposition (i.e., subcategorized prepositions and particles, see footnote 23). Meaningfulness did not affect performance of any of the patients in sentence completion. However, in some of the grammaticality judgment tasks DC, DOR, and TH, the anomic patient, performed as predicted: meaningful prepositions were better preserved than meaningless syntactic

prepositions (for DOR in forced choice grammaticality judgment) and meaningful lexical prepositions were better preserved than meaningless lexical prepositions (for DC and TH in grammaticality judgment of single sentences and for TH also in forced choice grammaticality judgment). The sporadic presence of the effect in grammaticality judgment in the case of the two most impaired Broca's aphasic patients suggest that meaning might have a role in comprehension, and/or in tasks that are timed and in which responses have to be made within a short time (as in all the grammaticality judgment tasks). As for the anomic patient, she had severe short term memory problems which may explain her reliance on meaning of the prepositions when judging the grammaticality of the sentences. However, since meaningfulness did not consistently facilitate performance of all patients, and in particular not in the more demanding sentence completion task, it may safely be concluded that meaningfulness of prepositions does not overall contribute to their production and judgment (therefore rejecting hypothesis (v)).

According to the second parameter (parameter (II), Bennis et al., 1983), syntactic prepositions are expected to be impaired in the Broca's aphasic patients, while lexical prepositions (meaningful and subcategorized prepositions) are expected to be spared. The opposite pattern is predicted for the anomic aphasic patient (hypothesis (ii)). Since syntactic prepositions are meaningless, only meaningless lexical prepositions (i.e., subcategorized prepositions and particles, see footnote 23) were included in the comparison. None of the patient's performance was as predicted (only DOR's performance in forced choice grammaticality judgment was as predicted). BG and TH showed the opposite pattern in sentence completion. This was expected for TH, the anomic aphasic patient, but not for BG, a Broca's aphasic patient. Since lexicality did facilitate performance in some tests and for some patients only, and even in the direction opposite to the predicted, it may be concluded that its effects on the availability of prepositions are not important (thus rejecting hypothesis (ii)).

Parameter (III) proposed that phonological properties of a preposition determine its preservation/impairment (Druks, 1991; Kean, 1977; 1979). Kean suggested that those morphemes that do not receive stress (i.e., the class of non-phonological words, predominantly, grammatical morphemes) are omitted in agrammatism. This distinction divides English prepositions into two: those that are polysyllabic and receive stress and those that are monosyllabic and unstressed. According to

hypothesis (iv), it was expected that the Broca's aphasic patients in the study would perform poorly on monosyllabic but not on bisyllabic prepositions in production (this parameter was not considered to be applicable for grammaticality judgment). For the anomic patient no difference was predicted. There was no support for this hypothesis for any of the (Broca's aphasic) patients in any of the tasks: their performance, against prediction, was not influenced by length. This was also true for the anomic patient, in line with the hypothesis.

Since frequency is known to be an important psycholinguistic factor that affects lexical retrieval (see e.g., Segui et al., 1982), and previous research has demonstrated its effect on the production of prepositions in connected speech (Kreindler & Mihãilescu, 1970), the possibility that the frequency of prepositions could contribute to their preservation/impairment in aphasia was considered in parameter (IV). It was expected that the anomic aphasic patient, due to her presupposed lexical deficit, would show frequency effects in preposition use. Broca's aphasic patients, because their underlying deficit is believed not to be lexical, would not be affected by frequency (hypothesis (vi)). Although it seems unlikely to find frequency effects in grammaticality judgement, it was shown to be a significant factor for DOR in contrastive grammaticality judgment and forced choice grammaticality judgment, albeit in the opposite direction to the predicted. Thus, less frequently occurring prepositions were judged more accurately. For the rest of the patients, no frequency effects were found in any of the tasks (thus rejecting the predictions of hypothesis (vi)).

It has to be noted, however, that the interpretation of effects of frequency is difficult because frequency differences coincide with prepositional subcategories: syntactic prepositions are the most frequent ones, subcategorized prepositions, being polysemic, are of medium frequency, and spatial and temporal prepositions that are non-polysemic (e.g., *since*) are of the lowest frequency (CELEX database by Baayen, Piepenbrock, & Gulikers, 1995). It is, therefore, impossible to disentangle the effects of frequency and function of a preposition. The effect found for DOR, for example, may mean that he was very impaired in judging the grammaticality of sentences with syntactic prepositions, and he performed better in sentences with (non-polysemic) meaningful prepositions that belong to the least frequently used prepositions. This is in line with his general performance pattern of performing somewhat better on meaningful prepositions. Nevertheless, it seems that the effect of frequency is likely

to be less relevant than the effect of prepositional subcategory. This is because frequency differences between high, medium, and low frequency prepositions are small and, therefore, unlikely to result in significant performance differences. Furthermore, all prepositions (at least some of them being grammatical morphemes) are high in frequency. They, together with other grammatical morphemes, are vulnerable in aphasia, despite their high frequency.

While the first four parameters refer to the lexical characteristics of prepositions – their meaning, lexical status, phonological properties or frequency – parameter (V) is a structural parameter according to which government affects the availability of prepositions in Broca's but not anomic aphasic patients (Grodzinsky, 1988, hypothesis (iii)). This claim was rejected because none of the Broca's aphasic patients of the present study performed better, as Grodzinsky predicted, on ungoverned than governed prepositions (DOR was affected by government in the opposite direction in sentence completion). It seems, therefore that the availability of prepositions is unrelated to syntactic government.

In conclusion, despite some variation in the performance of the patients, the results show that, contrary to hypothesis (i), the use of prepositions was found impaired in both Broca's *and* anomic aphasic patients and that, contrary to hypotheses (ii), (iii), (iv), and (vi), the performance patterns of Broca's aphasic patients and the anomic aphasic patient did not differ.

Parameters and predictions derived from previous theories of agrammatism that were not evaluated statistically

Five additional theories of agrammatic speech production and the predictions they make on the preservation/impairment of prepositions in aphasia are discussed here, though their applicability was not tested statistically. These studies are discussed descriptively only because their evaluation (i) depends on prepositional subcategories that were not included in the present study because they are difficult to elicit (e.g., the complementizer *for*), (ii) is untestable in English (e.g., accusative versus dative case assigning prepositions), or (iii) confounds the critical variable (e.g. recoverability, direct/indirect lexical access) with other parameters that have been found to affect a preposition's availability (e.g., meaningfulness, lexicality, government etc.).

Recoverability

Lonzi and colleagues (2007) claim that some principles of the pronunciation of grammatical morphemes (in Optimality Theory) are re-ranked according to their relevance in aphasia. This affects, in particular, the Telegraph Constraint, which maintains that function words must not be pronounced and results in omissions (and substitutions) of grammatical morphemes such as prepositions; however, Lonzi et al. maintain that errors are not at random. The reason is that additional principles operate – among them the Recoverability Condition. The Recoverability Condition proposes that elements with semantic content must be pronounced, unless their deletion can be recovered by a local antecedent (i.e., a verb). This divides prepositions into recoverable prepositions (e.g., subcategorized prepositions and some spatial prepositions) and unrecoverable prepositions (e.g., syntactic and some spatial and 'other theta-role assigning' prepositions). The prediction made by the authors is that if a preposition is recoverable, it is more likely to be affected by omissions (and substitution errors) than if it is unrecoverable.

As recoverable prepositions are also governed and unrecoverable prepositions are also ungoverned, the present study is in a position to re-evaluate Lonzi et al.'s study. Since it was found that government was not a parameter that influenced performance, it may be concluded that recoverability is similarly irrelevant.

The tree pruning hypothesis

Friedmann's theory (Friedmann & Grodzinsky, 1997; Friedmann, 2002) contributes, predominantly, to the understanding of impairments of verb inflections and the lack of complex sentences in agrammatic production. However, Friedmann's proposal that maintains that nodes below the pruning site are available in agrammatism, while nodes above the pruning site are inaccessible can be extended to explain differential impairments within the grammatical class of prepositions. For the examination of Friedmann's theory, two types of prepositions need to be distinguished: those that reside below the most common pruning site TP, and those that reside above TP (complementizer *for*, infinitival *to*). *For* and *to* can further be distinguished: while the former resides above TP (in CP), the latter resides in TP. Friedmann's theory predicts a disproportionate deficit for the infinitival *to* and the complementizer *for* (not tested in the present study) while other prepositions are expected to be spared.

In the present study the infinitival *to* was however relatively well preserved in the majority of the patients. Friedmann's theory could still account for the data for patients for whom the pruning site is not TP but CP. This presupposes that TP is intact which, in turn, implies that not only the infinitival *to* is spared but also verb inflections. However, it was shown that most of the Broca's aphasic patients (BG, DC, and DOR) had severe problems with verbs and verb inflections (see Chapter 3) but not with the infinitival *to* (BG, DC). Moreover, irrespective of pruning site, the evidence of (differential) impairment of prepositions that are located below TP shows that the preposition deficit cannot be explained by the tree pruning hypothesis.

A relation between the production of case assigners and case-morphology
Ruigendijk's (2002) theory of agrammatism also makes implicit predictions about the impairment of different types of prepositions. She argues that agrammatic patients have difficulty in accessing the syntactic properties of case assigners. This explains omissions and substitutions of case morphology. Thus, Ruigendijk suggests that there is a link between the availability of case assigners and case morphology. Importantly, although she does not explicitly claim that case assigners (in contrast to non-case assigners) are difficult because of their case assigning properties, this could be implied. This is because non-case assigners lack case specification and, therefore, are likely to be less complex than case assigners. This would predict that the production of case assigning prepositions is more difficult than the production of prepositions that do not assign case. Ruigendijk's theory would distinguish between two groups of prepositions: particles and prepositional adverbials (which do not assign case), and meaningful, subcategorized, and syntactic prepositions (which assign case). This was not borne out by the results of the present study. Non-case assigning prepositions (i.e., particles) were severely impaired in most patients. In some patients they were as impaired as case assigning prepositions (i.e., subcategorized prepositions for BG; syntactic prepositions for DOR; spatial prepositions for DC) and for other patients (EW and TH) particles were the most impaired subcategory of prepositions. The finding that purely case assigning prepositions are relatively well preserved while non-case assigning prepositions are impaired exemplifies that the property of case assignment is not a disadvantage for preposition use.

Garrett's model of sentence production

Garrett (1984) proposed that prepositions together with content words such as nouns and verbs are inserted at the functional level in his sentence production model. On entering the positional level prepositions change their status from being lexical to functional. This proposal is able to accommodate the hybrid behaviour of prepositions found in speech errors of healthy speakers. According to this account prepositions are treated as a uniform category. Dissociations between different types of prepositions as found in the present study cannot support the proposal of Garrett.

As a modification to Garrett's original theory, Friederici (1985) proposed that meaningful prepositions and particles are inserted at the functional level and syntactic and subcategorized prepositions (and most likely meaningless particles), at the positional level. Since it has often been argued that agrammatic aphasics have a deficit at the positional level (e.g., Caramazza & Hillis, 1989; Garrett, 1984), this predicts disproportionate impairments for meaningless particles, syntactic and subcategorized prepositions. None of these two proposals are supported by the present data. First, particles, subcategorized, and syntactic prepositions did not cluster together but were affected differently. In fact, there was dissociation between particles and syntactic prepositions in most patients and syntactic and subcategorized prepositions in some patients. Second, three of the four agrammatic Broca's aphasic patients of the present study performed best on syntactic prepositions which is at odds with impairments at the positional level.

Levelt's model of sentence production

Levelt's (1989) psycholinguistic model of language processing distinguishes two types of prepositions depending on the manner of access to the lexicon: those whose lemmas are retrieved *directly* from the lexicon (meaningful prepositions) and those whose lemmas are accessed *indirectly* through another word's lemma (subcategorized, syntactic prepositions, particles). Their retrieval is indirect because it is not driven by conceptual features, but depends on access of another lemma (in the case of subcategorized prepositions and particles) or on the rules of phrase structure building (in the case of syntactic prepositions). Although Levelt did not make the claim, it could be speculated that indirect lemma access is a more complex process than direct lemma access because more steps are involved, and hence more

errors could occur. On the other hand, it could also be easier because lexical search is constrained by another word's lemma.

The division into different types of prepositions is exactly as in Garrett's model (although for different reasons), that is, a difference in performance between meaningful prepositions and meaningless prepositions (subcategorized, syntactic prepositions, and (some) particles) is expected. The performance of the majority of the patients in the present study (i.e., the relative preservation of syntactic prepositions) shows that indirect lemma access is not more impaired than direct lemma access. More importantly, different indirectly retrieved prepositions were affected differently by the impairment. There was a strong dissociation between particles and syntactic prepositions in most patients and syntactic and subcategorized prepositions in some patients. Hence, Levelt's division of prepositions into two groups depending on lemma access cannot explain the patterns of impairment in the patients. The data suggests that manner of lexical access, as explicated in Levelt's model, does not determine a preposition's availability.

Summary

The results show that the availability of prepositions was determined by different parameters in different patients and sometimes by more than one parameter. For DOR the availability of prepositions was determined by the meaningfulness and lexical status of a preposition in the predicted direction. This effect was found in one task only. Interestingly, in the same task but within lexical prepositions only, DOR was not sensitive to meaningfulness. This shows that it was his disproportionate impairment for syntactic prepositions (the syntactic *of*) and not meaningfulness that influenced DOR's performance. DOR's performance on prepositions was also determined by government and frequency, however in the opposite direction to the predicted (and only in some tasks). Other patients were influenced by other parameters (although again only in some tasks): for BG and TH syntactic prepositions were better preserved than lexical prepositions and for DC and TH meaningful lexical prepositions were better preserved than meaningless lexical prepositions (i.e., subcategorized prepositions and particles, see footnote 23). That different parameters affect patients differently has also been shown in previous studies (e.g., Bennis et al., 1983; Friederici, 1982; Grodzinsky, 1988), however, these studies were group studies and differences among patients were explained in terms of

different clinical profiles. The multiple single case approach in the present study showed that individual patients of different clinical profiles perform similarly (for BG and TH syntactic prepositions were better preserved than lexical prepositions) and patients of the same clinical profile perform according to different accounts (while lexical status of a preposition had an effect on DOR's performance in the direction predicted, BG performed opposite). Overall, most of the patients performed contrary to what was predicted for their type of aphasia: the Broca's aphasic patients showed disproportionate preservation for syntactic prepositions (BG) or governed prepositions (DOR), and they showed no length effects but frequency effects (DOR), while the anomic patient showed (if at all) small frequency effects in the opposite direction to the predicted, and, more importantly, a mild-to-moderate impairment in preposition use.

The multiple single case approach also demonstrated that none of the previous parameters can explain all data. Even those parameters that have determined some of the patient's data did not do so in both production *and* grammaticality judgment or in *all* grammaticality judgment tasks. There was however one finding that concerned the majority of patients across modalities and tasks: contrary to expectation, syntactic prepositions were relatively well preserved in Broca's (BG, EW) and anomic aphasia (TH) and in production (BG, TH, trend: EW) and grammaticality judgment (trend: EW, TH). This finding will be discussed in detail in the next section.

5.2   CONSTRAINT ON LEXICAL CHOICE – NEW EVIDENCE FOR AN OLD PARAMETER

A structural constraint on lexical choice

Contrary to expectations and previous findings, syntactic prepositions were not the most vulnerable subcategory in the patients of the present study. At least one of the two syntactic prepositions – the syntactic *of* and the infinitival *to*[43] – were among the

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[43] The relatively preservation of the infinitival *to* in Broca's aphasic patients is an interesting finding and particularly surprising in patients who otherwise have problems with verb inflections and/or the production of auxiliaries/modal verbs. This is because, despite its prepositional roots, the infinitival *to*, like auxiliaries/modal verbs and verb inflections, is situated in TP as the marker of (infinitive) inflection of the verb and thus is often analyzed as an auxiliary element (e.g., Mittwoch, 1990). It is argued later in this section that the infinitival *to* is relatively spared in the patients because its identity is highly constrained by the sentence structure: it is the only preposition (or preposition-like element) that occurs prior to an infinitive verb. Alternatively, it could be argued that the infinitival *to*, being a free grammatical marker of inflection, is spared while those grammatical markers of inflection that are bound (e.g., past tense – *ed*) are impaired. If true, there should be no difference in performance on the infinitival *to* and auxiliary verbs. Under 6.3 this issue is re-visited and proposed as subject for future investigations.

best preserved subcategories for four of the patients (BG, DC, EW, and TH). An advantage for syntactic prepositions was found in aphasic patients with mild (e.g., BG, EW) and severe preposition deficits (e.g., DC) and in Broca's (BG, DC, EW) and anomic aphasia (TH). Even DOR, who was most impaired in sentence completion and (forced choice) grammaticality judgment and whose performance was facilitated by meaningfulness and lexical status of a preposition, performed relatively well on the syntactic *of* in sentence completion and the infinitival *to* in forced choice grammaticality judgment.

Further evidence for the relative preservation of syntactic prepositions comes from the error analysis. Three Broca's aphasic patients tended to use certain prepositions as substitutes in the sentence completion task: BG preferred *of*, DC *for* and DOR overused *by*. All of these prepositions have grammaticalized functions. *Of*, when used as a syntactic preposition, is the most grammaticalized preposition of all. It is semantically empty and it is known to be acquired late (around 2.5 years, see Littlefield, 2006), a fact that might suggest vulnerability in language breakdown. This was however not the case: *of* often functioned as default preposition. Similarly to *of*, *for* is an abstract preposition with several usages and when used as a prepositional complementizer it fulfils a syntactic role in the sentence. *For* (even when used as a meaningful preposition) is not depictable, and the semantic relationship between different functions of *for* are often not clear-cut (see e.g., Lindstromberg, 1997). Finally, *by* is one of the most polysemic of all English prepositions and its usage ranges from the depictable spatial function to the thoroughly syntactic function in passives. The analysis of substitute preferences thus shows that Broca's aphasic patients not only perform relatively well on producing syntactic prepositions, but also that they use prepositions with syntactic functions as defaults which suggests that they are relatively easily available[44].

How can the preservation of syntactic prepositions be explained? At first glance the selective preservation of syntactic prepositions in aphasia does not appear plausible. The facts that syntactic prepositions have no meaning and that their occurrence is determined by the syntactic structure of the sentence seem a disadvantage (in particular) for Broca's aphasic patients. Since it has been argued that Broca's aphasic patients lack syntactic knowledge (e.g., Caramazza & Zurif,

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[44] Of course, one cannot be certain which functions of the prepositions *for* or *by* (syntactic or meaningful) were used by the patients.

1976) or syntactic knowledge is at least partially impaired (e.g., Grodzinsky, 1984), these patients are claimed to rely on lexical knowledge and knowledge of the world to parse sentences. Consequently, performance in Broca's aphasia is expected (and found in many studies) to be particularly vulnerable in tasks where the focus is on *syntactic* processing. Thus, syntactic prepositions are expected to be particularly vulnerable in Broca's aphasia. However, syntactic prepositions have potential advantages too: they are not theta-role assigners, and sentence structure (relatively) unambiguously constrains their identity. All these characteristics may be beneficial for their production.

One way of explaining the relative preservation of syntactic prepositions is in assuming that the degree of (lexical and/or structural) constraint on lexical choice has a facilitating effect on their production (as has previously been suggested by Wales & Kinsella, 1981)[45]. They found that while the level of constraint that is provided in the sentence had no effect on the production of spatial prepositions, the production of subcategorized prepositions benefited from being constrained by the verb. They concluded that a '*higher constraint is restricting options in lexical search by syntactic means*' (p. 306). As argued in Chapter 2 (see *Constraint on lexical search*) it is likely that the positive effects of constraint as observed previously for subcategorized prepositions extend to syntactic prepositions because, in their case, the choice of the preposition token is maximally constrained by sentence structure. Consequently, if a patient is able to parse sentences and use syntactic structure as a cue, then syntactic prepositions are expected to be available. This is what happened in the case of the majority of the patients. It must be concluded that the availability of a syntactic preposition benefits from high structural constraint on lexical choice.

Lexical choice can also be constrained lexically

Is the effect of constraint on lexical choice restricted to structure? As indicated by Wales and Kinsella, the answer is *no*. Subcategorized prepositions and particles are neither facilitated by meaning (because they are (relatively) meaningless) nor, unlike syntactic prepositions, by the syntactic structure of the sentence. Instead, they are licensed by the lexical properties of the verb. The licensing is idiomatic, that is,

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[45] An alternative account which explains the relative preservation of syntactic prepositions independently of structural context will be outlined in Chapter 6.

which preposition is licensed by the verb is (relatively) unpredictable: the availability of subcategorized prepositions and particles is therefore *lexically* constrained.

The question arises whether the lexical and structural constraints are independent, and hence can be impaired selectively, or whether they are different facets of a single constraint, in which case the ability to employ them should not dissociate. Patients' data suggests that the former is the answer. Subcategorized prepositions and particles were significantly more impaired than syntactic prepositions for BG and TH (a comparable deficit for subcategorized prepositions and particles as found in the present study is in contrast to previous studies that often found particles to be better preserved than subcategorized prepositions (see Friederici, 1985; Wales & Kinsella, 1981), and DC and EW's performance patterns as will be discussed below). Despite extensive self-initiated search (as seen in the large number of substitution errors) BG and TH often failed to pick up the correct preposition that was required by the verb, and they were often unsure about the accuracy of their response. In contrast, they were usually aware if they had found the correct syntactic preposition via search. The data suggest that the selective deficit for subcategorized prepositions and particles for BG and TH is not due to impaired sentence parsing, which would affect syntactic prepositions too, or impaired verb retrieval (since the verbs were provided). As the deficit affected both subcategorized prepositions and particles, it is plausible to claim that accessing information about an idiomatically selected preposition in a verb's lexical entry is impaired for BG and TH due to an inability to make use of the lexical constraint. This is in contrast to their good use of the structural constraint which is crucial to use syntactic prepositions.

DC and EW's performance patterns are less clear-cut. For them, subcategorized prepositions were (relatively) well preserved at a level comparable to syntactic prepositions, while particles were very impaired[46]. The finding of a disproportionate deficit for particles is surprising because the few previous studies that probed particles in aphasia reported good performance (in contrast to poor performance on subcategorized prepositions). For example, Friederici (1985) conducted a word monitoring tasks with agrammatic aphasic patients (and healthy speakers, see

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[46] The contrast between syntactic and meaningless lexical prepositions (i.e., subcategorized prepositions and particles, see footnote 23) was tested statistically (parameter II) but not the difference between subcategorized prepositions and particles. The reason for not comparing each subcategory with each other was to keep the number of statistical comparisons small and meaningful by testing only the predictions made by the parameters statistically. Therefore, the discussion of DC and EW's performance patterns on those two prepositional subcategories is descriptive.

Chapter 2, *Garrett's model of sentence production*). Patients were presented with a target word which they had to detect in sentences that were embedded in related or unrelated contexts. The task probed among other word classes meaningful (spatial) and subcategorized prepositions and (most likely resultative) particles. Particles (and spatial prepositions) were affected by context while context had no effect on subcategorized prepositions, and reaction times were faster for particles (and spatial prepositions) than for subcategorized prepositions. Friederici interpreted these findings as evidence that the processing of particles (and spatial prepositions) depends on semantics (which was well persevered) and not on syntax (which was impaired). Wales and Kinsella (1981) who tested the production of particles and other types of prepositions (spatial and subcategorized) in Broca's aphasic patients using a sentence completion task found particles to be best preserved.

For DC and EW, it can be ruled out that the selective deficit for particles is due to impaired ability to syntactically analyse the sentence (as they were able to produce syntactic prepositions which require parsing of the sentence structure), or impaired idiomatic licensing (as they were able to produce subcategorized prepositions), or (since the verbs were provided) by impaired verb retrieval. A possible explanation is a difference in the *degree* of constraint between particles and subcategorized prepositions. While most verbs subcategorize one and exactly one preposition (e.g., *refrain from, dispose of*), they often can select more than one particle (e.g., *turn in/on/over/off*) and which particle is required is identified on the basis of the sentence's meaning. The lower level of constraint on lexical choice and, consequently, higher number of possible candidates for particles may be a disadvantage in production while the high level of lexical constraint for subcategorized prepositions (and the high level of syntactic constraint for syntactic prepositions) is beneficial and explains their relative preservation for DC and EW (see also Wales & Kinsella, 1981).

Good performance on subcategorized prepositions and poor performance on particles may rule out a deficit in idiomatic licensing, however, the opposite pattern of better performance on particles and poorer performance on subcategorized prepositions does not[47]. This was DOR's performance pattern. DOR was severely impaired in the production of prepositions (overall 18% correct), however, the

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[47] The comparison of subcategorized prepositions and particles is based on descriptive results. The reason for this is as illustrated in footnote 46.

impairment was most pronounced when producing subcategorized prepositions (2% correct); in contrast, particles were less error-prone (25% correct) and were produced at a similar level with the syntactic preposition *of* (21% correct). This is even more extraordinary as particles were among the best preserved subcategories for DOR in production (and grammaticality judgment), that is, at a level similar to meaningful prepositions (24% correct). A closer look at the data revealed differences between resultative (i.e., less idiomatic) and non-resultative (i.e., more idiomatic) particles. Relatively good performance on resultative particles (42% correct in production, 100% correct in forced choice grammaticality judgment) in contrast to non-resultative particles (8% correct in production, 17% correct in forced choice grammaticality judgment) caused a relatively high accuracy for particles overall[48]. DOR's poor performance on non-resultative particles was in fact comparable to that of subcategorized preposition. What is the reason for resultative particles to belong to DOR's best preserved subcategories while non-resultative particles belong to his most impaired subcategories? It may be argued that the identity of resultative particles, like that of subcategorized prepositions and non-resultative particles, is determined by idiomatic licensing through the verb but, unlike that of subcategorized prepositions and non-resultative particles, it is also supported by the relative meaningfulness of the resultative particles themselves[49]. Their licensing is, therefore, less idiomatic than that of subcategorized prepositions and non-resultative particles. Hence, it may be possible to argue that DOR (like BG and TH) presents a severe deficit in accessing the information about the idiomatically selected particle/preposition in a verb's lexical entry which strongly affects subcategorized prepositions and non-resultative particles. It also has an effect on resultative particles. However, the relative meaningfulness of resultative particles supported

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[48] The difference between resultative and non-resultative particles was statistically examined, and, for DOR in forced choice grammaticality judgment it resulted in a statistical trend which is described in detail in 4.5 under *Particles*.

[49] Subcategorized prepositions in general are highly lexically constrained, whereas particles and verbs are not matched one-to-one and thus, the degree of lexical constraint on lexical choice for particles is generally lower (compare the one-to-one matching of most verbs and subcategorized prepositions (e.g., *refrain from, decide on*) with that of resultative particles such as *in, on, off,* and *over* for the verb *turn* and non-resultative particles such as *in* and *up* for the verb *give*). While the identity of a resultative particle is however additionally supported by its meaningfulness (e.g., *When John comes home after work he firstly turns the radio* ____ requires most likely *on*, because upon arrival it is more likely to turn the radio *on*), the identity of a non-resultative particle is not (e.g., *Before listening to the evidence the judge swore the witness* ____). Licensing of the non-resultative particle (here *in*) by the verb is therefore purely idiomatic.

their availability. This is in line with DOR's overall sensitivity to meaningfulness as a parameter to identify a preposition.

The availability of prepositions depending on either the lexical or structural constraint dissociated in the patients. This shows that these constraints are independent. It also demonstrates that patients are not merely sensitive to the degree of constraint on lexical choice but also to the type of constraint. DC and EW demonstrated well-preserved use of both the lexical and structural constraints and BG and TH presented with well-preserved use of the structural but impaired use of the lexical constraint. As for DOR, because of his overall severe preposition deficit, it must be concluded that he was only minimally assisted by both constraints and even less so by the lexical constraint. Because of this, DOR relied more on the meaning of the sentence and of the preposition than on information from lexical or syntactic cues provided by the sentence or individual words.

Finally, although the linguistic classification of prepositions was not the focus of the present study, the results contribute to some extent to the debate about it. Syntactic and subcategorized prepositions were affected differently in the patients. This suggests that they do not have the same linguistic status contra to what is suggested by some linguists. Littlefield (2006), for example, claimed that subcategorized and syntactic prepositions pattern together in that they are both syntactic prepositions. The results however appear to support the view, (as, for example, argued by Neeleman, 1997), that subcategorized prepositions are very different from syntactic prepositions.

Re-evaluating the effects of meaningfulness of prepositions in aphasia
In the previous section I discussed why for some patients, contrary to expectations, syntactic prepositions were well preserved, why (some) particles were impaired, and why subcategorized prepositions were relatively spared in some patients but impaired in others. What remains to be discussed is DOR's sensitivity to meaningfulness. His performance is in contrast to the rest of the patients, and cannot be attributed to type or severity of aphasia. This is because DC, with the same type and severity of aphasia as DOR, presented the opposite pattern of performance. Furthermore, both patients have deficits in the comprehension of reversible sentences which are usually taken as indication for syntactic impairments. Yet, DC performed well on syntactic prepositions, and even DOR did relatively well in production of the

syntactic *of* (in comparison to other types of prepositions). The difference between the two patients was the severity of the preposition impairment: DOR's preposition impairment was the most severe of all patients. It may be speculated that patients with severe preposition deficits rely *more* on meaning to select the right preposition than patients with less severe preposition deficits (who rely more on structural and/or lexical constraints). This is not to say that syntax and use of the structural or lexical constraint are necessarily lost to patients like DOR. Aspects of DOR's performance – his relatively good performance on the syntactic *of*, his preference to use a grammaticalized preposition such as *by* as a substitute, and the fact that the majority of his errors were within-category substitution errors – all show that syntactic cues are to some extent available to him. Nevertheless, DOR cannot use the structural constraint as effectively as BG, DC, EW, and TH, and his ability to make use of the lexical constraint is also severely disrupted (similarly to BG and TH). It seems therefore that patients like him resort to semantic cues to determine the identity of the preposition required. These cues are (somewhat) reliable in case of meaningful prepositions (and to some extent resultative particles) but fail in case of meaningless prepositions. It could be said that DOR resorts to meaningfulness when lexical and syntactic information is insufficient like agrammatic Broca's aphasic patients resort to lexical knowledge and knowledge of the world to interpret syntactically complex sentences (Caramazza & Zurif, 1976).

Summary

On the basis of the present data, three parameters have been identified that guide the selection of the right preposition: meaningfulness, syntactic constraint and lexical constraint. Each of these parameters is intrinsically linked to certain types of prepositions: the lexical constraint applies to subcategorized prepositions and particles, the syntactic constraint to syntactic prepositions, and meaningfulness to meaningful prepositions. Sometimes two parameters are operative for one prepositional subcategory (e.g., particles are identified through application of the lexical constraint (not unambiguously, though, since a verb can take different particles) *and* meaningfulness (which helps to determine which particle is required)).

Overall, prepositions that are highly constrained (that is, either lexically or structurally) were better preserved in the patients. This accounts for the relative preservation of syntactic prepositions (BG, DC, EW, and TH) and subcategorized

prepositions (DC, EW)[50]. For most patients of the present study, the structural constraint was more facilitatory than the lexical constraint (BG, TH, DOR and to a lesser extent EW). The data of BG and TH (and, to some extent, of DOR) show that the lexical and structural constraints operate independently. In contrast, meaningfulness assigns very little constraint on lexical choice. As none of the patients showed disproportionate impairments for meaningful prepositions it must be concluded that this parameter was available to all patients of the present study. However, it is the last resort for selecting a preposition only in cases of severe preposition deficits in combination with an inability to make use of lexical and structural constraints (as seen in DOR).

The importance of the structural and lexical constraint on lexical choice for the patients of the present study shows that the problem patients have is in *selecting* the right preposition: when the choice of potential candidate prepositions was maximally constrained (by structural or lexical means) patients performed relatively well, when, however, the choice of possible candidate prepositions was large, they performed poorly. Further, most patients of the present study benefited from the structural constraint more than from the lexical constraint. This finding strongly suggests that the underlying reason of the preposition deficit is not syntactic, but takes place *after* syntax. Further, the underlying reason for the preposition deficit is likely to be identical for the anomic and Broca's aphasic patients in the present study. The reasons for this claim are manifold: first, prepositions were found impaired in *all* types of aphasia: in the present and previous studies impairments of production, comprehension, and grammaticality judgment of prepositions were found in Broca's aphasia (e.g., BG, DC, DOR, EW, Druks, 1991; Friederici, 1981; 1982; Friederici et al., 1982; Leikin, 2002; Smith, 1974), anomic aphasia (e.g., TH, Smith, 1974), Wernicke's aphasia (e.g., Friederici, 1981; 1982; Friederici et al., 1982; Leikin, 2002), transcortical sensory aphasia, (Leikin, 2002), and transcortical motor aphasia

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[50] It has to be acknowledged, though, that in the case of some verbs there is a choice of subcategorized prepositions that can be legally used too. For example, *remind* (at least for some speakers) may idiomatically subcategorize both *of* and *about (*see also *rejoice in/at*) and a syntactic structure such as DP-P-DP (e.g., *the translation-P-the book*) may contain not only the syntactic *of* but also meaningful prepositions (e.g., *under, for,* etc.). However, the number of potential candidates is smaller for subcategorized and syntactic prepositions than for meaningful prepositions (e.g., *the book is in/on/under/near/beside the shelf*). In addition, a structure such as *the translation of the book* is more probable than a structure such as *the translation under the book* because the latter would require context that presupposes the existence of two translations. Without such context *of* is the most appropriate preposition to be selected, and this is what the patients and controls tended to do.

(e.g., Kemmerer, 2005). Second, levels of accuracy of the Broca's and anomic aphasic patients were comparable: in the present study, patients of different clinical profiles (e.g., BG, EW and TH) showed similar levels of accuracy on prepositions (and patients of similar clinical profiles and severity of aphasia (e.g., DOR and DC) showed different levels). Third, performance patterns of patients of different clinical profiles were comparable: BG, one of the high-level Broca's aphasic patients in the present study, showed the same performance pattern as TH, the anomic patient, namely selective preservation of syntactic prepositions. Finally, error patterns did not differ in the Broca's and anomic aphasic patients: all patients of the present study tended to substitute rather than omit prepositions and in their substitution errors they usually maintained word class.

In contrast, early studies found differences in the levels of accuracy on prepositions in different types of aphasia (e.g., Bennis et al., 1983; Friederici, 1981; 1982, in grammaticality judgment only; Goodglass et al., 1970; Mack, 1981), even though some differences were small, and differential performance patterns for the different subcategories of prepositions for Broca's and Wernicke's aphasic patients (see Bennis et al., 1983; Friederici, 1981; 1982; Friederici et al., 1982; Grodzinsky, 1988), and they reported different errors types for patients of different types of aphasia (e.g., Friederici, 1981; 1982). The problem with early studies such as Friederici's or Bennis et al.'s is, probably, that none of them reported data of individual patients. Only when the focus is on the performance of single patients, idiosyncratic performance patterns that cannot be associated with certain types of aphasia can be revealed. The results of multiple single case studies such as the present study show that preposition impairments and the form they take are independent of clinical profile (see also Kemmerer & Tranel, 2003; Kemmerer, 2005).

In the next section, more evidence for the suggestion that the underlying reason for the preposition deficit of the patients of the present study is not syntactic, is presented.

5.3   EVIDENCE AGAINST A SYNTACTIC SOURCE OF THE PREPOSITION DEFICIT

In order to select the preposition that correctly completes the sentence frame (in sentence completion) the patients had to parse the sentence, that is, to assign syntactic structure to it. Traditionally this process was believed to be disrupted in

Broca's aphasia, and the impaired production of prepositions was taken as evidence of syntactic deficits (Bennis et al., 1983; Friederici, 1982; Grodzinsky, 1988). The performance patterns of the patients of the present study however suggest preserved syntactic representations. Below are seven arguments to show that syntactic knowledge of the patients is well preserved at least in so far that it is required to produce prepositional (matrix) sentences.

(i) Syntactic prepositions were relatively well preserved.

In the sentence completion task syntactic prepositions belonged to the best preserved subcategory of prepositions in all patients. Even for DOR there was no difference in performance between meaningful prepositions (that were best preserved) and the syntactic *of.*

Because the patients of the present study (i) did not display a disproportionate deficit for syntactic prepositions; because they, in fact, (ii) did disproportionately well on them; and (iii) because syntactic prepositions can only be identified by intact parsing of the sentence structure, a syntactic impairment is unlikely to be the source of the prepositions deficit in these patients.

(ii) The quality of errors of all patients shows preserved syntactic knowledge for grammatical class.

In the sentence completion task all patients tended to substitute rather than omit prepositions and in substituting they usually preserved the word's category. Within-category errors indicate adequate sentence parsing and suggest sensitivity to the grammatical class of the missing word[51]. This finding is in contrast to early studies (e.g., Friederici, 1981; 1982) but in line with the findings of more recent studies (e.g., Druks, 1991; Leikin, 2002).

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[51] One might argue that the participants knew which word class they were expected to insert during the course of the production tasks, that is, the sensitivity for word class is task-induced. There are, however, a number of reasons why this is most likely not the case. One is that most substitutions of prepositions in connected speech also maintained word class. Further, the number of substitution errors that violated word class did not decrease in the course of the sentence completion task but was comparable between the 25 first and last substitutions made (number of across-category substitutions for the 25 first and last substitution errors made by BG 7/7; DC 8/7; DOR 1/2; EW 4/5, TH 5/6).

(iii) The patients demonstrated sensitivity to the subtle differences in the syntactic and semantic make-up of different prepositions.

The prepositions produced by the patients as substitutes were mostly of the same function as the target. In description of spatial situations from pictures, for example, patients tended to replace spatial prepositions with spatial prepositions. There was only a single case in which a non-spatial preposition (i.e., *with*) was used instead (see Table 10 in Chapter 4). The prepositions produced by the patients as substitutes were not only within category but also preserved subcategory (i.e., spatial prepositions of place (e.g., *above*) were replace by spatial prepositions of place (e.g., *on*, *on top of*) and spatial prepositions of path (e.g., *to*) were replaced by spatial prepositions of path (e.g., *away from/from*)). Moreover, these errors often differed in one or two features only from the target. For example, *above, on*, and *on top of* not only all assign the theta-role *place* to their complements but also locate the subject directly over the landmark with the minimal difference that *on* and *on top of* prototypically describe contact between subject and landmark, while *above* does not denote direct contact of subject and landmark.

(iv) Patients showed preserved syntactic knowledge for the position of prepositions in sentences.

Connected speech data revealed that the aphasic patients in this study never placed prepositions in illegal positions in the sentence. This is a finding that shows that patients are sensitive to sentence structure and they are aware that prepositions are heads of phrases and that they take complements.

(v) Patients showed preserved syntactic knowledge for the case assigned by prepositions.

In connected speech no case violations on pronouns were made by the patients (e.g., BG: *a man calls another man to invite him for a dinner*, DC: *for me that's finished, two of them is phoning them*, DOR: *for me it's ninety percent it's rain*, EW: *I worked for him three years*, TH: *I haven't spoke to her for a quite a few years now because she's gone, obviously they'll be having friends coming around to have dinner with them*). This shows sensitivity to the syntactic property of case assignment by prepositions (and verbs) to pronouns.

(vi) Patients showed preserved syntactic knowledge for word order rules.

Patients made only few word order errors in connected speech (n = 20). Mostly these errors involved the misplacing of adverbials (e.g., *she looks her probably spots on the face* 'she is probably looking at the spots on her face'), but there was also one instance of a misplacing of the auxiliary verb in a wh-question (*why one egg is on the floor*). The small number of word order errors (in comparison to the relatively large number of omission, insertion, and substitution errors on prepositions (n = 130) shows that patients have preserved knowledge of phrase and sentence structure rules.

(vii) The Broca's and anomic aphasic patients in the present study behaved similarly in relation to prepositions.

Traditionally, Broca's aphasic patients are assumed to have underlying syntactic (and phonological) deficits, and anomic aphasic patients, lexical deficits. This implies that Broca's aphasic patients (but not the anomic aphasic patient) are expected to perform poorly on syntactic prepositions, and that their performance should be affected by structural parameters such as government and by phonological parameters such as length. Contrary to expectation, the availability of prepositions in the Broca's aphasic patients was neither influenced by government nor length, and syntactic prepositions fared well. They also produced many within-category substitution errors which suggest preserved syntactic knowledge of grammatical class. The anomic patient performed similarly.

Summary

While the presence of other forms of syntactic impairments in Broca's (and anomic) aphasia cannot be ruled out on these grounds, it is argued here that the underlying reason for the preposition deficit is not syntactic. Consequently, it is suggested that preposition deficits do not provide evidence for syntactic impairments in (agrammatic) Broca's aphasia as it had been claimed previously (e.g., Bennis et al., 1983; Friederici, 1982; Grodzinsky, 1988). Also, while it cannot be ruled out that patients of different clinical syndromes differ on other grounds, the preservation/impairment of prepositions in aphasia cannot distinguish between the Broca's and anomic aphasic patients.

Having ruled out that the preposition impairment has syntactic origins, in chapter 6 an alternative account for the preposition deficit is proposed which places the

preposition deficit after syntax at spell-out, the interface that maps syntactic representations to phonology. Substitution errors show that very specific features of individual prepositions were available even if the target itself could not be produced showing that *selection* of the target is deficient.

A spell-out deficit would be compatible with the occurrence of (similar) preposition deficits in patients of different clinical profiles; selective impairments/preservations of different types of prepositions; and the prevalence of within-category substitution errors.

Chapter 6: General discussion

In Chapter 5 it has been shown that syntactic prepositions were relatively well preserved in all patients. Another important finding was that the majority of errors were within-category substitution errors. For these reasons, and in contrast to most previous theories (e.g., Bennis et al., 1983; Friederici, 1981; 1982; Garrett, 1984; Grodzinsky, 1988), it has been concluded here that the underlying reason for the preposition deficit is not syntactic.

In the final chapter of the thesis an alternative approach based on current linguistic theory that identifies the source of the difficulties aphasic patients have with prepositions as a deficit in *selection* (which explains the prevalence of within-category substitutions) at the level of spell-out – the *post syntactic* interface between syntax and phonology – is presented. The chapter ends with suggestions for research carried out in the future.

6.1 TOWARDS A NEW EXPLANATION OF THE PREPOSITION DEFICIT

The linguistic theory

A syntactic impairment underlying the preposition deficit was ruled out for all patients, and it was suggested that the problem must occur post syntactically. In particular, it is hypothesized here that the underlying reason for the preposition deficit is a malfunctioning spell-out. This notion is in line with hypothesis (vii) of the present study which holds that the preposition deficit in the Broca's and anomic aphasic patients is due to a failure to select the correct preposition at post syntactic spell-out. Before evidence in support of this claim is presented, the following section explains what spell-out is, where in the grammar it is located, and how it operates.

The architecture of grammar within the Minimalist Program consists of two levels of representation, the phonetic form (PF) and the logical form (LF), two operations, *merge* and *move*, and the lexicon (Chomsky, 1995). Linguistic structures are created through derivation. A derivation starts with accessing the lexicon in order to select the lexical elements that are needed to build the linguistic structure in question. Words emerge from the lexicon fully inflected, that is, they carry with them all their syntactic and semantic features (but no phonological features, according to e.g., Halle & Marantz, 1993). Together, they form the numeration. M*erge* combines two words from the numeration (e.g., a determiner and a noun) and thus creates a

new category (e.g., a determiner phrase, DP). This is how the syntactic tree is built up in a bottom-up fashion until the last word from the numeration is integrated into the syntactic tree. If necessary, *move* applies. This operation moves a phrase from its base position to another position in the structure. The linguistic structure is then at the point of entering the two levels of representation, PF and LF. While PF can process phonetic features only, LF can process semantic features only. The reason is that PF is linked to and directly inputs the external acoustic-phonetic interface (A-P interface) which can only interpret phonetic information; and LF is linked to and directly inputs the intentional-conceptual interface (I-C interface) which can only interpret semantic information. These connections are constrained by *legibility conditions* in that representations at PF and LF must be interpretable at A-P interface and I-C interface, respectively. Hence, a derivation that includes phonetic features only at PF and semantic features only at LF satisfies the *Full Interpretation Principle* and ensures that the derivation will converge. A derivation that violates the *Full Interpretation Principle* at PF and/or LF will crash. In order to ensure a converging derivation, all features that are uninterpretable at PF and LF have to be marked as deletable before the linguistic structure enters PF and LF. This process is called *feature checking* (and is also the motivation for movement operations). The end product of a derivation that fully satisfies the *Full Interpretation Principle* at PF and LF is a well-formed sentence.

For example, a word (e.g., *he*) is retrieved from the lexicon with all its syntactic features (e.g., pronoun, 3rd person, singular, male, nominative case). During derivation and before entering PF and LF these syntactic features have to be checked (in conjunction with the features of the verb associated with the pronoun). During checking some of these features will be marked for deletion. Features that, beside the syntactic information they carry, have semantic value are interpretable at LF. These features will remain unmarked for deletion. For example, in the case of *he*, the features *person*, *number,* and *gender* are interpretable at LF: the gender, person, and number features of a pronoun, although being syntactic features, make considerable semantic contributions that are needed for interpretation at LF. In contrast, the case

of a pronoun is uninterpretable at LF because it has no semantic value[52]. Hence, it will be marked for deletion and removed at LF.

In relation to PF, the terminal nodes in a syntactic tree of a derivation do not contain phonological information (e.g., Halle & Marantz, 1993). Hence, there is a need for an interface that can read syntactic information and translate it into phonological information – spell-out.

Some linguists use the term *spell-out* to refer to the point at which the derivational 'path' enters PF and LF. According to these linguists, spell-out operates *before* the derivation divides into PF and LF and this is the *point* at which syntax meets phonology and the operation switches to PF (e.g., Chomsky, 1995, p. 189). According to other linguists, spell-out is a *process* that connects syntax and phonology *after* the derivation divides into PF and LF (e.g., Ackema & Neeleman, 2004; Jackendoff, 1997; Halle & Marantz, 1993; Neeleman & Szendröi, 2007). The location of spell-out according to these two ways of using the term *spell-out* is illustrated in (20).

(20)

merge & move   merge & move

lexicon ——————→ LF   lexicon ——————→ LF
                      PF   PF

point of spell-out   process of spell-out
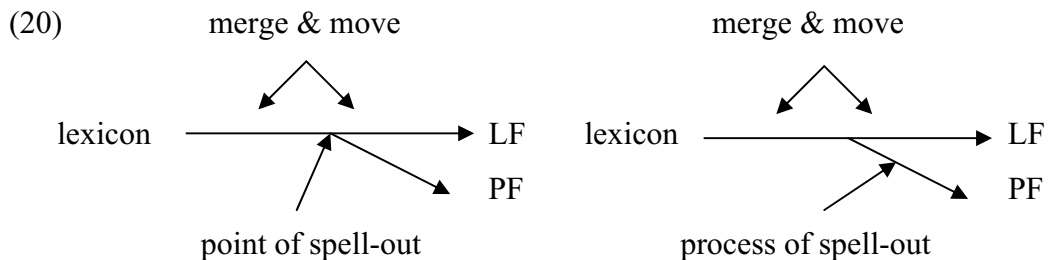
It is the latter interpretation of the term (often called 'late lexical insertion' or 'vocabulary insertion', see e.g., Halle & Marantz, 1993) that is adopted in the present study because it conceives spell-out as a *process* that builds up the phonological representation of a given syntactic representation. As such it can better account for mismatches between syntax and phonology. I will use the term 'late spell-out' for Halle & Marantz' *late lexical insertion/vocabulary insertion*.

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[52] The number and gender features of *he* semantically restrict the antecedents that can be associated with *he* in that *he* can only refer to one antecedent of male gender while it cannot be associated with more than one male antecedent or with female antecedents of any number. The person feature of a pronoun also contributes to semantics by indicating the antecedent from the speaker's point of view. *He* does not refer to the speaker or the person that is spoken to but to a third person (either present or not). In contrast, independently of its case, at LF a pronoun will always be interpreted in relation to the sentence structure, for example, as the subject of the verb *win* in 'they expect *he* will win'/'they expect *him* to win'.

Late spell-out

Spell-out mediates between syntax and phonology; it maps syntactic features onto appropriate phonological features. The theory of late spell-out assumes that terminal nodes consist of (morpho-)syntactic and semantic feature bundles (e.g., [pronoun PERSON: 3rd, NUMBER: sing, GENDER: male, CASE: nom]), but not lexical material (e.g., *he*). Chomsky's Minimalist Program approach is similar in that terminal nodes also contain only features and not lexical material; it is however different in that the features contained are not only syntactic and semantic but *also* phonological. This has implications with respect to the lexicon: while in the Minimalist Program the lexicon is assumed to operate at the beginning of the derivational process by providing *all* types of features of a word for the numeration, in the late spell-out framework, lexical access occurs early for syntactic and semantic features and later, at the interface between syntax and phonology, for phonological features. It is argued that at late spell-out the lexicon is accessed to find items whose phonological features map onto the syntactic and semantic features in the terminal nodes of the tree (Halle & Marantz, 1993). Work on the implications of late spell-out has highlighted the advantages of this hypothesis. For example, the late insertion of vocabulary not only allows the spell out of the content of single terminal nodes but also of larger units of structure (e.g., Neeleman & Szendröi, 2007; Radford, 1988). For example, this can explain the spell out of two syntactically distinct categories such as the French preposition *de* 'of/from' and the French determiner *le* 'the' (masculine gender) using one phonological form such as *du* 'of the/from the'. Spell out of *du* can only be achieved if the co-occurrence of the two distinct terminal nodes for *de* and *le* is taken into account at late spell-out (see also Sproat, 1985). This example is one of many to show that the mapping of syntactic onto phonological features is often not one-to-one but rather many-to-many (consider also the pronoun *you* which has one phonological realization but two syntactic forms – singular (as in *you like yourself*) and plural (as in *you like yourselves*), or the English comparative which has two forms of phonological realizations (i.e., happ*ier*/*more* interesting) but which could be instances of a single syntactic rule (see also Bresnan, 1973)). Therefore, for the mediation between syntax and phonology at the interface, the grammar uses a set of correspondence rules – spell-out rules – that specify that syntactic structure *X* corresponds to phonological structure *Y* (e.g., Jackendoff, 1997) and, in order to

prevent mismatches, selection of the correct spell-out rule is widely assumed to be guided by two principles, the *Subset Principle* and the *Elsewhere Principle*.

The Subset Principle and the Elsewhere Principle

The Subset Principle ensures that the target word (represented by syntactic features) can only be realized by spell-out rules that contain in their specification a subset of the syntactic features of the target word (unlike a superset, or a partially overlapping set) (e.g., Halle, 1997; Halle & Marantz, 1993). The Elsewhere Principle guarantees that the most specific spell-out rule (i.e. the rule that mentions the most features) will be applied whenever more than one spell-out rule is compatible with the syntactic features of the target (Kiparsky, 1973). A potential example of the syntactic feature specifications for the English pronouns and their corresponding spell-out rules is in (21).

(21) *Syntactic features*
[PRONOUN, PERSON: 1st, NUMBER: sing, GENDER: neutral, CASE: nom] 'I'
[PRONOUN, PERSON: 2nd, NUMBER: sing, GENDER: neutral, CASE: nom] 'you'
[PRONOUN, PERSON: 3rd, NUMBER: sing, GENDER: male, CASE: nom] 'he'
[PRONOUN, PERSON: 1st, NUMBER: plural, GENDER: neutral, CASE: nom] 'we'
[PRONOUN, PERSON: 2nd, NUMBER: plural, GENDER: neutral, CASE: nom] 'you'
[PRONOUN, PERSON: 3rd, NUMBER: plural, GENDER: neutral, CASE: nom] 'they'

Spell-out rules
[PRONOUN, PERSON: 1st, NUMBER: sing, GENDER: neutral, CASE: nom] ↔ /I/
[PRONOUN, PERSON: 3rd, NUMBER: sing, GENDER: male, CASE: nom] ↔ /he/
[PRONOUN, PERSON: 1st, NUMBER: plural, GENDER: neutral, CASE: nom] ↔ /we/
[PRONOUN, PERSON: 3rd, NUMBER: plural, GENDER: neutral, CASE: nom] ↔ /they/
[PRONOUN, PERSON: 2nd, GENDER: neutral, CASE: nom] ↔ /you/

The singular and plural *you* in (21) receive the same phonological form, because the spell-out rule that realizes them is underspecified for the feature [NUMBER]. A more economic decomposition of words is that using privative features (i.e., features that are either present or not). For example, pronouns could be syntactically encoded by three features: [ADDRESSEE] and [PARTICIPANT] (instead of [PERSON]) which refer to the members that are part of the speech act and [PLURAL] (see e.g., Ackema & Neeleman, 2004; Harley & Ritter, 2002; Neeleman & Szendröi, 2007). The potential featural decomposition of the pronouns and their corresponding spell-out rules is illustrated in (22). This account of the featural make-up of pronouns also maintains

that the spell-out rule that realizes the singular and plural *you* is underspecified for one feature, [PLURAL].

(22)   *Syntactic features*
        [PRONOUN, PARTICIPANT] 'I'
        [PRONOUN, ADDRESSEE, PARTICIPANT] 'you'
        [PRONOUN] 'he'
        [PRONOUN, PLURAL, PARTICIPANT] 'we'
        [PRONOUN, PLURAL, ADDRESSEE, PARTICIPANT] 'you'
        [PRONOUN, PLURAL] 'they'

        Spell-out rules
        [PRONOUN, PARTICIPANT] ↔ /I/
        [PRONOUN] ↔ /he/
        [PRONOUN, PLURAL, PARTICIPANT] ↔ /we/
        [PRONOUN, PLURAL] ↔ /they/
        [PRONOUN, ADDRESSEE, PARTICIPANT] ↔ /you/

Irrespective of the nature of the featural make-up of pronouns, in order to select the target spell-out rule, say, for the singular pronoun *you*, the Subset Principle selects those spell-out rules whose syntactic feature specification is a subset of the target's. Spell-out rules which contain syntactic features that are not shared by the target will not be included in the subset. Adopting the feature specification given in (22), the subset of the spell-out rules that compete for the phonological realization of *you* is as illustrated in (23).

(23)   *Subset of spell-out rules for the phonological realization of 'you'*
        [PRONOUN, PARTICIPANT] ↔ /I/
        [PRONOUN, ADDRESSEE, PARTICIPANT] ↔ /you/
        [PRONOUN] ↔ /he/

The spell-out rules for *I* and *he* are included in the subset – the competitor set – because their syntactic features are a subset of the target's while they do not contain features that are not part of the target's feature specification. All other spell-out rules (as listed in (22)) are excluded because their syntactic feature specifications contain features that are not shared by the target (e.g., [PLURAL]). In order to ensure that the spell-out rule for the (target) pronoun *you* is favoured over that of *I* and *he,* the Elsewhere Principle guaranties that the most specific spell-out rule is selected from the subset of competing candidates. As the spell-out rule for *you* spells out more

features than that of *I* and *he*, the Elsewhere Principle will give preference to the phonological realization of *you.*

There are more examples to show how the two principles guide the selection of the correct spell-out rule for a given target word. Depending on the presence/absence of the two features [ADDRESSEE] and [PARTICIPANT] the application of the Subset Principle and Elsewhere Principle also determines, for example, the assignment of different verb agreements to different pronouns. Using a morphologically richer language than English for illustration, the syntactic features for the German (singular) pronouns and their corresponding spell-out rules for person-verb agreement could be as illustrated in (24) (partly taken from Neeleman & Szendröi, 2007).

(24)   *Syntactic features*
         [PRONOUN, PARTICIPANT] 'ich' (I)
         [PRONOUN, ADDRESSEE, PARTICIPANT] 'du' (you)
         [PRONOUN] 'er' (he)

         Spell-out rules for verb agreement
         [PRONOUN, PARTICIPANT] ↔ /e/
         [PRONOUN, ADDRESSEE, PARTICIPANT] ↔ /st/
         [PRONOUN] ↔ /t/

There is a separate verb agreement spell-out rule for each (singular) person. In order to select the person-verb agreement spell-out rule, say, for the pronoun *ich* 'I', the Subset Principle will select a subset of those person-verb agreement spell-out rules whose syntactic feature specification is a subset of the target's (i.e., [PRONOUN] and/or [PARTICIPANT]. Spell-out rules which contain syntactic features (i.e., [ADDRESSEE]) that are not shared by the target will not be included in the subset (see (25)).

(25)   *Subset of spell-out rules for verb agreement for the pronoun 'ich' (I)*
         [PRONOUN, PARTICIPANT] ↔ /e/
         [PRONOUN] ↔ /t/

The result is a subset of two competing spell-out rules. As the spell-out rule that represents verb inflection in the form of the suffix /e/ is most specific, that is, spells out the most features, the Elsewhere Principle will give its phonological realization

preference. Consequently, verb agreement for the pronoun *ich* 'I' will appropriately be realized on the verb (as in *ich gehe* '*I walk*').

The examples demonstrate the nature of the decompositional approach to characterize the representational make-up of words: that syntax operates on feature bundles rather than lexical material. This is well established for the analysis of grammatical morphemes such as pronouns and verb inflections (see e.g., Halle & Marantz, 1993; Neeleman & Szendröi, 2007; Trommer, 2008). The examples also show that the decomposition is an economic approach as it assumes that different syntactic feature bundles for the different functions of polysemic words such as *you* map onto one phonological representation (i.e., two syntactic and one phonological feature specifications for *you* as illustrated in (21) and (22)). Alternatively, the two realizations of *you* could be considered syntactically *and* phonologically distinct with phonological and syntactic feature specifications for each function of *you*.

The decompositional account of prepositions

The decompositional make-up of prepositions (and the operation of late spell-out in relation to prepositions) has not yet been described or, at least, not in as much detail as for other grammatical morphemes such as pronouns or verb inflections. The following account of prepositions is therefore still at a speculative stage, constituting an outline for further linguistic analysis, although there is a wealth of work on the semantics of prepositions which provides a basis for the formulation of spell-out rules for prepositions (see e.g., Svenonius, 2004; 2007; Tyler & Evans, 2003a).

Despite the absence of a theory on the derivation of prepositions it is likely that the make-up of prepositions is decompositional too. The function of prepositions could be syntactically encoded through a set of syntactic features and individual prepositions could be conceived as a 'bunch of features' some of which would be shared by all prepositions and some only by a subset of them. For example, all prepositions would have the feature of [P] for the class *preposition*, all locational spatial prepositions (and at least some directional spatial prepositions) would have the feature of [PLACE], and all (spatial) directional prepositions would also have the feature of [PATH], and so on. A potential example of possible feature bundles for the English prepositions *of*, *in*, *into*, and *under* is in (26).

(26)   *Syntactic features*
       [P] 'of'
       [P, PLACE: IN] locational 'in'
       [P, PATH: TO, PLACE: IN] directional 'into'
       [P, PLACE: UNDER] locational 'under'
       [P, PATH: TO, PLACE: UNDER] directional 'under'

While [P], [PATH] and [PLACE] are *features* that are part of a preposition's structural description, [IN], [TO], and [UNDER] indicate *values* that specify a preposition's distinct properties such as containment (for the locational *in*), contact (for the spatial *on*), and so on. It may be speculated that these syntactic feature bundles are spelled out by the following spell-out rules (see (27)):

(27)   *Spell-out rules*
       [P] ↔ /of/
       [P, PLACE: IN] ↔ /in/
       [P, PATH: TO, PLACE: IN] ↔ /into/
       [P, PLACE: UNDER] ↔ /under/

The decompositional account proposes that the same phonological form is assigned to the locational and directional *under*, because the spell-out rule that realizes them is underspecified for the feature [PATH]. Thus, the decompositional account maintains that the two prepositions are syntactically and semantically distinct, while it stipulates that they have the same phonological form. This is important, because locational and directional prepositions in some languages assign different cases, and therefore are evidently syntactically distinct, despite having the same phonological form. An example is German *in* 'in', which assigns accusative when directional and dative when locational. According to the logic of the decompositional approach, the two prepositions, despite being syntactically distinct, could share one spell-out rule that is underspecified for the features [PATH] and [CASE] as illustrated in (28).

(28)   *Syntactic features*
       [P, PLACE: IN, CASE: DAT] locational 'in'
       [P, PATH: TO, PLACE: IN, CASE: ACC] directional 'in'

       Spell-out rule
       [P, PLACE: IN] ↔ /in/

Assuming an underspecification for [PATH] in the mutual spell-out rule of homophonic prepositions that are ambiguous for [PLACE] and [PATH] such as English *under* (and German *in* 'in') is in line with the observation that in languages with rich morphology, the morpheme denoting [PLACE] is always closer to the word stem than the morpheme denoting [PATH] (e.g., Svenonius, 2007). Even in English where morphological distinction is lacking and some prepositions are ambiguous between locational and directional meanings (e.g., *under the bridge*), [PLACE] and [PATH] show different patterns of syntactic distribution. If locational and directional prepositions co-occur, the preposition denoting [PLACE] is closer to the landmark than the preposition denoting [PATH] (e.g., *it looked at me from under the bed*/* *it looked at me under from the bed*) (Ramchand & Tungseth, 2006). This not only shows that the internal structure of a prepositional phrase is decomposed for [PLACE] and [PATH] (e.g., Svenonius, 2007; van Riemsdijk, 1990) but the nature of decomposition also suggests that [PATH] is derived from [PLACE] denotations (see e.g., Zwarts, 2005).

If the assumption of the decompositional nature of prepositions is correct, then there is a great deal of featural overlap in the characterization of individual prepositions. The phonological realization of prepositions via the spell-out rules must therefore be regulated in order to prevent mismatches. For example, any preposition could be spelled out as /of/ as all prepositions have in their specification the feature [P]. Similarly, the directional *into* could be realized as /in/ as a result of the shared feature [PLACE: IN]. In order to prevent such errors, the Subset Principle and the Elsewhere Principle apply. First, the Subset Principle selects a subset of those spell-out rules that contain in their feature specification a subset of the features of the target preposition. For example, if the preposition to be pronounced is *into*, then all spell-out rules that contain the features [P], [PLACE] and/or [PATH] and the values IN and/or TO will be included in the subset. Spell-out rules which contain features or values (i.e., [UNDER]) that are not shared by the target will not be included in the subset (see (29)).

(29)   *Subset of spell-out rules for the phonological realization of 'into'*
       [P] ↔ /of/
       [P, PLACE: IN] ↔ /in/
       [P, PATH: TO, PLACE: IN] ↔ /into/

In a second step, the Elsewhere Principle ensures that the most specific rule will be applied whenever more than one spell-out rule is compatible with the syntactic feature bundles of the target. The Elsewhere Principle has the effect that *into* will not be realized as /of/ or /in/ as there is another, more specific spell-out rule that better matches the syntactic features of *into* namely the one that mentions all required features [P, PATH: TO, PLACE: IN].

The source of the preposition deficit: impaired selection at late spell-out

The present study has shown that the patients had little difficulty with syntactic operations involving prepositions. They successfully combined prepositions and nouns to prepositional phrases (correct application of *merge*), they never placed prepositions or prepositional phrases in illegal positions in the sentence structure (no violation of phrase structure and *move*), they successfully checked the case features assigned by prepositions (and verbs) to pronouns (no case violations on pronouns in connected speech), they produced, if not the right preposition at least another preposition, thus selected the correct grammatical class, and they fared well on prepositions that can only be identified by successful sentence structure parsing. This suggests that the problem with prepositions is located post syntactically at LF, PF and/or late spell-out.

LF is relevant only for a subset of prepositions, those that carry (interpretable) semantic features – meaningful prepositions. A selective deficit at LF is expected to result in selective impairment of meaningful prepositions, but spare all subcategories of prepositions that are meaningless. This was not observed in the patients of the present study. Instead, for example, a distinction was found between meaningless lexical (i.e., subcategorized prepositions and particles, see footnote 23) and meaningless syntactic prepositions in the case of BG and TH. As meaningful prepositions were neither well preserved nor the most impaired subcategory of prepositions in the patients of the present study, the underlying locus of impairment is most likely to be found elsewhere.

A deficit at PF (that is, a phonological deficit as suggested by Kean, 1977; 1979) is expected to have equal consequences for all types of prepositions – be it meaningless or meaningful, lexical or syntactic. A phonological deficit would involve an inability to employ the phonological form of prepositions which should result in an inability to pronounce prepositions, or, at least phonological properties

such as length and the presence/absence of stress of prepositions should have an influence on their production. None of these conditions were observed in the present study (but see Druks, 1991). Selective impairments for different subcategories of prepositions were found but these were independent of their length and stress properties, and patients tended to produce, if not the right preposition, at least another preposition. This strongly leads to the assumption that the problem with prepositions is located at the point where syntax meets phonology – at late spell-out.

But what effect does a deficit in late spell-out have on the availability of prepositions in aphasia? In order to produce a preposition (e.g., *into*) the Subset Principle must be applied which selects the spell-out rules of those prepositions whose structural description is a subset of the features of the target (i.e., *of*, *in*, *into*, see (29)). This creates a subset of prepositions with shared features that includes the target. In order to ensure that the target preposition *into* is produced, the Elsewhere Principle is applied which selects the most appropriate spell-out rule from the subset (e.g., [P, PATH: TO, PLACE: IN]). If there was a disruption of these operations, several possible pitfalls could occur. A deficit in accessing the syntactic features of prepositions would lead to omission errors, unrelated errors or across-category substitution errors. Within-category substitution errors, which were the majority of errors for the patients in this study, indicate that access to the syntactic features of prepositions has been possible, and, therefore, the deficit must be in applying the Subset Principle and/or the Elsewhere Principle in order to select the correct spell-out rule from the set of competitors.

A deficit in selecting an appropriate subset may result in making substitution errors that are *more* specific than the target (e.g., *in → into*). The reason is that the malfunctioning Subset Principle includes spell-out rules that contain features or values that are not part of the target's spell-out rule such as [PATH] or [TO] (see (30)). Therefore, the subset selected would wrongly include *into* in the set to produce *in.*

(30)   *Incorrect subset of spell-out rules for the phonological realization of 'in'*
       [P] ↔ /of/
       [P, PLACE: IN] ↔ /in/
       *[P, PATH: TO, PLACE: IN] ↔ /into/

In this case the Elsewhere Principle would (appropriately) select *into* as the most specific preposition of the subset which has the effect that *in* will be realized as

/into/. Faulty application of the Elsewhere Principle would result in making substitution errors that are *less* specific than the target (e.g., *into → in*; *in → of*). The reason is that the malfunctioning Elsewhere Principle fails to select the most specific spell-out rule from the subset of competitor spell-out rules. For example, the appropriately selected subset of spell-out rules for the target preposition *into* is in (31).

(31)   *Subset of spell-out rules for the phonological realization of 'into'*
         [P] ↔ /of/
         [P, PLACE: IN] ↔ /in/
         [P, PATH: TO, PLACE: IN] ↔ /into/

Failure of the Elsewhere Principle to evaluate the spell-out rules correctly and thus identify the most specific one from the set of competitors (i.e., *into*) will result in the erroneous selection of a less specific spell-out rule (i.e., *in*).

Since a fully worked-out analysis of prepositions in terms of featural decomposition and late spell-out is not yet available (but see e.g., Svenonius, 2004; 2007; and Tyler & Evans, 2003a, for work on spatial prepositions), it is difficult at this stage to distinguish on the basis of patient errors among deficits in the application of the Subset Principle, deficits in the application of the Elsewhere Principle, and deficits that result from combination of both.

One way of exploring this is to consider syntactic prepositions. According to the logic of the decompositional approach, prepositions such as *of* have the least specific set of syntactic features and are therefore more likely to be included in the initially selected subset of spell-out rules of most or all other prepositions. This means that they are also more likely to be used as a substitute for other prepositions in case the Elsewhere Principle is not applied properly, while they are themselves less likely to be replaced by other prepositions. Thus, they are candidates for patients using them as the default preposition. BG indeed uses *of* in this way. Of course, this observation remains speculative as we do not yet know the featural make-up of all prepositions including *of* and other so called syntactic prepositions (e.g., *by*, *for*, *to*), and how they differ from each other.

Another way to explore this issue is to analyze the quality of the within-subcategory substitutions made by the patients during description of spatial situations. There have been only very few cases in which a more specific preposition

(e.g. *into*) was substituted by a less specific preposition (e.g., *in*) (see Table 10 in Chapter 4). There were somewhat more errors in which a less specific preposition (e.g., *in*) was substituted by a more specific preposition (e.g., *into*). The fact that there were fewer substitution errors of the kind *into* → *in* might indicate more sensitivity to the requirements of the Elsewhere Principle than the Subset Principle. The observation that the direction of errors was non-random (patients tended to add a feature (i.e., such as [PLACE] → [(PLACE), PATH]) argues against the more obvious interpretation of substitution errors as being simply semantically related to the target.

This conclusion however must be treated with caution for three reasons. First, the number of more and less specific within-subcategory substitutions was very small in general. Second, the vast majority of spatial prepositions required in the picture description task were locational, that is, there was little opportunity to make errors on directional (i.e., more specific) target prepositions. Third, and most importantly, because the decompositional approach to prepositions is not yet available, the form of their feature specifications as presented here is pure speculation at this stage.

So far, the only secure conclusion to be drawn is that the quality of the errors advocates a post syntactic deficit at late spell-out which leads to faulty selection of the correct preposition. Whether it is caused by failure to apply either the Subset Principle or the Elsewhere Principle, or both is left to be disentangled once the decompositional approach of prepositions is fully understood. Nevertheless, the tendency of the patients to systematically produce more specific errors in production shows that the within-subcategory substitution errors are not merely semantically close to the target but rather indicate failure to apply (non-semantic) rules that guide selection – the Subset Principle and/or the Elsewhere Principle. While the present study was not geared towards testing these possibilities, in a future study it would be feasible to target both directional and locational prepositions and observe the errors that they elicit.

It should be pointed out at this stage, first, that the source of the preposition impairment is unlikely to be uniform across all patients. Nevertheless, the patients of the present study represent typical Broca's and anomic aphasic patients, presumably similar to patients participating in previous studies, and therefore, the claims made here may generalize to other aphasic patients presenting with a preposition deficit. A pre-requisite is however that there is evidence, like in the present study, for relatively well preserved syntactic knowledge.

Second, manifestations of the deficit at spell-out are expected to carry over to other domains in which selection is an important factor – in word classes organized in paradigms. The selection of pronouns, correct verb agreement, and tense marking, for example, may be affected by a malfunctioning selection process at spell-out. In addition, the Subset Principle is most likely also involved in other (very different) linguistic phenomena such as language acquisition or binding theory. It is therefore speculated that a malfunctioning Subset Principle leads to impairments in these linguistic domains too. The investigation of these phenomena will have to be carried out in future studies.

The hypothesis that the source of preposition impairments is a deficit in selection rather than syntax is not new, though it has not previously been articulated explicitly. Wales and Kinsella, 28 years ago, already speculated that although '*it seems clear that crucial syntactic factors cannot be ignored in the description of the language deficit of Broca's aphasics […] it is not surprising (given the emphasis by Chomsky and others on viewing language as a system) that phonological factors might interact with syntactic ones. However, there seems no way in which all of the […] results could be accounted for in these terms*' (1981, p. 306).

A deficit in selection across modalities

As the preposition deficit was not confined to production, the locus of deficit cannot be restricted to the output modality. Instead, it is more likely that the preposition deficit is present at all levels of language representation, though it is most pronounced at the level of production[53]. For example, deficits for spatial prepositions were most pronounced in production but present to some extent in comprehension, and differential impairments of different types of prepositions were most likely to be detected in production, although they were also found in grammaticality judgment (but see Lonzi et al., 2007, who found selective impairments for different types of prepositions in sentence completion but not in grammaticality judgment).

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[53] Due to the nature of the tasks, in different modalities different error types may occur. In grammaticality judgment and comprehension tasks only two types of errors are possible and their quality is predetermined by the nature of the task (i.e., *no responses* and within-category substitution errors) while in production the type and quality of the errors is not predetermined and thus can potentially reveal much indirect knowledge about the target. Given this important role of the errors, it is probable that the preposition deficit and the form it takes can be identified better in production than grammaticality judgment and comprehension.

The above proposal of a malfunctioning late spell-out as the locus of the preposition impairment is however confined to production because late spell-out, although involved in both productive and receptive linguistic processes, operates very differently during production, comprehension, and grammaticality judgment. The processes involved in language production start with semantic and syntactic representations which are then mapped onto phonological representations. In contrast, the processes involved in comprehension and grammaticality judgment start with phonological input which is then mapped onto semantic and syntactic representations. For example, in production, a preposition's phonological representation is selected on the basis of features that specify its meaning and syntax. Thus, the set of competing spell-out rules for the production of the directional preposition *into* could be as in (32).

(32)   *Subset of spell-out rules for the phonological realization of 'into'*
       [P] ↔ /of/
       [P, PLACE: IN] ↔ /in/
       [P, PATH: TO, PLACE: IN] ↔ /into/

If the phonological representation /into/ is available first (as in comprehension and grammaticality judgment tasks) the competing spell-out rules to relate phonological form with meaning and syntax could be as in (33). The illustration in (33) follows the assumption that phonological encoding of words begins with the first phoneme and proceeds from left to right (i.e., /i/ → /in/ → /int/ → /into/) (see Marslen-Wilson, 1987). Therefore, many spell-out rules could initially be included in the set of competitors.

(33)   *Subset of spell-out rules for target prepositions 'into'*
       /**ill**/ ↔ [ADJECTIVE...]
       /**if**/ ↔ [CONJUNCTION...]
       …
           /**in**/ ↔ [P, PLACE: IN (CONTAINMENT)]
           /**in**/ ↔ [P, TIME: IN (BEGINNING, END)]
           /**in**ane/ ↔ [ADJECTIVE...]
           /**inn**/ ↔ [NOUN]
           ...
               /**int**act/ ↔ [ADJECTIVE…]
               /**int**end/ ↔ [VERB…]
               …
               → /**into**/ ↔ [P, PATH: TO PLACE: IN]

If this approach is true, the initial set of competitor spell-out rules based on form input is larger than that based on syntax and meaning. However, the number of spell-out rules included in the set of competitors (based on form input) is narrowed down once the full word is phonologically encoded. At the point of word recognition, all candidates whose form constitutes only a subset of the target's are excluded. In the case of non-homophonic words such as the preposition *into* only the target's spell-out rule will remain because its phonological representation (i.e., /into/) is mentioned in one spell-out rule only (i.e. /into/ ↔ [P, PATH: TO PLACE: IN][54]. In the case of homophonic words such as *in*, all phonologically identical words will remain in the final subset of competitors (see (34)).

(34)   *Subset of spell-out rules for target prepositions 'in' after the point of word recognition*
        /in/ ↔ [P, PLACE: IN (CONTAINMENT)]
        /in/ ↔ [P, TIME: IN (BEGINNING, END)]
        /inn/ ↔ [NOUN]

What needs to be considered is that (34) illustrates the spell-out rules involved in comprehension (and grammaticality judgment) of *single* words. In the present study, comprehension of single (spatial) prepositions was tested in one task only; the remaining six tasks probed the comprehension and grammaticality judgment of prepositions in sentence structure. Provision of sentence structure may constrain the identity of the grammatical class of the word in question. This may reduce the number of potential spell-out rules included in the subset of competitors, for example, for the preposition *in* (see (35)).

(35)   *Subset of spell-out rules for target prepositions 'in'*
        /in/ ↔ [P, PLACE: IN]
        /in/ ↔ [P, TIME: IN]

Therefore, the sets of competing spell-out rules in comprehension and grammaticality judgment, although initially large, are on average smaller than those in production. Smaller sets of spell-out rules (which, in the case of non-homophonic

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[54] This implies that in comprehension and grammaticality judgment, non-homophonic prepositions are at an advantage. Indeed, in the present study, DOR, DC, and TH produced fewer misselections on low frequency prepositions (which are non-homophonic spatial and temporal prepositions) than medium and high frequency prepositions (which are homophonic meaningful, syntactic, and subcategorized prepositions).

words, may consist of the target word only in comprehension and grammaticality judgment but *not* in production) may evoke fewer errors (in line with the findings of the present study). Moreover, the number of erroneous responses made in comprehension/grammaticality judgment is further reduced because *value* substitution errors (i.e., where one phonological form becomes associated with more than one syntactic feature bundle, see (35)) are impossible to detect on the basis of form alone. In contrast, value substitution errors in production often differ in form (i.e., *in* → *on*). Also, in the present study, homophonic prepositions with different features where not tested in the comprehension and grammaticality judgment tasks[55]. Nevertheless, some erroneous responses were made, albeit fewer in number than in production. These errors show that patients misselected the phonological *and* value representation of the target preposition (e.g., /in/ ↔ [P, PLACE: IN] → /on/ ↔ [P, PLACE: ON]). It is likely that some of these errors were made due to difficulties in holding in memory the target preposition until a decision could be made. This is reflected in the relatively large number of repetitions (which in turn often caused time-out errors) requested, for example, by DC. This may mean that some of the errors made in comprehension were due to working memory limitations and not due to misselection at spell-out.

Although late spell-out operates very differently in production and comprehension, the theory of impaired late spell-out in production exemplifies the grammatical processes involved in language processing in general including comprehension and grammatically. Crucially, the quality of errors in production, comprehension and grammaticality judgment tasks supports the notion of a deficit in selection across modalities: patients tended to produce/select the wrong preposition while *no responses* were less common.

6.2   CONCLUSION

The present study has shown that prepositions, irrespective of the clinical profile of the patients, are a difficult category. Only few of the parameters previous researchers have identified were supported, and most of the parameters were shown to be irrelevant for preposition use by the patients.

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[55] The comprehension of the preposition /in/ ↔ [P, PLACE: IN], for example, was tested using four pictures one of them depicting the spatial situation *in*, the others depicting spatial situations such as *beside, on,* and *under*. There was no picture representing the temporal function of *in* (i.e., /in/ ↔ [P TIME: IN]).

Contrary to expectations, prepositions with syntactic function only were more likely to be correctly produced than particles, meaningful, or subcategorized prepositions. This was accounted for by the high constraint on lexical choice provided by sentence structure. Alternatively, the relative preservation of syntactic prepositions in combination with the second finding, that patients made many within-category substitution errors and that syntactic prepositions were often used as default prepositions, was interpreted as evidence for impairments at post syntactic late spell-out.

6.3   SUGGESTIONS FOR FUTURE RESEARCH

The present study extended at least somewhat our knowledge of the nature of preposition deficits in aphasia. However, data of five patients are not sufficient to make strong claims, especially, if the variability of the patients in the present study and in the population of patients in general is considered. In a future study, the performance of larger groups of aphasic patients of different clinical profiles needs to be investigated. This will make possible to find out whether the claims made on the basis of the patients in the present study can be generalized to other patients.

Below are suggestions for a future study to include additional materials and comparisons. Due to the controversial status of the infinitival *to*, the passive *by*, and the dative *to*, (i) future research on syntactic prepositions would need to focus on the availability of the syntactic *of* – the only preposition, according to most linguists, with a syntactic only function. Because of their similarities, it is however also of interest to set up comparisons between (ii) the syntactic *of* and infinitival *to*, (iii) the passive *by* and non-passive *by*, and (iv) between the dative *to* and the spatial *to*. This may help to decide on the category membership of these controversial prepositions. It is also of interest to (v) compare the availability of the infinitival *to* with auxiliaries, modal verbs and verb inflections. If the auxiliary-like analysis of the infinitival *to*, as suggested by some linguists (e.g., Mittwoch, 1990), is correct, there should be a relation in their impairment/preservation in aphasia. In the comparison, verb inflections should be ignored, and *to* should be contrasted with modal/auxiliary verbs that are also free morphemes. Also, the growing body of evidence that points towards an analysis of prepositions into five independent subcategories (i.e., meaningful prepositions, subcategorized prepositions, syntactic prepositions, particles, and prepositional adverbials) motivates (vi) the extension of the materials

used in the study with respect to prepositional adverbials (which have not been tested in the present study).

On a more theoretical level, while evidence that supports the notion of a deficit at late spell-out at this stage is quite strong, whether the deficit is in applying the Subset Principle and/or the Elsewhere Principle cannot be said with confidence yet. Because patients' within-subcategory substitution errors tended to be in one direction, that is, they were non-random (i.e., [PLACE] → [(PLACE), PATH]), there is some indication for the faulty application of the Subset Principle. As soon as linguistic work provides a thorough decompositional analysis of prepositions and the corresponding spell out rules, the quality of the patients' within-subcategory substitution errors will be more fully understood.

Over and above the specification of features such as [PLACE] and [PATH], the complexity of the values that are also part of a preposition's structural description needs to be worked out. For example, the substitution of *above* with *on* is at present analyzed as equal in complexity (because both are prepositions of place). However, in terms of the values, *on* is likely to be semantically more complex than *above* because *on* entails the additional meaning of *contact*. Similarly, *in* and *through* not only differ in terms of the presence/absence of the [PATH] feature but also in their values: *through* shares some meaning with *in* (*containment*) and has additional meanings (*in on one side and out on the other*). The majority of within-category substitution errors violated values (e.g., *above* → *on*) while they maintained features (e.g., PLACE → PLACE, see Table 10 in Chapter 4). Substitutions of values show that patients are sensitive not only to a preposition's feature specification but also to the specific values it contains. The reason is that value substitutions made by the patients were often semantically very close (e.g., *on* and *above* both entail that a subject is located higher than a surface-like landmark, while *on* additionally entails contact between the two). This is in accordance with the hypothesis of the preposition deficit taking place at spell-out. As it is likely that the different values also differ in complexity, the substitution of *above* by *on*, for example, may demonstrate a failure in the application of the Subset Principle. However, only when a decompositional analysis of prepositions in terms of features *and* values becomes available, we will fully understand the nature of errors. It is most likely that the types of errors made by the patients will be able to inform the linguistic analysis.

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APPENDICES

APPENDIX I

DIAGNOSTIC PROFILES OF THE BOSTON DIAGNOSTIC APHASIA EXAMINATION

Patient's Name __BG__   Date of rating __9/2006__

Rated by _____

APHASIA SEVERITY RATING SCALE

0. No usable speech or auditory comprehension.

1. All communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. The range of information that can be exchanged is limited, and the listener carries the burden of communication.

2. Conversation about familiar subjects is possible with help from the listener. There are frequent failures to convey the idea, but patient shares the burden of communication with the examiner.

3. The patient can discuss almost all everyday problems with little or no assistance. Reduction of speech and/or comprehension, however, makes conversation about certain material difficult or impossible.

4. Some obvious loss of fluency in speech or facility of comprehension, without significant limitation on ideas expressed or form of expression.

5. Minimal discernible speech handicaps; patient may have subjective difficulties that are not apparent to listener.

RATING SCALE PROFILE OF SPEECH CHARACTERISTICS

Patient's Name ___DC___   Date of rating ___10/2006___

Rated by _____

APHASIA SEVERITY RATING SCALE

0. No usable speech or auditory comprehension.

1. All communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. The range of information that can be exchanged is limited, and the listener carries the burden of communication.

(2.) Conversation about familiar subjects is possible with help from the listener. There are frequent failures to convey the idea, but patient shares the burden of communication with the examiner.

3. The patient can discuss almost all everyday problems with little or no assistance. Reduction of speech and/or comprehension, however, makes conversation about certain material difficult or impossible.

4. Some obvious loss of fluency in speech or facility of comprehension, without significant limitation on ideas expressed or form of expression.

5. Minimal discernible speech handicaps; patient may have subjective difficulties that are not apparent to listener.

RATING SCALE PROFILE OF SPEECH CHARACTERISTICS

Patient's Name **DOR**   Date of rating **APRIL 02**

Rated by _____

APHASIA SEVERITY RATING SCALE

0. No usable speech or auditory comprehension.

1. All communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. The range of information that can be exchanged is limited, and the listener carries the burden of communication.

2. Conversation about familiar subjects is possible with help from the listener. There are frequent failures to convey the idea, but patient shares the burden of communication with the examiner.

3. The patient can discuss almost all everyday problems with little or no assistance. Reduction of speech and/or comprehension, however, makes conversation about certain material difficult or impossible.

4. Some obvious loss of fluency in speech or facility of comprehension, without significant limitation on ideas expressed or form of expression.

5. Minimal discemible speech handicaps; patient may have subjective difficulties that are not apparent to listener.
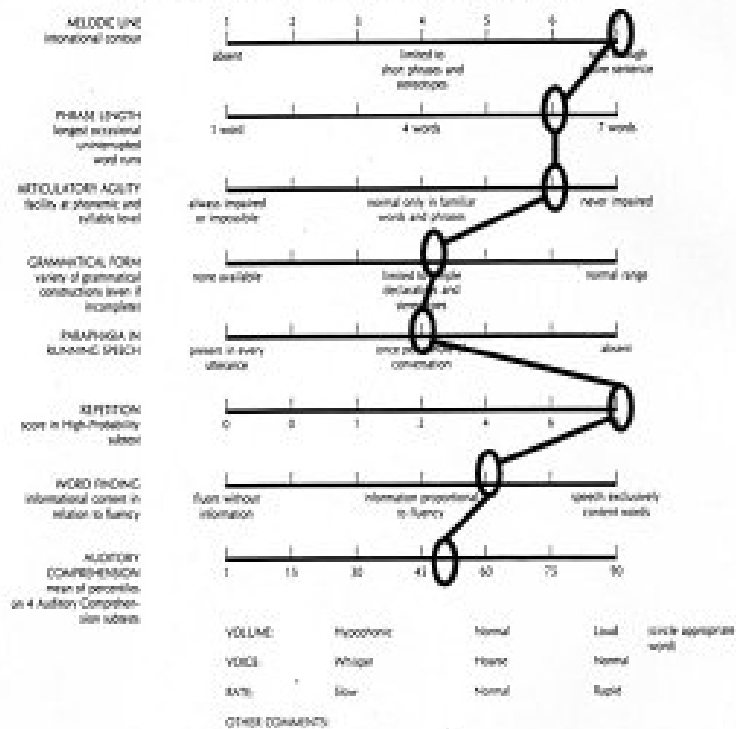
RATING SCALE PROFILE OF SPEECH CHARACTERISTICS

Fig. 3. Aphasia severity rating scale and rating scale profile of speech characteristics.

Patient's Name __EW__   Date of rating __8/2006__

Rated by _____

APHASIA SEVERITY RATING SCALE

0. No usable speech or auditory comprehension.

1. All communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. The range of information that can be exchanged is limited, and the listener carries the burden of communication.

2. Conversation about familiar subjects is possible with help from the listener. There are frequent failures to convey the idea, but patient shares the burden of communication with the examiner.

3. The patient can discuss almost all everyday problems with little or no assistance. Reduction of speech and/or comprehension, however, makes conversation about certain material difficult or impossible.

4. Some obvious loss of fluency in speech or facility of comprehension, without significant limitation on ideas expressed or form of expression.

5. Minimal discernible speech handicaps; patient may have subjective difficulties that are not apparent to listener.

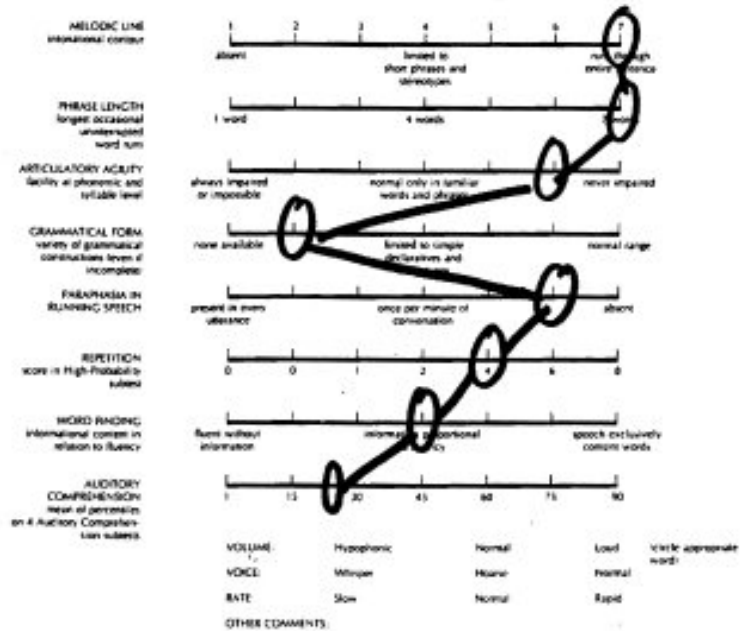### RATING SCALE PROFILE OF SPEECH CHARACTERISTICS

Patient's Name __TH_____ Date of rating __Nov-Dec 06__

Rated by _____

APHASIA SEVERITY RATING SCALE

0. No usable speech or auditory comprehension.

1. All communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. The range of information that can be exchanged is limited, and the listener carries the burden of communication.

2. Conversation about familiar subjects is possible with help from the listener. There are frequent failures to convey the idea, but patient shares the burden of communication with the examiner.

3. The patient can discuss <u>almost all everyday problems</u> with little or no assistance. Reduction of speech and/or comprehension, however, makes conversation about certain material difficult or impossible.

4. Some obvious loss of fluency in speech or facility of comprehension, without significant limitation on ideas expressed or form of expression.

5. Minimal discernible speech handicaps; patient may have subjective difficulties that are not apparent to listener.

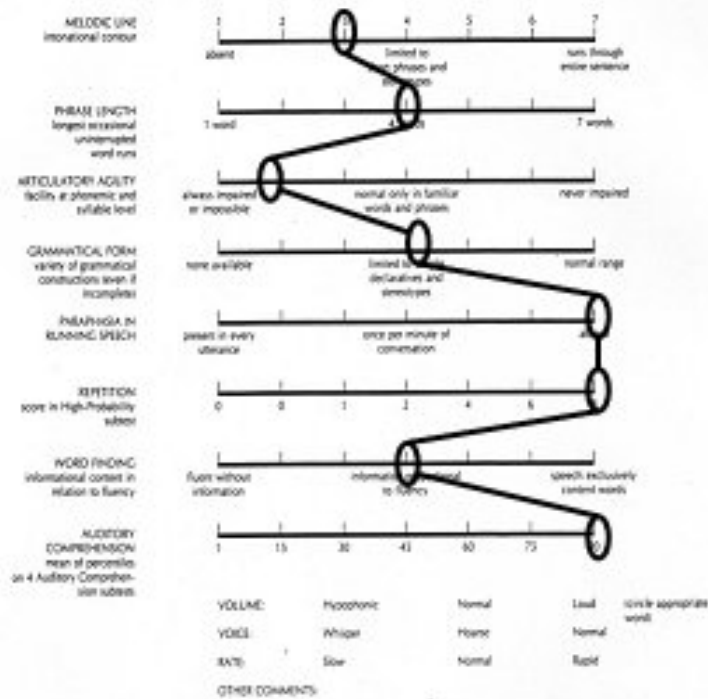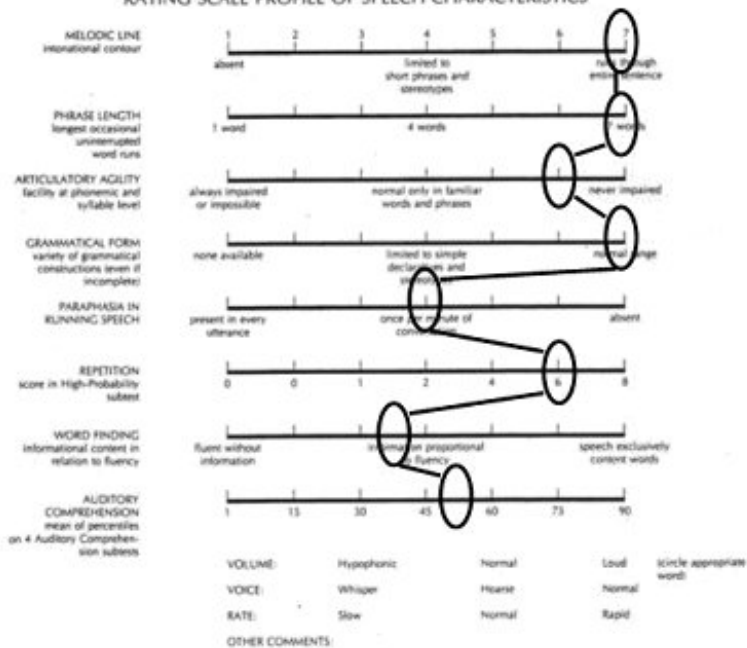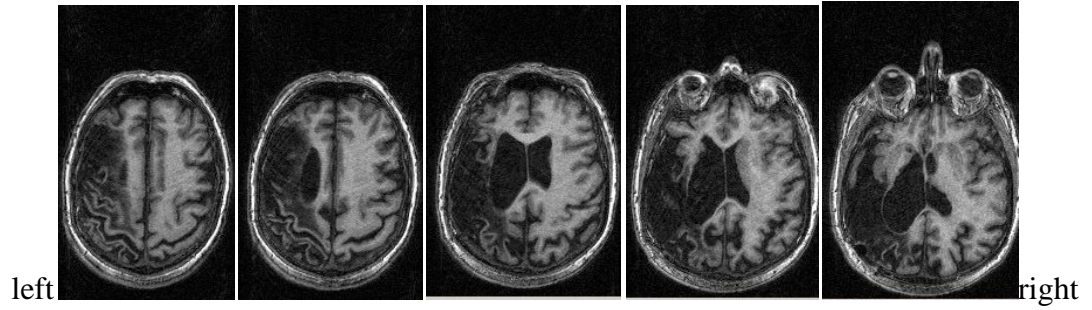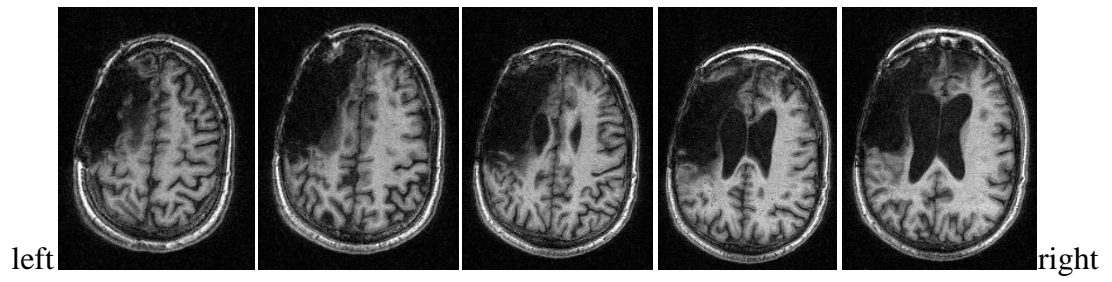### RATING SCALE PROFILE OF SPEECH CHARACTERISTICS

APPENDIX II

SCAN INFORMATION FOR DOR AND EW

DOR

left   right

EW

left   right

APPENDIX III

SPEECH DATA FROM DESCRIPTION OF THE *CAT AND FISH STORY*

BG

a man calls another man to invite him for a dinner / the recipients of the party...he is write it down the information on a piece of paper with a pen / the woman and man are cooking in their kitchen / the man doing the washing up / the woman cooking on top of the stove / she stir the food in the sauce pan / the back of the frontal picture is a fish / this is Smith / the woman and man are in the dining room / they set the table in the … / plate and knife and fork and glasses and candles and two bottles of wine and the fish and potatoes / there a dog under the table / you can see his tail and back legs / the Smiths are in their bedroom getting ready for the party / the woman have long dress / she doing her necklace to do it up / the man have tie and suits / he doing up his tie / they 're in the hall now greeting their guests / the woman have big bunch of flowers with her hand / the man shaking the other man hands / I now see / they're in the dining room / just coming the dining room they saw the fish is not there / they all then are horrified / the Smith man look two fingers one eye to look what happened / Mrs. Smith is crying / she's have her hands over her face / the woman guest pampering her while Mr. Smith running out the door / the other picture says he's gone and buy fish and chips for guests and himself / now they're sitting / they finished dinner in dining room / they're quite happy now / you can see the cat happy as well / this cat licking his paw with his tongue

DC

it's four guys / two men and women / men and women they are married / that's two marriages / two of them is phoning them / six o'clock in the evening / how do you want dinner / this is the guy making out / I'll see you in about an hour or six hours / put the phone down / the man and woman starting to the dinner and fish / the kitten is the fish / he is cooking / the man is drying the plates / that's Mickey and June / it is lighting the stars / two wine and potatoes and fish / that's four dining places / is ready for the cooking / the cat is slowly creeping under this table / this is the bedroom / Jane's black / she is: come on let's go / the white here / that is fantastic / I'm going to the dining room / Mickey and Jane and :how do you do / Phil / How do you do Phil / Sue, God Sue fantastic / flowers for you / Jane is fantastic / suddenly the dining room / where is the fish / Mickey and Jane : It's gone / where is it gone / Sue and Phil said where is the fish / Jane said: Come on Sue, is alright / Mickey sort of getting fish and chips / he's got the fish and chips / got four fish / Mickey and Jane and Sue and Phil have got the fish and chips / how do the cat / cattle eaten the fish

DOR

he's on the phone / the two blokes on the phone / he's writing down / he's in the kitchen and lady and man and a bloody fish / it's crazy / it's loads and loads of pots / in the washing up is a bloke / it's definitely a large fish / with salt and pepper and pots and plates / and small plates and large plates / it's a candle / it's a bottle / it's two candles / that's four candles / like a feast / dog / I'm not sure if it's a dog or a cat / maybe a dog / napkins and a gravy boat and a fish / it's a large fish / I don't like fish /

it's like a dining room / not a going out to dinner / very posh / it just maybe a dinner / it's two ladies and two men / it's a bunch of flowers here / it's definite to dinner / it's gone / any money like the dog's taken it / dog ate it / it's the cat / it's licking the lips / fish and chips / is very sad / two blokes and two ladies in fish and chips / now fish and chips

EW

the tea time party / it's phoning and writing the appointment / cooking fish / he's just washing up / cat under the table / is going to sit there and call / is dressing up and fitting the necklace on / this is shirt and tie / they've got some flowers / is shaking hands / she smiling / person has stolen the piece / fish and chips / is just running / that cat that's licking out paws / it finished the fish / that's looking all right / chatting

TH

somebody's having a party / one of them is calling the other man to say would you like to come to the party / this is normal / mummy has to be cooking / it's very unusual but the dad are be washing up / it's… fish she is cooking / it's where we actually sit down and eat…our food / they're getting the table ready / obviously they'll be having friends coming around to have dinner with them / the drinks and everything of course / lucky people / there's a little cat or dog running under it / there's pictures on the wall / everything is more or less what we all do when we're having our dinner / obviously they are going out / the lady is getting dressed / obviously the man is getting dressed as well….. in their bedroom / here come the friends / they are having somewhere out for their dinner / these it must be their two friends coming in / man and woman as always / she's holding flowers…. probably to give to the other lady that's cooking … as a present / something's gone wrong / I don't know what happened / there's no fish / why would I put fish up / I personally wouldn't do that / they go to the shop to get the fish and chips / they can take it home to the friends they've …invited…for dinner / now the four are just sitting there eating

APPENDIX IV

PICTURES USED FOR THE ELICITATION OF THE *CAT AND FISH STORY*
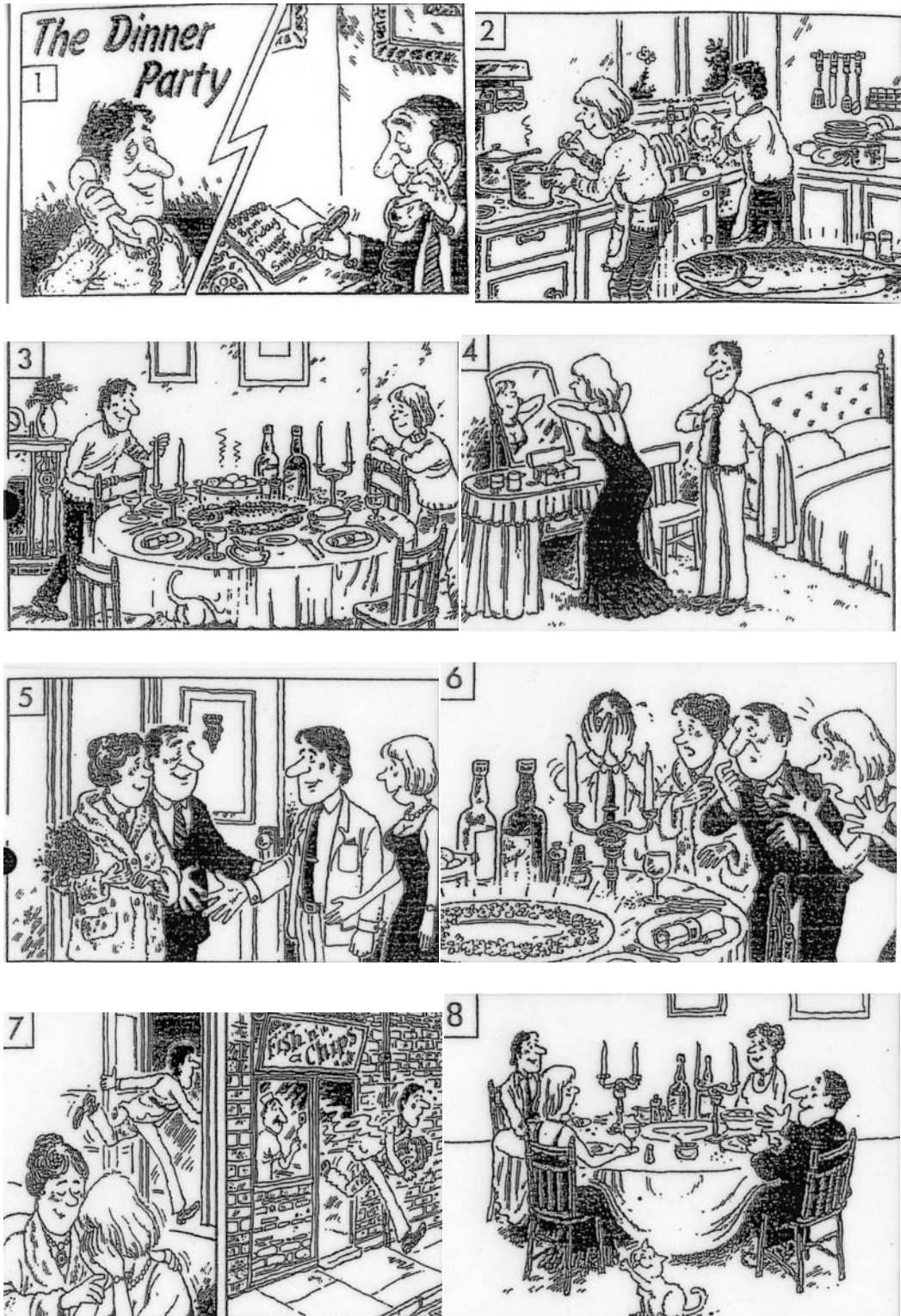
APPENDIX V

TABLES FOR SPONTANEOUS SPEECH ANALYSIS AND DESCRIPTION OF THE *CAT AND FISH STORY*

Table A: Breakdown of utterances of individual patients and control group for a sample of 300 words of spontaneous speech

	Statistics of utterances						
	no. of…			proportion of grammatical utterances		proportion of ungrammatical utterances	proportion of ungrammatical utterances that are grammatical out of context
	utterances	MLU	LGU	total	with embeddings	total	total
BG	49	6.2	15	.33	.13	.55	.12
DC	44	6.9	12	.25	.18	.66	.09
DOR	59	5.2	7	.20	0	.53	.27
EW	23	4.7	7	.22	0	.61	.17
TH	39	7.6	14	.80	.19	.21	0
NORMAL RANGE	26-42[a]	7.2-11.5[a]	15-38[a]	.95-1[b]	.02-.61[b]	0-.05[b]	0[b]

[a] The range of words produced by the controls.
[b] For proportions, the normal range was calculated as two standard deviations above and below the controls' mean.

Table B: Breakdown of utterances of individual patients and control group for the *Cat and Fish story* description

	Statistics of utterances						
	no. of…			**proportion of grammatical utterances**		**proportion of ungrammatical utterances**	**proportion of ungrammatical utterances that are grammatical out of context**
	utterances	MLU	LGU	total	with embeddings	total	total
BG	35	8.1	11	.26	.22	.74	0
DC	44	5.3	13	.34	0	.59	.07
DOR	37	5.3	12	.22	.13	.57	.22
EW	18	4.3	5	.22	0	.78	0
TH	30	7.9	15	.77	.22	.20	.03
NORMAL RANGE	**25-54**[a]	**7.4-11.4**[a]	**18-37**[a]	**.96-1**[b]	**0-.64**[b]	**0-.05**[b]	**0**[b]

[a] The range of words produced by the controls.
[b] For proportions, the normal range was calculated as two standard deviations above and below the controls' mean.

Table C: Count of narrative words *correctly* produced by individual patients and control group in a sample of 300 words of spontaneous speech (if possible)

Breakdown of narrative words correctly produced

| | number of… | proportion of… | | | | | | | | | | | | | | | |
| | words | verbs | | | | | nouns | | | | pronouns | | prepositions | | determiners | | other words |
	total	lexical verb tokens	lexical verb types	auxiliaries/modals tokens	auxiliaries/modals types	*is* (copula)	common noun tokens	common noun types	plural noun tokens	proper noun tokens	pronoun tokens	pronoun types	preposition tokens	preposition types	definite/indefinite articles tokens	definite/indefinite articles types	other words tokens
BG	303	.08	.64	.24	.63	.03	.17	.58	.11	.01	.20	.18	.08	.40	.08	.17	.21
DC	303	.07	.57	.46	.39	.06	.12	.53	.18	.12	.08	.16	.07	.33	.09	.19	.22
DOR	304	.05	.69	.24	.60	.04	.16	.77	.22	.04	.12	.11	.05	.86	.04	.15	.32
EW	107	.13	.79	.22	.75	.02	.23	.72	.32	0	.16	.24	.11	.58	.04	.75	.18
TH	298	.15	.67	.35	.46	.03	.11	.75	.30	.02	.20	.27	.12	.32	.04	.33	.22
NORMAL RANGE	**297-302 [a]**	**.08-.16 [b]**	**.39-.66 [b]**	**.19-.32 [b]**	**.47-.85 [b]**	**.002-.09 [b]**	**.13-.16 [b]**	**.55-.82 [b]**	**.09-.40 [b]**	**0-.08 [b]**	**.09-.19 [b]**	**.14-.29 [b]**	**.07-.17 [b]**	**.15-.48 [b]**	**.08-.12 [b]**	**.11-.20 [b]**	**.21-.29 [b]**

[a] The range of words produced by the controls.
[b] For proportions, the normal range was calculated as two standard deviations above and below the controls' mean.

Table D: Count of narrative words *correctly* produced by individual patients and control group in the *Cat and Fish* story

Breakdown of narrative words correctly produced

| | number of… | proportion of… | | | | | | | | | | | | | | | |
| | words | verbs | | | | | nouns | | | | pronouns | | prepositions | | determiners | | other words |
	total	lexical verb tokens	lexical verb types	auxiliaries/modals tokens	auxiliaries/modals types	is (copula)	common noun tokens	common noun types	plural noun tokens	proper noun tokens	pronoun tokens	pronoun types	preposition tokens	preposition types	definite/indefinite articles tokens	definite/indefinite articles types	other word tokens
BG	283	.10	.75	.22	.38	.03	.25	.67	.17	.01	.11	.38	.11	.36	.14	.05	.14
DC	232	.10	.67	.37	.43	.06	.20	.54	.24	.09	.07	.47	.06	.64	.12	.14	.19
DOR	196	.04	1	.33	.75	.07	.27	.48	.39	0	.08	.19	.05	.67	.11	.14	.26
EW	78	.22	1	41.	.33	0	.23	.78	.22	0	.05	1	.06	.80	.09	.29	.13
TH	237	.15	.56	.39	.44	.04	.15	.64	.22	0	.14	.38	.10	.46	.08	.26	.21
NORMAL RANGE	**220-590** [a]	**.11-.16** [b]	**.49-.93** [b]	**.31-.52** [b]	**.12-.46** [b]	**.007-.06** [b]	**.18-.21** [b]	**.56-.72** [b]	**.02-.30** [b]	**0-.03** [b]	**.06-.17** [b]	**.03-.70** [b]	**.10-.15** [b]	**.20-.45** [b]	**.08-.18** [b]	**.04-.14** [b]	**.11-.21** [b]

[a] The range of words produced by the controls.
[b] For proportions, the normal range was calculated as two standard deviations above and below the controls' mean.

Table E: Count of narrative words substituted, wrongly inserted, or omitted by individual patients and control group in a sample of 300 words of spontaneous speech

		Breakdown of words/inflectional markings that were substituted (S) / wrongly inserted (I) / or omitted (O)																
	number of…																	
	words	verbs						nouns				pronouns		prepositions			determiners	
	total	lexical verb	auxiliaries/modals	is (copula)	past tense inflection	progressive-marker	agreement marking	nouns	plural marking	singular marking	case marking	pronouns	case marking	prepositions	substitutions within word class	substitutions within the subcategory of preposition	determiners	plural marking
BG	303	S 2 I 0 O 3	S 3 I 0 O 2	S 1 I 0 O 4	S 9 I 0 O 2	S 1 I 0 O 1	S 0 I 0 O 0	S 1 I 0 O 1	S 0 I 0 O 4	S 0 I 0 O 0	S 0 I 0 O 3	S 0 I 3 O 4	S 0 I 0 O 0	S 1 I 2 O 8	1	0	S 1 I 1 O 11	S 0 I 0 O 0
DC	303	S3 I 0 O4	S 2 I 2 O 2	S 0 I 0 O 0	S 5 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 0	S 9 I 2 O 4	S 0 I 1 O 1	S 0 I 0 O 0	S 0 I 0 O 0	S 1 I 0 O 8	S 0 I 0 O 0	S 3 I 3 O 17	1	0	S 0 I 6 O 5	S 0 I 0 O 0
DOR	304	S 7 I 0 O 9	S 4 I 0 O 3	S 0 I 2 O 3	S 17 I 0 O 3	S 0 I 0 O 0	S 0 I 0 O 0	S 1 I 0 O 2	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 1	S 10 I 3 O 10	S 0 I 0 O 0	S 1 I 0 O 7	1	1	S 2 I 1 O 6	S 0 I 0 O 0
EW	107	S 0 I 0 O 3	S 0 I 0 O 1	S 0 I 0 O 2	S 4 I 0 O 1	S 0 I 0 O 1	S 0 I 0 O 0	S 1 I 0 O 1	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 0	S 2 I 0 O 7	S 0 I 0 O 0	S 0 I 0 O 4	-	-	S 0 I 2 O 4	S 0 I 0 O 0
TH	298	S 0 I 0 O 0	S 0 I 0 O 1	S 0 I 0 O 0	S 2 I 0 O 0	S 0 I 0 O 0	S 2 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 0	S 1 I 1 O 0	S 0 I 0 O 0	S 0 I 1 O 1	-	-	S 0 I 1 O 0	S 0 I 0 O 0
CONTROL GROUP	**297-302** [a]	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 1**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 1**	-	-	**S 0 I 0 O 0**	**S 0 I 0 O 0**

[a] The range of words produced by the controls.

Table F: Count of narrative words substituted, wrongly inserted, or omitted by individual patients and control group in the *Cat and Fish* story

Breakdown of words/inflectional markings that were substituted (S) / wrongly inserted (I) / or omitted (O)

number of…

	words	verbs						nouns				pronouns		prepositions			determiners	
	total	lexical verb	auxiliaries/ modals	is (copula)	past tense inflection	progressive-marker	agreement marking	nouns	plural marking	singular marking	case marking	pronouns	case marking	prepositions	substitutions within word class	substitutions within the subcategory of preposition	determiners	plural marking
BG	283	S 4 I 0 O 0	S 0 I 0 O 11	S 0 I 0 O 3	S 0 I 0 O 0	S 0 I 0 O 4	S 4 I 0 O 0	S 1 I 1 O 2	S 0 I 2 O 4	S 0 I 0 O 0	S 0 I 0 O 1	S 0 I 2 O 2	S 0 I 0 O 0	S 2 I 0 O 6	1	0	S 1 I 0 O 5	S 1 I 0 O 0
DC	232	S 2 I 0 O 11	S 1 I 0 O 9	S 0 I 0 O 3	S 1 I 0 O 0	S 0 I 0 O 1	S 2 I 0 O 0	S 2 I 0 O 3	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 1	S 2 I 1 O 10	S 0 I 0 O 0	S 0 I 0 O 2	-	-	S 2 I 0 O 4	S 0 I 0 O 0
DOR	196	S 2 I 0 O 5	S 0 I 0 O 1	S 0 I 0 O 8	S 0 I 0 O 0	S 0 I 0 O 0	S 3 I 0 O 0	S 1 I 0 O 2	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 0	S 7 I 0 O 12	S 0 I 0 O 0	S 2 I 2 O 0	1	1	S 1 I 2 O 5	S 0 I 0 O 0
EW	78	S 0 I 0 O 1	S 0 I 0 O 4	S 0 I 0 O 3	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 2	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 0	S 1 I 0 O 9	S 0 I 0 O 0	S 0 I 1 O 1	-	-	S 2 I 1 O 5	S 0 I 0 O 0
TH	237	S 1 I 0 O 0	S 0 I 1 O 0	S 0 I 0 O 1	S 1 I 0 O 0	S 0 I 0 O 0	S 1 I 0 O 0	S 0 I 0 O 1	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 2 O 1	S 0 I 0 O 0	S 0 I 0 O 0	-	-	S 0 I 1 O 2	S 0 I 0 O 0
CONTROL GROUP	**220-590** [a]	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 1 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 0 I 0 O 1**	**S 0 I 0 O 0**	**S 0 I 1 O 0**	**-**	**-**	**S 0 I 0 O 0**	**S 0 I 0 O 0**

[a] The range of words produced by the controls.

APPENDIX VI

TASKS' INSTRUCTIONS AND STIMULI LISTS

Sentence completion

Instructions for the patients for sentence completion

You will see sentences in which one short word is missing. Your task is to say this word. Here is an example.

Instructions for timed sentence completion (for the control participants)

You will see sentences in which one short word is missing. Your task is to say this word at the right place as fast as you can. Even if you are not sure say the first word that comes to your mind. Here is an example.

Stimuli
Practice
1. The book is **on** the table.
2. The doll is **under** the box.
3. The shoe is **behind** the ball.
4. The mountain is 500 meters **above** sea level.
5. She became depressive **after** the death of her husband.
6. Mike ate sweets and chips **at** the same time.
7. In the last election Tom voted **for** the government.
8. They have not seen each other **for** a while.
9. Robert's parents are working long hours and therefore he has to care **for** his little sister.
10. John brought home some souvenirs **from** Rome.
11. Suzanne ordered a large scoop **of** vanilla ice cream.
12. Leicester square is in the centre **of** the city.
13. Sue got the cake out of the oven and could not resist. She bit a piece **off**.
14. Everything had gone wrong but Rachel kept calm and sorted **out** the problem.

Target items

Spatial prepositions
1. The aero plane is flying **above** the cloud.   (locational)
2. The bird is flying **above** the nest.   (locational)
3. The butterfly is flying **above** the tree.   (locational)
4. The clock is **above** the wardrobe.   (locational)
5. The moon is **above** the cloud.   (locational)
6. The painting is **above** the table.   (locational)
7. By now Sam should have arrived **at** the station.   (locational)
8. Jane and Tom will marry soon. The couple met two years ago **at** (locational)
   university.
9. Jeremy is currently **at** work.   (locational)
10. John is a very active child. He cannot sit still **at** the table. (locational)
11. The accident occurred precisely **at** the corner.   (locational)
12. Sue and Kim have been friends since they met **at** school.   (locational)
13. The ball is **behind** the box.   (locational)
14. The doll is sitting **behind** the teddy.   (locational)
15. The girl is running **behind** her mother.   (locational)
16. The moon is **behind** the cloud.   (locational)
17. The motorcyclist is riding **behind** the car.   (locational)
18. The tree is growing **behind** the house.   (locational)

19. A lion escaped **from** the local zoo.	(directional)
20. Ed was shocked by what he saw so he ran **from** the scene of the crime.	(directional)
21. It is already dark when Tim returns **from** work.	(directional)
22. Julie went for a long holiday and sent a postcard **from** Spain.	(directional)
23. Sue's parents come **from** Africa.	(directional)
24. The vase is imported **from** China.	(directional)
25. The key is **in** the pocket.	(locational)
26. The slippers are **in** the wardrobe.	(locational)
27. The team played hockey **in** the hall.	(locational)
28. The hypnotist said: Look **into** my eyes!	(directional)
29. He drove the car **into** the garage.	(directional)
30. John jumped **into** the pond.	(directional)
31. Julie was leaning **on** her elbow.	(locational)
32. The cake is **on** the box.	(locational)
33. The flowers are growing **on** the tree.	(locational)
34. Accidentally Anna spilt some wine **on** the tablecloth.	(directional)
35. The new teacher wrote his name **on** the black board.	(directional)
36. The cat jumped **on** the lap.	(directional)
37. The government sent the immigrants back **to** their countries.	(directional)
38. Every morning Julian commutes **to** work.	(directional)
39. Matt took his friend **to** the match.	(directional)
40. Sue planned a visit **to** the theatre.	(directional)
41. The guide led the tourist **to** the modern art museum.	(directional)
42. The taxi took her from the hotel **to** the station.	(directional)
43. The slippers are **under** the wardrobe.	(locational)
44. The aero plane is flying **under** the cloud.	(locational)
45. The flower is **under** the cup.	(locational)
46. The fork is **under** the table.	(locational)
47. The moon is **under** the cloud.	(locational)
48. The TV is **under** the table.	(locational)

Temporal prepositions

1. Dan was late. He came about 20 minutes **after** the meeting had begun.	(open interval)
2. I cannot tell you while we are eating. You will hear about everything **after** dinner.	(open interval)
3. Ron was released from prison **after** serving three years.	(open interval)
4. She died two years **after** her divorce.	(open interval)
5. The play closed **after** just a few performances.	(open interval)
6. You did not know anything because it happened **after** you left.	(open interval)
7. Dennis took a plane **at** noon.	(closed interval)
8. Sue arrived **at** 5 o'clock.	(closed interval)
9. Sue will arrive home late **at** night.	(closed interval)
10. The headmaster is ill **at** the moment.	(closed interval)
11. They clean the streets **at** night.	(closed interval)
12. They finished the job precisely **at** the end of May.	(closed interval)
13. He left **before** anyone noticed it.	(open interval)
14. It is raining so come in **before** you get wet.	(open interval)
15. Monday comes two days **before** Wednesday.	(open interval)
16. Please clean up **before** you leave.	(open interval)
17. She did not get a chance to tell him because he left **before** she could explain what happened.	(open interval)
18. Teeth are formed in the gum long **before** birth.	(open interval)
19. After school was finished Alex went abroad **for** a year.	(closed interval)
20. Could you babysit my son **for** a couple of hours?	(closed interval)
21. Helen wished to be on holiday **for** the rest of her life.	(closed interval)
22. John worked as a teacher **for** 25 years.	(closed interval)
23. Mary was unable to find a job **for** many years.	(closed interval)
24. The weather had been bad **for** several days.	(closed interval)
25. Andrea is working **from** 9am until 3pm each day.	(open interval)
26. The doctor is on lunch break **from** 11 to 12pm.	(open interval)

27. The fair takes place **from** Tuesday to Friday.   (open interval)
28. The station is closed **from** 11pm onwards.   (open interval)
29. The winter lasted **from** October until April.   (open interval)
30. Tom queued for tickets **from** morning until evening.   (open interval)
31. Helen woke up early **in** the morning.   (closed interval)
32. It gets dark early **in** winter.   (closed interval)
33. Hugh went to Spain **in** the summer of 1997.   (closed interval)
34. The building was finished **in** 1999.   (closed interval)
35. Tom watches TV **in** the evenings.   (closed interval)
36. We live **in** the 21st century.   (closed interval)
37. Anna returns home **on** Friday.   (closed interval)
38. It was raining **on** each Monday this month.   (closed interval)
39. John left **on** Wednesday.   (closed interval)
40. Shelly was born **on** Sunday.   (closed interval)
41. The meeting took place **on** Tuesday.   (closed interval)
42. The TV show was repeated **on** Saturday night.   (closed interval)
43. Four years ago I joined the company but I have not had a pay rise **since**   (open interval)
    I took that job.
44. James has constantly been in pain **since** the accident.   (open interval)
45. Jane is worried about Kate because she has not been seen **since**   (open interval)
    Monday.   (open interval)
46. Julie has sold over 200 cars **since** she joined the company.   (open interval)
47. Sue had wanted to become a singer **since** her childhood.   (open interval)
48. Tom has not eaten **since** the morning.   (open interval)
49. Lunch will be available from 12 **to** 3pm.   (open interval)
50. The doctor is on his lunch break from 11 **to** 12pm.   (open interval)
51. The fair takes place from Tuesday **to** Friday.   (open interval)
52. The lecture will last from 1pm **to** 3pm.   (open interval)
53. The restaurant is open from 4pm **to** 12am.   (open interval)
54. The season for asparagus is from mid-April **to** mid-June.   (open interval)
55. He could not stop himself drinking so he drank **until** he fainted.   (open interval)
56. Henry will be very tired tomorrow because tonight he watched TV   (open interval)
    until late.
57. It is best to stay in bed **until** you feel better.   (open interval)
58. Keep your seat belt fastened **until** we get there.   (open interval)
59. They overslept because the night before they had been talking **until**   (open interval)
    dawn.
60. We will not stay **until** the end.   (open interval)

Prepositions assigning theta-roles other than spatial and temporal
1. After work John likes to go out for a drink **with** his friends.   (comitative)
2. Helen danced **with** every boy in the room.   (comitative)
3. James discussed his problems **with** his family.   (comitative)
4. Jane failed her exam. All her friends sympathized **with** her.   (comitative)
5. The children went in the garden to play **with** the dog.   (comitative)
6. We drank wine **with** our meal.   (comitative)
7. Erin babysat **with** great pleasure.   (manner/degree)
8. John loves Mary **with** all his heart.   (manner/degree)
9. She opened the box **with** great care.   (manner/degree)
10. He covered the floor **with** sand.   (substance)
11. She filled the glass **with** wine.   (substance)
12. She sprayed the wall **with** paint.   (substance)
13. Anna could not find any cutlery so she ate the salad **with** her fingers.   (instrument)
14. Hannah can write perfectly **with** both her hands.   (instrument)
15. Janet cleaned the windows **with** a cloth.   (instrument)
16. Jeremy mended the torn bank note **with** adhesive tape.   (instrument)
17. John broke the ice on the surface of the lake **with** a hammer.   (instrument)
18. Sue opened the tin **with** a can opener.   (instrument)
19. Sam bought flowers **for** Sue.   (benefactor)
20. Jamie organised a party **for** her little brother.   (benefactor)

21. Jane could not think of a better present than a necklace **for** her friend   (benefactor)
Sue.
22. Sue knitted a sweater **for** the baby.   (benefactor)
23. Suzanne prepared the bottle **for** the baby.   (benefactor)
24. The indicator board read: This train is **for** Nottingham.   (goal, idiomatic)
25. Adam stole 10 pounds **from** the old man.   (animate source)
26. Ellen has received a phone call **from** her daughter.   (animate source)
27. Erin got the recipe **from** Sue.   (animate source)
28. Jeremy received a letter **from** his uncle.   (animate source)
29. Robin Hood gave to the poor and took **from** the rich.   (animate source)
30. Sue did not buy the painting in a gallery but **from** the artist himself.   (animate source)
31. Erin sold the ring **to** her friend.   (recipient)
32. He gave the money **to** the cook.   (recipient)
33. Jeremy showed the map **to** his mother.   (recipient)
34. Max behaved unkindly **to** him.   (recipient)
35. Sue demonstrated the rules of the game **to** her friends.   (recipient)
36. Tom sent the letter **to** his father.   (recipient)
37. This book is **by** Jane Austen.   (animate source)
38. Her letter got lost **by** mistake.   (manner)
39. Jane met Sue **by** accident.   (manner)
40. John unscrewed the jar **by** hand.   (instrument)
41. Sam is English **by** birth.   (manner)
42. The prices went up **by** 25%.   (degree)
43. America was discovered **by** Columbus.   (agent)
44. Pasta was invented **by** the Italians.   (agent)
45. The book was written **by** Ian Fleming.   (agent)
46. The lawn was mown **by** the gardener.   (agent)
47. The whole cake was eaten up **by** the children.   (agent)
48. Today the letters were delivered **by** the new postman.   (agent)

Subcategorized prepositions
1. At the museum the pupils marveled **at** the Egyptian mummies.
2. James scoffed **at** Bill's ugly tie.
3. Jane is very modest but it is true that she excels **at** chess.
4. John frowned **at** the idea to walk across a cemetery at night.
5. The couple did not plan to have a baby but they rejoiced **at** the news.
6. The rodent gnawed **at** the tree.
7. James is late but Helen will wait **for** him.
8. Julie has worked hard. Now she longs **for** a holiday.
9. Peter hopes **for** a pay rise.
10. Rita decided to apply **for** a new job.
11. Sean was arrested **for** robbery.
12. Tom asked **for** another pint.
13. Anna spilt some wine on the sofa but she tried to hide it **from** Bill.
14. Because Sue is pregnant Edward tries to refrain **from** smoking.
15. The two copies of the picture differed **from** each other.
16. Erin was disqualified **from** the competition.
17. John saved Helen **from** drowning.
18. Kim suffers **from** asthma.
19. Every now and again Gemma indulges **in** chocolate.
20. John was disappointed by communism but he still believes **in** social values.
21. John went to medical school and specialized **in** cardiology.
22. Ron does not like literature or the arts but he is very interested **in** sports.
23. The judge knew that it was John who was involved **in** the robbery.
24. Tony invested a lot of money **in** his house.
25. Gemma is very forgetful. She has to be reminded **of** everything.
26. Ralph's wife left. Now Ralph wonders what will become **of** him.
27. Sandra disposed **of** her old car.
28. The building consists **of** four floors.
29. The judge was convinced **of** the defendant's innocence.

30. The warning at the entrance read: Beware **of** wild wolves in this wood.
31. Jim finds it hard to concentrate **on** his work.
32. John closed the door of his office in order to focus **on** his work.
33. John could not decide whether to buy a red or a green car. In the end he decided **on** the red car.
34. Sue knows she can always rely **on** her friends.
35. Tom and Bill know that they can always count **on** each other.
36. Tom and Mary went out to a restaurant. When the bill arrived Tom insisted **on** paying.
37. Chelsea lost **to** Arsenal.
38. Erin enjoys listening **to** the pianist playing Beethoven's sonatas.
39. Hannah and John are very good hosts. They always see **to** their guests devotedly.
40. John made a mistake but apologized **to** everybody.
41. Sheila devotes herself **to** her children.
42. The saleswoman reduced the price **to** a minimum.
43. Despite winning the lottery John did not dispense **with** his old job.
44. Helen was not satisfied **with** what she had achieved.
45. In Shakespeare's famous play the Montagues feuded **with** the Capulets.
46. The company supplies the office **with** stationery.
47. The garden was swarming **with** bees.
48. The judge charged Bill **with** murder.

Particles

1. Before listening to the evidence the judge swore **in** the witness.	(non-resultative)
2. Before listening to the evidence the judge swore the witness **in**.	(non-resultative)
3. Sandra filled **in** the form.	(non-resultative)
4. Sandra filled the form **in**.	(non-resultative)
5. Sarah received a cheque and she went straight to the bank and paid **in** the cheque.	(non-resultative)
6. Sarah received a cheque and she went straight to the bank and paid the cheque **in**.	(non-resultative)
7. Darren was shoplifting. His wife decided to turn her husband **in**.	(resultative)
8. Darren was shoplifting. His wife decided to turn **in** her husband.	(resultative)
9. John found a purse on the underground. He went to the police station and handed **in** the purse.	(resultative)
10. John found a purse on the underground. He went to the police station and handed the purse **in**.	(resultative)
11. Sarah's parents told her never to let any stranger **in**.	(resultative)
12. Sarah's parents told her never to let **in** any stranger.	(resultative)
13. Despite the storm warnings John carried his journey **on**.	(non-resultative)
14. Despite the storm warnings John carried **on** his journey.	(non-resultative)
15. John finished the old project and immediately took a new one **on**.	(non-resultative)
16. John finished the old project and immediately took **on** a new one.	(non-resultative)
17. One generation passes **on** their traditions to another.	(non-resultative)
18. One generation passes their traditions **on** to another.	(non-resultative)
19. Every time John starts a new painting he firstly dabs **on** some colour.	(resultative)
20. Every time John starts a new painting he firstly dabs some colour **on**.	(resultative)
21. It was raining heavily so Sheila put her Wellingtons **on**.	(resultative)
22. It was raining heavily so Sheila put **on** her Wellingtons.	(resultative)
23. When John comes home after work he firstly turns **on** the radio.	(resultative)
24. When John comes home after work he firstly turns the radio **on**.	(resultative)

Syntactic prepositions

1. Allan drew the best pictures for the advertisement **of** the new product.	(derived)
2. She liked the translation **of** the book.	(derived)
3. Term will end at the beginning **of** summer.	(derived)
4. Allan mourned the loss **of** his brother.	(derived)
5. Angie watched the opening **of** the Olympics.	(derived)
6. The author is preparing the third edition **of** his book.	(derived)
7. The newspapers reported the assassination **of** the politician.	(derived)

8. Hannah failed the exams due to lack **of** knowledge.   (derived)
9. Thomas read about the invasion **of** Troy.   (derived)
10. Helen was responsible for the preparation **of** the party.   (derived)
11. James likes the taste **of** Australian wines.   (derived)
12. Tom disagreed with the choice **of** music for the party.   (derived)
13. Darren was impressed by the beauty **of** the landscape.   (not derived)
14. John untied the laces **of** his shoes.   (not derived)
15. Gemma was annoyed about the tone **of** his voice.   (not derived)
16. Jonathan signed the letter **of** condolence.   (not derived)
17. Jennifer drank a glass **of** juice.   (not derived)
18. Sue felt sick in the middle **of** the lecture.   (not derived)
19. The politician got the majority **of** votes.   (not derived)
20. Jeremy took the biggest piece **of** the roast.   (not derived)
21. John bought a kilogram **of** flour.   (not derived)
22. The surface **of** the lake was frozen.   (not derived)
23. Thomas finished reading the last chapter **of** his book.   (not derived)
24. John took some pictures **of** his family in Paris.   (not derived)

Infinitival
1. Anna took a pill **to** get rid of her headache.   (in order to, purpose)
2. Henry drinks **to** forget about his problems.   (in order to, purpose)
3. Babies scream **to** get attention.   (in order to, purpose)
4. Jeremy went **to** the church to pray.   (in order to, purpose)
5. Jim broke the lock **to** gain access to the house.   (in order to, purpose)
6. Bill went on a diet **to** lose some weight.   (in order to, purpose)
7. Bill went to the bank **to** get some money.   (in order to, purpose)
8. John took on another degree **to** increase his chances of a good job.   (in order to, purpose)
9. Helen travels **to** increase her knowledge of the world.   (in order to, purpose)
10. John went to Paris **to** improve his French.   (in order to, purpose)
11. Helen went to the museum **to** see some old paintings.   (in order to, purpose)
12. Sue went to the library **to** work on her essay.   (in order to, purpose)
13. Jeremy does not know how **to** use a computer.   (bare)
14. Allan expected Darren **to** win the race.   (bare)
15. John had **to** make a tough decision.   (bare)
16. Bill likes **to** play football.   (bare)
17. John intended **to** quit smoking.   (bare)
18. Helen just wanted **to** leave the room.   (bare)
19. James prefers **to** travel by plane.   (bare)
20. Ron refuses **to** leave the house.   (bare)
21. Suzanne hoped **to** win the lottery.   (bare)
22. Jane learned quickly how **to** drive a car.   (bare)
23. Jane loves **to** dance.   (bare)
24. Tom intends **to** marry soon.   (bare)

Description of spatial situations

Instructions for free description of spatial situations

You will see a picture and your task is to describe the picture accurately. Please always start your sentence with the coloured object. Here is an example.

Prompted description of spatial situations

You will see a picture and hear the beginning of a sentence. Your task is to complete the sentence. Here is an example.
Stimuli

Practice
1. The book is **on** the table.
2. The doll is **under** the box.
3. The flower is **on** the cup.
4. The flower is **under** the cup.
5. The flowers are growing **behind** the doll.
6. The moon is **under** the cloud.
7. The painting is **under** the table.
8. The shoe is **behind** the ball.
9. The slippers are **in** the wardrobe.

Target items
1. The butterfly is flying **above** the tree. (locational)
2. The painting is **above** the wardrobe. (locational)
3. The painting is **above** the table. (locational)
4. The moon is **above** the cloud. (locational)
5. The clock is **above** the table. (locational)
6. The aero plane is flying **above** the cloud. (locational)
7. The butterfly is flying **around** the tree. (locational)
8. The car is moving **around** the house. (locational)
9. The flowers are growing **around** the tree. (locational)
10. The flowers are growing **around** the doll. (locational)
11. The girl is running **around** the pond. (locational)
12. The motorcyclist is riding **around** the car. (locational)
13. The ball is **behind** the box. (locational)
14. The doll is sitting **behind** the teddy. (locational)
15. The girl is running **behind** her mother. (locational)
16. The moon is **behind** the cloud. (locational)
17. The motorcyclist is going **behind** the car. (locational)
18. The tree is **behind** the house. (locational)
19. The chair is **beside** the table. (locational)
20. The doll is sitting **beside** the teddy. (locational)
21. The doll is sitting **beside** the wardrobe. (locational)
22. The motorcyclist is riding **beside** the car. (locational)
23. The standing lamp is **beside** the table. (locational)
24. The tree is growing **beside** the house. (locational)
25. The ball is **between** the table and the box. (locational)
26. The shoe is **between** the table and the chair. (locational)
27. The doll is sitting **between** the teddy and the box. (locational)
28. The moon is **between** the clouds. (locational)
29. The slippers are **between** the wardrobes. (locational)
30. The TV is **between** the table and the chair. (locational)
31. The doll is **in** the box. (locational)
32. The aero plane is **in** the cloud. (locational)
33. The ball is **in** the box. (locational)
34. The bucket is **in** the box. (locational)
35. The painting is **in** the wardrobe. (locational)
36. The tree is **in** the house. (locational)
37. The doll is sitting **on** the teddy. (locational)
38. The doll is sitting **on** the box. (locational)
39. The flowers are growing **on** the doll. (locational)
40. The flowers are growing **on** the tree. (locational)
41. The motorcycle is **on** the car. (locational)
42. The painting is **on** the table. (locational)
43. The ball is **under** the chair. (locational)
44. The bucket is **under** the box. (locational)
45. The shoe is **under** the table. (locational)
46. The motorcycle is **under** the car. (locational)
47. The slippers are **under** the wardrobe. (directional)
48. The TV is **under** the table. (directional)

49. The car is moving **to(wards)** the house.   (directional)
50. The girl is running **to(wards)** her mother.   (directional)
51. The girl is running **to(wards)** the boy.   (directional)
52. The girl is running **to(wards)** the house.   (directional)
53. The motorcycle is moving **to(wards)** the house.   (directional)
54. The motorcycle is moving **to(wards)** the pond.

Word/sentence comprehension

Instructions

You will see four pictures and hear one sentence/word. Point to the picture that describes best the sentence/word. Here is an example.

Practice	*distracter pictures*
1. The fork is **behind** box.	in/beside/between
2. The flowers are growing **on** doll.	around/behind/in front of
3. The girl is running **behind** car.	around/above/in front of
4. The aero plane is flying **in** the cloud.	under/beside/above
5. The fork is **beside** box.	in/behind/between
6. The slippers are **beside** wardrobe.	in/under/on
7. The girl is running **around** house.	to/away from/in front of
8. The bucket is **beside** the box.	in/under/in front of
9. The bird is flying **around** the tree.	above/beside/under

Target items	*distracter pictures*	
1. The moon is **above** the cloud.	behind/beside/under	(locational)
2. The aero plane is flying **above** the cloud.	in/beside/under	(locational)
3. The butterfly is flying **above** the tree.	beside/around/under	(locational)
4. The bird is flying **above** the tree.	around/beside/under	(locational)
5. The girl is walking **over** the car.	around/behind/in front of	(locational)
6. The painting is **above** the table.	on/beside/under	(locational)
7. The motorcyclist is riding **around** the car.	behind/beside/towards	(locational)
8. The butterfly is flying **around** the tree.	above/beside/under	(locational)
9. The girl is running **around** the car.	in front of/behind/over	(locational)
10. The flowers are growing **around** the tree.	under/on/in front of	(locational)
11. The flowers are growing **around** the doll.	behind/in front of/on	(locational)
12. The car is moving **around** the house.	in front of/towards/away from	(locational)
13. The tree is growing **behind** the house.	in/beside/in front of	(locational)
14. The doll is sitting **behind** the teddy.	in front of/on/beside	(locational)
15. The girl is running **behind** the mother.	towards/with/in front of	(locational)
16. The moon is **behind** the cloud.	beside/under/above	(locational)
17. The girl is running **behind** her brother.	with/away from/towards	(locational)
18. The motorcyclist is riding **behind** the car.	around/beside/towards	(locational)
19. The moon is **beside** the cloud.	behind/above/under	(locational)
20. The tree is growing **beside** the house.	behind/in front of/in	(locational)
21. The motorcyclist is riding **beside** the car.	behind/around/towards	(locational)
22. The doll is sitting **beside** the teddy.	on/behind/in front of	(locational)
23. The cake is **beside** the table.	on/between/under	(locational)
24. The painting is **beside** the wardrobe.	in/under/on	(locational)
25. The girl is running **between** her mother and her brother.	towards/in front of/away from	(locational)
26. The fork is **between** the boxes.	in/beside one box/beside two boxes	(locational)
27. The painting is **between** the wardrobes.	beside/on/under	(locational)
28. The cake is **between** the tables.	on/beside/under	(locational)
29. The slippers are **between** the wardrobes.	in/beside/under	(locational)
30. The doll is sitting **between** the teddy and	on/behind/beside	(locational)

the box.

31. The painting is **in** the wardrobe.	beside/on/under	(locational)
32. The fork is **in** the box.	beside one box/	(locational)
	beside two boxes/between	
33. The bucket is **in** the box.	beside/under/in front of	(locational)
34. The doll is **in** the box.	on/in front of/under	(locational)
35. The tree is growing **in** the house.	in front of/behind/beside	(locational)
36. The slippers are **in** the wardrobe.	beside/on/under	(locational)
37. The cake is **on** the table.	under/in front of/beside	(locational)
38. The doll is **on** the box.	in/in front of/under	(locational)
39. The painting is **on** the table.	above/under/beside	(locational)
40. The flowers are growing **on** the tree.	under/around/in front of	(locational)
41. The slippers are **on** the wardrobe.	in/beside/under	(locational)
42. The painting is **on** the wardrobe.	in/under/beside	(locational)
43. The girl is running **to** the house.	away from/around/in front of	(directional)
44. The car is moving **towards** the house.	around/in front of/away from	(directional)
45. The girl is running **to** her mother.	in front of/with/behind	(directional)
46. The motorcyclist is riding **to** the car.	around/behind/beside	(directional)
47. The motorcyclist is riding **to** the tree.	behind/in front of/around	(directional)
48. The girl is running **to** the boy.	behind/away from/with	(directional)
49. The painting is **under** the wardrobe.	in/on/beside	(locational)
50. The aero plane is flying **under** the cloud.	beside/in/above	(locational)
51. The painting is **under** the table.	above/beside/on	(locational)
52. The doll is **under** the box.	in/in front of/on	(locational)
53. The moon is **under** the cloud.	behind/beside/above	(locational)
54. The slippers are **under** the wardrobe.	in/on/beside	(locational)

Sentence-Picture-Verification

Instruction

You will see a picture and a sentence written down below. If you think the sentence and the picture match, press the YES button, if they do not match, press NO. Here is an example.

Practice picture	*sentence*
1. The shoe is **behind** the ball.	The shoe is **behind** the ball.
2. The shoe is **behind** the ball.	The clock is **behind** the ball.
3. The chair is **beside** the table.	The chair is **on** the table.
4. The chair is **beside** the table.	The box is **beside** the table.
5. The doll is sitting **beside** the teddy.	The doll is sitting **beside** the teddy.
6. The doll is sitting **beside** the teddy.	The ball is sitting **beside** the teddy.
7. The doll is sitting **beside** the wardrobe.	The doll is sitting **behind** the wardrobe.
8. The doll is sitting **beside** the wardrobe.	The shoe is sitting **beside** the wardrobe.
9. The book is **on** the table.	The book is **on** the table.
10. The book is **on** the table.	The cake is **on** the table.
11. The slippers are **on** the wardrobe.	The slippers are **under** the wardrobe.
12. The car is moving **towards** the house.	The car is moving **towards** the house.
13. The car is moving **towards** the house.	The bike is moving **towards** the house.
14. The girl is running **to** the house.	The girl is running **to** the house.
15. The girl is running **to** the house.	The dog is running **to** the house.
16. The motorcycle is moving **towards** the house.	The car is moving **towards** the house.
17. The motorcycle is moving **towards** the house.	The motorcycle is moving **around** the house.
18. The doll is **under** the box.	The doll is **on** the box.
19. The doll is **under** the box.	The bucket is **under** the box.

Target items

picture	*sentence*	*feature*
1. The aeroplane is **above** the cloud.	The aeroplane is flying **above** the cloud.	(locational)
The aeroplane is **above** the cloud.	The aeroplane is flying **in** the cloud	(locational)
The aeroplane is **above** the cloud.	The butterfly is flying **above** the cloud.	(locational)
2. The butterfly is flying **above** the tree.	The butterfly is flying **above** the tree.	(locational)
The butterfly is flying **above** the tree.	The butterfly is flying **around** the tree.	(locational)
The butterfly is flying **above** the tree.	The clock is flying **above** the tree.	(locational)
3. The clock is **above** the wardrobe.	The clock is **above** the wardrobe.	(locational)
The clock is **above** the wardrobe.	The clock is **in** the wardrobe.	(locational)
The clock is **above** the wardrobe.	The painting is **above** the wardrobe.	(locational)
4. The girl is running **over** the car.	The girl is running **over** the car.	(locational)
The girl is running **over** the car.	The girl is running **around** the car.	(locational)
The girl is running **over** the car.	The dog is running **over** the car.	(locational)
5. The painting is **above** the table.	The painting is **above** the table.	(locational)
The painting is **above** the table.	The painting is **on** the table.	(locational)
The painting is **above** the table.	The flower is **above** the table.	(locational)
6. The painting is **above** the wardrobe.	The painting is **above** the wardrobe.	(locational)
The painting is **above** the wardrobe.	The painting is **in** the wardrobe.	(locational)
The painting is **above** the wardrobe.	The clock is **above** the wardrobe.	(locational)
7. The butterfly is flying **around** the tree.	The butterfly is flying **around** the tree.	(locational)
The butterfly is flying **around** the tree.	The butterfly is flying **above** the tree.	(locational)
The butterfly is flying **around** the tree.	The aeroplane is flying **around** the tree.	(locational)
8. The flowers are growing **around** the doll.	The flowers are growing **around** the doll.	(locational)
The flowers are growing **around** the doll.	The flowers are growing **on** the doll.	(locational)
The flowers are growing **around** the doll.	The trees are growing **around** the doll.	(locational)
9. The flowers are growing **around** the tree.	The flowers are growing **around** the tree.	(locational)
The flowers are growing **around** the tree.	The flowers are growing **on** the tree.	(locational)
The flowers are growing **around** the tree.	The girls are growing **around** the tree.	(locational)
10. The girl is running **around** her mother.	The girl is running **around** her mother.	(locational)
The girl is running **around** her mother.	The girl is running **behind** her mother.	(locational)
The girl is running **around** her mother.	The kitten is running **around** her mother.	(locational)
11. The girl is running **around** the car.	The girl is running **around** the car.	(locational)
The girl is running **around** the car.	The girl is running **over** the car.	(locational)
The girl is running **around** the car.	The dog is running **around** the car.	(locational)
12. The motorcycle is moving **around** the car.	The motorcycle is moving **around** the car.	(locational)
The motorcycle is moving **around** the car.	The motorcycle is **under** the car.	(locational)
The motorcycle is moving **around** the car.	The girl is moving **around** the car.	(locational)
13. The ball is **behind** the box.	The ball is **behind** the box.	(locational)
The ball is **behind** the box.	The ball is **in** the box.	(locational)
The ball is **behind** the box.	The shoe is **behind** the box.	(locational)
14. The doll is sitting **behind** the teddy.	The doll is sitting **behind** the teddy.	(locational)
The doll is sitting **behind** the teddy.	The doll is sitting **on** the teddy.	(locational)
The doll is sitting **behind** the teddy.	The ball is sitting **behind** the teddy.	(locational)
15. The girl is running **behind** her mother.	The girl is running **behind** her mother.	(locational)
The girl is running **behind** her mother.	The girl is running **around** her mother.	(locational)
The girl is running **behind** her mother.	The dog is running **behind** the mother.	(locational)
16. The moon is **behind** the cloud.	The moon is **behind** the cloud. .	(locational)
The moon is **behind** the clouds.	The moon is **between** the clouds. .	(locational)
The moon is **behind** the cloud.	The aeroplane is **behind** the cloud. .	(locational)
17. The motorcycle is riding **behind** the car.	The motorcycle is riding behind the car.	(locational)
The motorcycle is riding **behind** the car.	The motorcycle is riding **on** the car.	(locational)
The motorcycle is riding **behind** the car.	The girl is **behind** the car.	(locational)
18. The tree is growing **behind** the house.	The tree is growing **behind** the house.	(locational)
The tree is growing **behind** the house.	The tree is growing **in** the house.	(locational)
The tree is growing **behind** the house.	The girl is growing **behind** the hou	(locational)
19. The ball is **between** the table and the box.	The ball is **between** the table and the box.	(locational)
The ball is **between** the table and the box.	The ball is **under** the table.	(locational)
The ball is **between** the table and the box.	The doll is **between** the table and the box.	(locational)
20. The cake is **between** the table and the chair.	The cake is **between** the table and the chair.	
		(locational)

The cake is **between** the table and the chair.	The cake is **under** the table. (locational)
The cake is **between** the table and the chair.	The box is **between** the table and the chair. (locational)
21. The doll is sitting **between** the teddy and the box.	The doll is sitting **between** the teddy and the box. (locational)
The doll is sitting **between** the teddy and the box.	The doll is sitting **on** the teddy and the box. (locational)
The doll is sitting **between** the teddy and the box.	The shoe is sitting **between** the teddy and the box. (locational)
22. The moon is **between** the clouds.	The moon is **between** the clouds. (locational)
The moon is **between** the clouds.	The moon is **behind** the cloud. (locational)
The moon is **between** the clouds.	The aeroplane is **between** the clouds. (locational)
23. The slippers are **between** the wardrobes.	The slippers are **between** the wardrobes. (locational)
The slippers are **between** the wardrobes.	The slippers are **under** the wardrobes. (locational)
The slippers are **between** the wardrobes.	The flowers are **between** the wardrobes. (locational)
24. The TV is **between** the table and the chair.	The TV is **between** the table and the chair. (locational)
The TV is **between** the table and the chair.	The TV is **under** the table. (locational)
The TV is **between** the table and the chair.	The cake is **between** the table and the chair. (locational)
25. The aeroplane is **in** the cloud.	The aeroplane is **in** the cloud. (locational)
The aeroplane is **in** the cloud.	The aeroplane is **above** the cloud. (locational)
The aeroplane is **in** the cloud.	The moon is **in** the cloud. (locational)
26. The ball is **in** the box.	The ball is **in** the box. (locational)
The ball is **in** the box.	The ball is **behind** the box. (locational)
The ball is **in** the box.	The doll is **in** the box. (locational)
27. The bucket is **in** the box.	The bucket is **in** the box. (locational)
The bucket is **in** the box.	The bucket is **under** the box. (locational)
The bucket is **in** the box.	The cake is **in** the box. (locational)
28. The clock is **in** the wardrobe.	The clock is **in** the wardrobe. (locational)
The clock is **in** the wardrobe.	The clock is **above** the wardrobe. (locational)
The clock is **in** the wardrobe.	The shoe is **in** the wardrobe. (locational)
29. The painting is **in** the wardrobe.	The painting is **in** the wardrobe. (locational)
The painting is **in** the wardrobe.	The painting is **above** the wardrobe. (locational)
The painting is **in** the wardrobe.	The doll is **in** the wardrobe. (locational)
30. The tree is **in** the house.	The tree is **in** the house. (locational)
The tree is **in** the house.	The tree is **behind** the house. (locational)
The tree is **in** the house.	The bucket is **in** the house. (locational)
31. The doll is sitting **on** the teddy and the box.	The doll is sitting **on** the teddy and the box. (locational)
The doll is sitting **on** the teddy and the box.	The doll is sitting **between** the teddy and the box. (locational)
The doll is sitting **on** the teddy and the box.	The ball is sitting **on** the teddy and the box. (locational)
32. The doll is sitting **on** the teddy.	The doll is sitting **on** the teddy. (locational)
The doll is sitting **on** the teddy.	The doll is sitting **behind** the teddy. . (locational)
The doll is sitting **on** the teddy.	The box is sitting **on** the teddy. . (locational)
33. The flowers are growing **on** the doll.	The flowers are growing **on** the doll. . (locational)
The flowers are growing **on** the doll.	The flowers are growing **around** the doll.(locational)
The flowers are growing **on** the doll.	The trees are growing **on** the doll. (locational)
34. The flowers are growing **on** the tree.	The flowers are growing **on** the tree. (locational)
The flowers are growing **on** the tree.	The flowers are growing **around** the tree.(locational)
The flowers are growing **on** the tree.	The clocks are growing **on** the tree. (locational)
35. The motorcycle is **on** the car.	The motorcycle is **on** the car. (locational)
The motorcycle is **on** the car.	The motorcycle is **behind** the car. (locational)
The motorcycle is **on** the car.	The dog is **on** the car. (locational)
36. The painting is **on** the table.	The painting is **on** the table. (locational)
The painting is **on** the table.	The painting is **above** the table. (locational)
The painting is **on** the table.	

37. The ball is **under** the table.
    The ball is **under** the table.
    The ball is **under** the table.
38. The bucket is **under** the box.
    The bucket is **under** the box.
    The bucket is **under** the box.
39. The cake is **under** the table (chair present).
    The cake is **under** the table (chair present).
    The cake is **under** the table (chair present).
40. The motorcycle is **under** the car.
    The motorcycle is **under** the car.
    The motorcycle is **under** the car.
41. The slippers are **under** the wardrobes.
    The slippers are **under** the wardrobes.
    The slippers are **under** the wardrobes.
42. The TV is **under** the table.
    The TV is **under** the table.
    The TV is **under** the table.

The shoe is **on** the table.   (locational)
The ball is **under** the table.   (locational)
The ball is **between** the table and the box.(locational)
The TV is **under** the table.   (locational)
The bucket is **under** the box.   (locational)
The bucket is **in** the box.   (locational)
The doll is **under** the box.   (locational)
The cake is **under** the table.   (locational)

The cake is **between** the table and the chair.
                                                     (locational)
The ball is **under** the table.   (locational)

The motorcycle is **under** the car.   (locational)
The motorcycle is moving **around** the car. (locational)
The dog is **under** the car.   (locational)
The slippers are **under** the wardrobes.   (locational)
The slippers are **between** the wardrobes.(locational)
The cakes are **under** the wardrobes.   (locational)
The TV is **under** the table.   (locational)
The TV is **between** the table and the chair.(locational)
The shoe is **under** the table.   (locational

Acting out

Instruction

You see those four objects as they are arranged right now. I want you to re-arrange them exactly as I will tell you. Sometimes I will say a sentence and sometimes I will say just one word. Here is an example.

Practice
1. Where is the banana?
2. Where is the basket?
3. Where is the coin?
4. Where is a mug?
5. Where is the box?
6. Take the mugs.
7. Take the bananas.
8. Take the mug.
9. Take the banana.
10. Take the coin.
11. Take the coins.
12. Take the boxes.
13. The banana is in front of the basket.
14. The coin is in front of the box.
15. The card is in front of the mug.
16. IN FRONT OF
17. IN FRONT OF
18. IN FRONT OF

Target sentences   *features*
1. Put the card **into** the mug!   (directional)
2. Put the banana **into** the basket!   (directional)
3. Put the coin **into** the box!   (directional)
4. INTO   (directional)

5.	INTO	(directional)
6.	INTO	(directional)
7.	The coin is **in** the box.	(locational)
8.	The banana is **in** the basket.	(locational)
9.	The card is **in** the mug.	(locational)
10.	IN	(locational)
11.	IN	(locational)
12.	IN	(locational)
13.	Put the card **onto** the mug!	(directional)
14.	Put the banana **onto** the basket!	(directional)
15.	Put the coin **onto** the box!	(directional)
16.	ONTO	(directional)
17.	ONTO	(directional)
18.	ONTO	(directional)
19.	The coin is **on** the box.	(locational)
20.	The banana is **on** the basket.	(locational)
21.	The card is **on** the mug.	(locational)
22.	ON	(locational)
23.	ON	(locational)
24.	ON	(locational)
25.	Put the card **under** the mug!	(locational)
26.	Put the banana **under** the basket!	(locational)
27.	Put the coin **under** the box!	(locational)
28.	UNDER	(locational)
29.	UNDER	(locational)
30.	UNDER	(locational)
31.	Put the card **over** the mug!	(locational)
32.	Put the banana **over** the basket!	(locational)
33.	Put the coin **over** the box!	(locational)
34.	OVER	(locational)
35.	OVER	(locational)
36.	OVER	(locational)
37.	Put the card **beside** the mug!	(locational)
38.	Put the banana **beside** the basket!	(locational)
39.	Put the coin **beside** the box!	(locational)
40.	BESIDE	(locational)
41.	BESIDE	(locational)
42.	BESIDE	(locational)
43.	Put the card **behind** the mug!	(locational)
44.	Put the banana **behind** the basket!	(locational)
45.	Put the coin **behind** the box!	(locational)
46.	BEHIND	(locational)
47.	BEHIND	(locational)
48.	BEHIND	(locational)
49.	Put the card **around** the mug.	(locational)
50.	Put the bananas **around** the basket.	(locational)
51.	Move the coin **around** the box.	(locational)
52.	AROUND	(locational)
53.	AROUND	(locational)
54.	AROUND	(locational)
55.	The card is **between** the mugs.	(locational)
56.	The banana is **between** the baskets.	(locational)
57.	The coin is **between** the boxes.	(locational)
58.	BETWEEN	(locational)
59.	BETWEEN	(locational)
60.	BETWEEN	(locational)
61.	Take the card **from** the mug.	(directional)
62.	Take the banana **from** the basket.	(directional)
63.	Take the coin **from** the box.	(directional)
64.	FROM	(directional)

65. FROM   (directional)
66. FROM   (directional)

Grammaticality Judgment

Instructions for grammaticality judgment of single sentences

You will hear a sentence which is either a good or bad English sentence. Press YES if it's good and NO if it's bad. Here is an example.

Instructions for contrastive grammaticality judgment of sentences

You will hear two sentences and your task is to decide which one is a good English sentence. Here is an example.

Stimuli for single sentence and contrastive judgment

Practice

Grammatical sentence

1. America was discovered **by** Columbus.
2. Anna could not find any cutlery so she ate the salad **with** her fingers.
3. Despite winning the lottery John did not dispense **with** his old job.
4. He covered the floor **with** sand.
5. Her letter got lost **by** mistake.
6. Jane is worried about Kate because she has not been seen **since** Monday.
7. Please clean up **before** you leave.
8. Ron was released from prison **after** serving three years.
9. Sandra filled **in** the form.
10. The book was written **by** Ian Fleming.
11. The garden was swarming **with** bees.
12. The prices went up **by** 25%.
13. We will not stay **until** the end.
14. When John comes home after work he firstly turns **on** the radio.

Ungrammatical structure

America was discovered from Columbus.
Anna could not find any cutlery so she ate the salad by her fingers.
Despite winning the lottery John did not dispense on his old job.
He covered the floor of sand.
Her letter got lost in mistake.
Jane is worried about Kate because she has not been seen during Monday.
Please clean up since you leave.
Ron was released from prison at serving three years.

Sandra filled at the form.
The book was written of Ian Fleming.
The garden was swarming from bees.
The prices went up on 25%.
We will not stay since the end.
When John comes home after work he firstly turns in the radio.

Target stimuli (for features see sentence completion tasks)

Grammatical sentence

Ungrammatical structure

Spatial prepositions

1. By now Sam should have arrived **at** the station.
2. Jane and Tom will marry soon. The couple met two years ago **at** university.
3. Jeremy is currently **at** work.
4. John is a very active child. He cannot sit still **at** the table.
5. Sue and Kim have been friends since they met **at** school.
6. The accident occurred precisely **at** the corner.
7. A lion escaped **from** the local zoo.

By now Sam should have arrived of the station.
Jane and Tom will marry soon. The couple met two years ago on university.
Jeremy is currently to work.
John is a very active child. He cannot sit still for the table.
Sue and Kim have been friends since they met to school.
The accident occurred precisely to the corner.
A lion escaped on the local zoo.

8. Ed was shocked by what he saw so he ran **from** the scene of the crime.

    Ed was shocked by what he saw so he ran in the scene of the crime.

9. It is already dark when Tim returns **from** work.

    It is already dark when Tim returns of work.

10. Julie went for a long holiday and sent a postcard **from** Spain.

    Julie went for a long holiday and sent a postcard at Spain.

11. Sue's parents come **from** Africa.

    Sue's parents come at Africa.

12. The vase is imported **from** China.

    The vase is imported at China.

13. The team played hockey **in** the hall.

    The team played hockey to the hall.

14. John jumped **into** the pond.

    John jumped from the pond.

15. The hypnotist said: Look **into** my eyes!

    The hypnotist said: Look to my eyes!

16. Accidentally Anna spilt some wine **onto** the tablecloth.

    Accidentally Anna spilt some wine in the tablecloth.

17. The new teacher wrote his name **onto** the black board.

    The new teacher wrote his name to the black board.

18. Every morning Julian commutes **to** work.

    Every morning Julian commutes in work.

19. Matt took his friend **to** the match.

    Matt took his friend in the match.

20. Sue planned a visit **to** the theatre.

    Sue planned a visit of the theatre.

21. The government sent the immigrants back **to** their countries.

    The government sent the immigrants back on their countries.

22. The guide led the tourist **to** the modern art museum.

    The guide led the tourist of the modern art museum.

23. The taxi took her from the hotel **to** the station.

    The taxi took her from the hotel for the station.

Temporal prepositions

1. Dennis took a plane at noon.

    Dennis took a plane over noon.

2. Sue arrived at 5 o'clock.

    Sue arrived to 5 o'clock.

3. Sue will arrive home late at night.

    Sue will arrive home late of night.

4. The headmaster is ill at the moment.

    The headmaster is ill to the moment.

5. They clean the streets at night.

    They clean the streets of night.

6. They finished the job precisely at the end of May.

    They finished the job precisely to the end of May.

7. After school was finished Alex went abroad for a year.

    After school was finished Alex went abroad to a year.

8. Could you baby-sit my son for a couple of hours?

    Could you baby-sit my son at a couple of hours?

9. Helen wished to be on holiday for the rest of her life.

    Helen wished to be on holiday of the rest of her life.

10. John worked as a teacher for 25 years.

    John worked as a teacher on 25 years.

11. Mary was unable to find a job for many years.

    Mary was unable to find a job to many years.

12. The weather had been bad for several days.

    The weather had been bad to several days.

13. Andrea is working from 9 till 3pm each day.

    Andrea is working of 9 till 3 pm each day.

14. The doctor is on lunch break from 11 to 12pm.

    The doctor is on lunch break on 11 to 12pm.

15. The fair takes place from Tuesday to Friday.

    The fair takes place in Tuesday to Friday.

16. The station is closed from 11pm onwards.

    The station is closed on 11pm onwards.

17. The winter lasted from October till April.

    The winter lasted in October till April.

18. Tom queued for tickets from morning until evening.

    Tom queued for tickets on morning until evening.

19. Helen woke up early in the morning.

    Helen woke up early for the morning.

20. Hugh went to Spain in the summer of 1997.

    Hugh went to Spain of the summer of 1997.

21. It gets dark early in winter.

    It gets dark early from winter.

22. The building was finished in 1999.

    The building was finished at 1999.

23. Tom watches TV in the evening.

    Tom watches TV of the evenings.

24. We live in the 21st century.

    We live to the 21st century.

25. Anna returns home on Friday.

    Anna returns home to Friday.

26. It was raining on each Monday this month.

    It was raining of each Monday this month.

27. John left on Wednesday.

    John left for Wednesday.

28. Shelly was born on Sunday.
29. The meeting took place on Tuesday.
30. The TV show was repeated on Saturday night.
31. Lunch will be available from 12 to 3pm.
32. The doctor is on his lunch break from 11 to 12pm.
33. The fair takes place from Tuesday to Friday.
34. The lecture will last from 1pm to 3 pm.
35. The restaurant is open from 4pm to 12am.
36. The season for asparagus is from mid-April to mid-June.

Shelly was born to Sunday.
The meeting took place in Tuesday.
The TV show was repeated to Saturday night.

Lunch will be available from 12 from 3pm.
The doctor is on his lunch break from 11 of 12pm.

The fair takes place from Tuesday on Friday.
The lecture will last from 1pm at 3pm.
The restaurant is open from 4pm of 12am.
The season for asparagus is from mid-April in mid-June.

Prepositions assigning theta-roles other than spatial and temporal
1. Jamie organized a party **for** her little brother.
2. Jane could not think of a better present than a necklace **for** her friend Sue.
3. Sam bought flowers **for** Sue.
4. Sue knitted a sweater **for** the baby.
5. Suzanne prepared the bottle **for** the baby.
6. The indicator board read: this train is **for** Nottingham.
7. Adam stole ten pounds **from** the old man.
8. Ellen has received a phone call **from** her daughter.
9. Erin got the recipe **from** Sue.
10. Jeremy received a letter **from** his uncle.
11. Robin Hood gave to the poor and took **from** the rich.
12. Sue did not buy the painting in a gallery but **from** the artist himself.
13. Erin sold the ring **to** her friend.
14. He gave the money **to** the cook.
15. Jeremy showed the map **to** his mother.
16. Max behaved unkindly **to** him.
17. Sue demonstrated the rules of the game **to** her friends.
18. Tom sent the letter **to** his father.

Jamie organized a party to her little brother.
Jane could not think of a better present than a necklace of her friend Sue.
Sam bought flowers at Sue.
Sue knitted a sweater to the baby.
Suzanne prepared the bottle from the baby.
The indicator board read: this train is of Nottingham.
Adam stole ten pounds on the old man.
Ellen has received a phone call to her daughter.
Erin got the recipe on Sue.
Jeremy received a letter at his uncle.
Robin Hood gave to the poor and took by the rich.
Sue did not buy the painting in a gallery but to the artist himself.
Erin sold the ring on her friend.
He gave the money on the cook.
Jeremy showed the map at his mother.
Max behaved unkindly of him.
Sue demonstrated the rules of the game from her friends.
Tom sent the letter on his father.

Subcategorized prepositions
1. At the museum the pupils marvelled **at** the Egyptian mummies.
2. James scoffed **at** Bill's ugly tie.
3. Jane is very modest but it is true that she excels **at** chess.
4. John frowned **at** the idea to walk across a cemetery at night.
5. The couple did not plan to have a baby but they rejoiced **at** the news.
6. The rodent gnawed **at** the tree.
7. James is late but Helen will wait **for** him.
8. Julie has worked hard. Now she longs **for** a holiday.
9. Peter hopes **for** a pay rise.
10. Rita decided to apply **for** a new job.
11. Sean was arrested **for** robbery.
12. Tom asked **for** another pint.
13. Anna spilt some wine on the sofa but she tried to hide it **from** Bill.

At the museum the pupils marvelled for the Egyptian mummies.
James scoffed for Bill's ugly tie.
Jane is very modest but it is true that she excels of chess.
John frowned for the idea to walk across a cemetery at night.
The couple did not plan to have a baby but they rejoiced to the news.
The rodent gnawed for the tree.
James is late but Helen will wait at him.
Julie has worked hard. Now she longs from a holiday.
Peter hopes from a pay rise.
Rita decided to apply on a new job.
Sean was arrested from robbery
Tom asked to another pint.
Anna spilt some wine on the sofa but she tried to hide it of Bill.

14. Because Sue is pregnant Edward tries to refrain **from** smoking.
    Because Sue is pregnant Edward tries to refrain of smoking.
15. Erin was disqualified **from** the competition.
    Erin was disqualified to the completition.
16. John saved Helen **from** drowning.
    John saved Helen in drowning.
17. Kim suffers **from** asthma.
    Kim suffers of asthma.
18. The two copies of the picture differed **from** each other.
    The two copies of the picture differed in each other.
19. Every now and again Gemma indulges **in** chocolate.
    Every now and again Gemma indulges at chocolate.
20. John was disappointed by communism but he still believes **in** social values.
    John was disappointed by communism but he still believes to social values.
21. John went to medical school and specialized **in** cardiology.
    John went to medical school and specialized of cardiology.
22. Ron does not like literature or the arts but he is very interested **in** sports.
    Ron does not like literature or the arts but he is very interested to sports.
23. The judge knew that it was John who was involved **in** the robbery.
    The judge knew that it was John who was involved of the robbery.
24. Tony invested a lot of money **in** the house.
    Tony invested a lot of money to the house.
25. Gemma is very forgetful. She has to be reminded **of** everything.
    Gemma is very forgetful. She has to be reminded at everything.
26. Ralph's wife left. Now Ralph wonders what will become **of** him.
    Ralph's wife left. Now Ralph wonders what will become on him.
27. Sandra disposed **of** her old car.
    Sandra disposed on her old car.
28. The building consists **of** four floors.
    The building consists to four floors.
29. The judge was convinced **of** the defendant's innocence.
    The judge was convinced from the defendant's innocence.
30. The warning at the entrance read: Beware **of** wild wolves in this wood.
    The warning at the entrance read: Beware on wild wolves in this wood.
31. Jim finds it hard to concentrate **on** his work.
    Jim finds it hard to concentrate of his work.
32. John closed the door of his office in order to focus **on** his work.
    John closed the door of his office in order to focus to his work.
33. John could not decide whether to buy a red or a green car. In the end he decided **on** the red car.
    John could not decide whether to buy a red or a green car. In the end he decided to the red car.
34. Sue knows she can always rely **on** her friends.
    Sue knows she can always rely from her friends.
35. Tom and Bill know that they can always count **on** each other.
    Tom and Bill know that they can always count in each other.
36. Tom and Mary went out to a restaurant. When the bill arrived Tom insisted **on** paying.
    Tom and Mary went out to a restaurant. When the bill arrived Tom insisted of paying.
37. Chelsea lost **to** Arsenal.
    Chelsea lost from Arsenal.
38. Erin enjoys listening **to** the pianist playing Beethoven's sonatas.
    Erin enjoys listening at the pianist playing Beethoven's sonatas.
39. Hannah and John are very good hosts. They always see **to** their guests devotedly.
    Hannah and John are very good hosts. They always see from their guests devotedly.
40. John made a mistake but apologized **to** everybody.
    John made a mistake but apologized of everybody.
41. Sheila devotes herself **to** her children.
    Sheila devotes herself in her children.
42. The saleswoman reduced the price **to** a minimum.
    The saleswoman reduced the price of a minimum.

Particles

1. Darren was shoplifting. His wife decided to turn her husband **in**.
   Darren was shoplifting. His wife decided to turn her husband up.
2. John found a purse on the underground. He went to the police station and handed the purse **in**.
   John found a purse on the underground. He went to the Police station and handed the purse by.
3. Sarah's parents told her never to let any stranger **in**.
   Sarah's parents told her never to let any stranger at.

4. Before listening to the evidence the judge swore the witness **in**.
5. Sandra filled the form **in**.
6. Sarah received a cheque and she went straight to the bank and paid the cheque **in**.
7. Every time John starts a new painting he firstly dabs some colour **on**.
8. It was raining heavily so Sheila put her Wellingtons **on**.
9. When John comes home after work he firstly turns the radio **on**.
10. Despite the storm warnings John carried his journey **on**.
11. John finished the old project and immediately took a new one **on**.
12. One generation passes their traditions **on** to another.

Before listening to the evidence the judge swore the witness on.
Sandra filled the form at.
Sarah received a cheque and she went straight to the bank and paid the cheque on.
Every time John starts a new painting he firstly dabs some colour off.
It was raining heavily so Sheila put her Wellingtons up.
When John comes home after work he firstly turns the radio in.
Despite the storm warnings John carried his journey up.
John finished the old project and immediately took a new one out.
One generation passes their traditions up to another.

Syntactic preposition 'of'
1. Allan drew the best pictures for the advertisement **of** the new product.
2. Allan mourned the loss **of** his brother.
3. Angie watched the opening **of** the Olympics.
4. Hannah failed the exams due to lack **of** knowledge.
5. Helen was responsible for the preparation **of** the party.
6. James likes the taste **of** Australian wines.
7. She liked the translation **of** the book.
8. Term will end at the beginning **of** summer.
9. The author is preparing the third edition **of** his book.
10. The newspapers reported the assassination **of** the politician.
11. Thomas read about the invasion **of** Troy.
12. Tom disagreed with the choice **of** music for the party.
13. Darren was impressed by the beauty **of** the landscape.
14. Gemma was annoyed about the tone **of** his voice.
15. Jennifer drank a glass **of** juice.
16. Jeremy took the biggest piece **of** the roast.
17. John bought a kilogram **of** flour.
18. John took some pictures **of** his family in Paris.
19. John untied the laces **of** his shoes.
20. Jonathan signed the letter **of** condolence.
21. Sue felt sick in the middle **of** the lecture.
22. The politician got the majority **of** votes.
23. The surface **of** the lake was frozen.
24. Thomas finished reading the last chapter **of** the book.

Allan drew the best pictures for the advertisement from the new product.
Allan mourned the loss in his brother.
Angie watched the opening to the Olympics.
Hannah failed the exams due to lack for knowledge.
Helen was responsible for the preparation to the party.
James likes the taste on Australian wines.
She liked the translation by the book.
Term will end at the beginning to
The author is preparing the third edition at his book.
The newspapers reported the assassination on the politician
Thomas read about the invasion for Troy.
Tom disagreed with the choice from music for the party.
Darren was impressed by the beauty to the landscape.
Gemma was annoyed about the tone for his voice.
Jennifer drank a glass for juice.
Jeremy took the biggest piece up the roast.
John bought a kilogram on flour.
John took some pictures on his family in Paris.
John untied the laces at his shoes.
Jonathan signed the letter for condolence.
Sue felt sick in the middle to the lecture.
The politician got the majority at votes.
The surface to the lake was frozen.
Thomas finished reading the last chapter to the book.

Infinitival to
1. Anna took a pill **to** get rid of her headache.
2. Babies scream **to** get attention.
3. Bill went on a diet **to** lose some weight.
4. Bill went to the bank **to** get some money.
5. Helen travels **to** increase her knowledge of the world.

Anna took a pill of get rid of her headache.
Babies scream at get attention.
Bill went on a diet for lose some weight.
Bill went to the bank in get some money.
Helen travels in increase her knowledge of the world.

6. Helen went to the museum **to** see some old paintings.
    Helen went to the museum from see some old paintings.
7. Henry drinks **to** forget about his problem.
    Henry drinks at forget about his problems.
8. Jeremy went to the church **to** pray.
    Jeremy went to the church at pray.
9. Jim broke the lock **to** gain access to the house.
    Jim broke the lock from gain access to the house.
10. John took on another degree **to** increase his chances of a good job.
    John took on another degree for increase his chances of a good job.
11. John went to Paris **to** improve his French.
    John went to Paris from improve his French.
12. Sue went to the library **to** read some books.
    Sue went to the library from read some books.
13. Allan expected Darren **to** win the race.
    Allan expected Darren from win the race.
14. Bill likes **to** play football.
    Bill likes from play football.
15. Helen just wanted **to** leave the room.
    Helen just wanted from leave the room.
16. James prefers **to** travel by plane.
    James prefers at travel by plane.
17. Jane learned quickly how **to** drive a car.
    Jane learned quickly how in drive a car.
18. Jane loves **to** dance.
    Jane loves from dance.
19. Jeremy does not know how **to** use a computer.
    Jeremy does not know how on use a computer.
20. John had **to** make a though decision.
    John had of make a tough decision.
21. John intended **to** quit smoking.
    John intended in quit smoking.
22. Ron refuses **to** leave the house.
    Ron refuses in leave the house.
23. Suzanne hoped **to** win the lottery.
    Suzanne hoped for win the lottery.
24. Tom intends **to** marry soon.
    Tom intends on marry soon.

Instructions for forced choice grammaticality judgment

You will hear a sentence with a word missing. It is replaced by a beep. Your task is to choose a word that would complete the sentence from a choice of three. Here is an example.

Stimuli for forced choice grammaticality judgment

Practice

Sentences	*distracter words*	
1. America was discovered **by** Columbus.	from	of
2. Anna could not find any cutlery so she ate the salad **with** her fingers.	by	from
3. Despite winning the lottery John did not dispense **with** his old job.	on	from
4. He covered the floor **with** sand.	of	by
5. Her letter got lost **by** mistake.	on	in
6. Jane is worried about Kate because she has not been seen **since** Monday.	during	at
7. Please clean up **before** you leave.	until	after
8. Ron was released from prison **after** serving three years.	in	at
9. Sandra filled **in** the form.	at	up
10. The book was written **by** Ian Fleming.	from	of
11. The garden was swarming **with** bees.	from	of
12. The prices went up **by** 25%.	on	at
13. We will not stay **until** the end.	since	on
14. When John comes home after work he firstly turns **on** the radio.	out	in

Target stimuli		*distracter words*

sentences
Spatial prepositions

1.	By now Sam should have arrived **at** the station.	of	on
2.	Jane and Tom will marry soon. The couple met two years ago **at** university.	on	for
3.	Jeremy is currently **at** work.	to	on
4.	John is a very active child. He cannot sit still **at** the table.	for	in
5.	Sue and Kim have been friends since they met **at** school.	to	on
6.	The accident occurred precisely **at** the corner.	from	to
7.	A lion escaped **from** the local zoo.	on	of
8.	Ed was shocked by what he saw so he ran **from** the scene of the crime.	by	in
9.	It is already dark when Tim returns **from** work.	of	in
10.	Julie went for a long holiday and sent a postcard **from** Spain.	at	in
11.	Sue's parents come **from** Africa.	at	for
12.	The vase is imported **from** China.	at	for
13.	John jumped **into** the pond.	from	of
14.	The hypnotist said: Look **into** my eyes!	to	on
15.	The team played hockey **in** the hall.	to	of
16.	Accidentally Anna spilt some wine **on(to)** the tablecloth.	in	to
17.	The new teacher wrote his name **on(to)** the black board.	to	from
18.	Every morning Julian commutes **to** work.	in	of
19.	Matt took his friend **to** the match.	in	at
20.	Sue planned a visit **to** the theatre.	of	at
21.	The government sent the immigrants back **to** their countries.	for	on
22.	The guide led the tourist **to** the modern art museum.	of	at
23.	The taxi took her from the hotel **to** the station.	for	in

Temporal prepositions

1.	Dennis took a plane **at** noon.	over	from
2.	Sue arrived **at** 5 o'clock.	to	from
3.	Sue will arrive home late **at** night.	of	in
4.	The headmaster is ill **at** the moment.	to	for
5.	They clean the streets **at** night.	of	in
6.	They finished the job precisely **at** the end of May.	to	of
7.	After school was finished Alex went abroad **for** a year.	to	at
8.	Could you baby-sit my son **for** a couple of hours?	at	from
9.	Helen wished to be on holiday **for** the rest of her life.	of	in
10.	John worked as a teacher **for** 25 years.	at	on
11.	Mary was unable to find a job **for** many years.	to	of
12.	The weather had been bad **for** several days.	to	from
13.	Andrea is working **from** 9 till 3pm each day.	of	to
14.	The doctor is on lunch break **from** 11 to 12pm.	on	of
15.	The fair takes place **from** Tuesday to Friday.	at	in
16.	The station is closed **from** 11pm onwards.	on	of
17.	The winter lasted **from** October till April.	in	on
18.	Tom queued for tickets **from** morning until evening.	on	to
19.	Helen woke up early **in** the morning.	for	at
20.	Hugh went to Spain **in** the summer of 1997.	of	from
21.	It gets dark early **in** winter.	from	for
22.	The building was finished **in** 1999.	at	to
23.	Tom watches TV **in** the evenings.	of	to
24.	We live **in** the 21st century.	to	for
24.	Anna returns home **on** Friday.	to	in
25.	It was raining **on** each Monday this month.	up	from
26.	John left **on** Wednesday.	for	at
27.	Shelly was born **on** Sunday.	to	of
28.	The meeting took place **on** Tuesday.	in	to
29.	The TV show was repeated **on** Saturday night.	to	of

30. Lunch will be available from 12 **to** 3pm.	from	for
31. The doctor is on his lunch break from 11 **to** 12pm.	of	over
32. The fair takes place from Tuesday **to** Friday.	in	on
33. The lecture will last from 1pm **to** 3 pm.	at	on
34. The restaurant is open from 4pm **to** 12am.	of	in
35. The season for asparagus is from mid-April **to** mid-June.	in	from

Prepositions assigning theta-roles other than spatial and temporal

1. Jamie organised a party **for** her little brother.	to	at
2. Jane could not think of a better present than a necklace **for** her friend Sue.	of	at
3. Sam bought flowers **for** Sue.	at	to
4. Sue knitted a sweater **for** the baby.	to	of
5. Suzanne prepared the bottle **for** the baby.	from	to
6. The indicator board read: this train is **for** Nottingham.	of	on
7. Adam stole ten pounds **from** the old man.	on	to
8. Ellen has received a phone call **from** her daughter.	to	on
9. Erin got the recipe **from** Sue.	on	in
10. Jeremy received a letter **from** his uncle.	at	to
11. Robin Hood gave to the poor and took **from** the rich.	by	at
12. Sue did not buy the painting in a gallery but **from** the artist himself.	to	on
13. Erin sold the ring **to** her friend.	on	from
14. He gave the money **to** the cook.	on	at
15. Jeremy showed the map **to** his mother.	at	on
16. Max behaved unkindly **to** him.	of	for
17. Sue demonstrated the rules of the game **to** her friends.	from	at
18. Tom sent the letter **to** his father.	on	in

Subcategorized prepositions

1. At the museum the pupils marvelled **at** the Egyptian mummies.	for	to
2. James scoffed **at** Bill's ugly tie.	for	to
3. Jane is very modest but it is true that she excels **at** chess.	of	to
4. John frowned **at** the idea to walk across a cemetery at night.	for	to
5. The couple did not plan to have a baby but they rejoiced **at** the news.	to	from
6. The rodent gnawed **at** the tree.	for	to
7. James is late but Helen will wait **for** him.	at	to
8. Julie has worked hard. Now she longs **for** a holiday.	from	to
9. Peter hopes **for** a pay rise.	from	to
10. Rita decided to apply **for** a new job.	on	of
11. Sean was arrested **for** robbery.	from	to
12. Tom asked **for** another pint.	to	from
13. Anna spilt some wine on the sofa but she tried to hide it **from** Bill.	of	in
14. Because Sue is pregnant Edward tries to refrain **from** smoking.	of	to
15. Erin was disqualified **from** the competition.	for	to
16. John saved Helen **from** drowning.	in	to
17. Kim suffers **from** asthma.	of	to
18. The two copies of the picture differed **from** each other.	to	in
19. Every now and again Gemma indulges **in** chocolate.	at	of
20. John was disappointed by communism but he still believes **in** social values.	to	of
21. John went to medical school and specialized **in** cardiology.	of	to
22. Ron does not like literature or the arts but he is very interested **in** sports.	to	of
23. The judge knew that it was John who was involved **in** the robbery.	of	for
24. Tony invested a lot of money **in** the house.	to	of
25. Gemma is very forgetful. She has to be reminded **of** everything.	at	to
26. Ralph's wife left. Now Ralph wonders what will become **of** him.	on	to
27. Sandra disposed **of** her old car.	on	to
28. The building consists **of** four floors.	to	at
29. The judge was convinced **of** the defendant's innocence.	from	to

30. The warning at the entrance read: Beware **of** wild wolves in this wood.	on	to
31. Jim finds it hard to concentrate **on** his work.	of	from
32. John closed the door of his office in order to focus **on** his work.	to	for
33. John could not decide whether to buy a red or a green car. In the end he decided **on** the red car.	to	from
34. Sue knows she can always rely **on** her friends.	from	of
35. Tom and Bill know that they can always count **on** each other.	in	to
36. Tom and Mary went out to a restaurant. When the bill arrived Tom insisted **on** paying.	of	to
37. Chelsea lost **to** Arsenal.	from	in
38. Erin enjoys listening **to** the pianist playing Beethoven's sonatas.	at	of
39. Hannah and John are very good hosts. They always see **to** their guests devotedly.	from	of
40. John made a mistake but apologised **to** everybody.	of	on
41. Sheila devotes herself **to** her children.	in	of
42. The saleswoman reduced the price **to** a minimum.	of	from

Particles

1. Darren was shoplifting. His wife decided to turn her husband **in**.	up	by
2. John found a purse on the underground. He went to the Police station and handed the purse **in**.	by	up
3. Sarah's parents told her never to let any stranger **in**.	at	on
4. Before listening to the evidence the judge swore the witness **in**.	out	on
5. Sandra filled the form **in**.	at	up
6. Sarah received a cheque and she went straight to the bank and paid the cheque **in**.	on	up
7. Every time John starts a new painting he firstly dabs some colour **on**.	off	up
8. It was raining heavily so Sheila put her Wellingtons **on**.	up	of
9. When John comes home after work he firstly turns the radio **on**.	in	out
10. Despite the storm warnings John carried his journey **on**.	up	in
11. John finished the old project and immediately took a new one **on**.	out	in
12. One generation passes their traditions **on** to another.	up	in

Syntactic preposition 'of'

|		
36. Allan drew the best pictures for the advertisement **of** the new product.	from	at
37. Allan mourned the loss **of** his brother.	in	at
38. Angie watched the opening **of** the Olympics.	to	on
39. Hannah failed the exams due to lack **of** knowledge.	for	on
40. Helen was responsible for the preparation **of** the party.	to	by
41. James likes the taste **of** Australian wines.	on	from
42. She liked the translation **of** the book.	by	at
43. Term will end at the beginning **of** summer.	to	for
44. The author is preparing the third edition **of** his book.	at	in
45. The newspapers reported the assassination **of** the politician.	on	from
46. Thomas read about the invasion **of** Troy.	for	to
47. Tom disagreed with the choice **of** music for the party.	from	to
48. Darren was impressed by the beauty **of** the landscape.	to	on
49. Gemma was annoyed about the tone **of** his voice.	for	from
50. Jennifer drank a glass **of** juice.	for	to
51. Jeremy took the biggest piece **of** the roast.	up	on
52. John bought a kilogram **of** flour.	on	at
53. John took some pictures **of** his family in Paris.	on	at
54. John untied the laces **of** his shoes.	to	at
55. Jonathan signed the letter **of** condolence.	for	to
56. Sue felt sick in the middle **of** the lecture.	to	from
57. The politician got the majority **of** votes.	at	on
58. The surface **of** the lake was frozen.	to	for
Thomas finished reading the last chapter **of** the book.	to	on

Infinitival 'to'

59. Allan expected Darren **to** win the race.	from	on

60. Anna took a pill **to** get rid of her headache.   of   from
61. Babies scream **to** get attention.   at   for
62. Bill likes **to** play football.   from   for
63. Bill went on a diet **to** lose some weight.   for   at
64. Bill went to the bank **to** get some money.   in   of
65. Helen just wanted **to** leave the room.   from   at
66. Helen travels **to** increase her knowledge of the world.   in   of
67. Helen went to the museum **to** see some old paintings.   from   for
68. Henry drinks **to** forget about his problem.   at   of
69. James prefers **to** travel by plane.   at   of
70. Jane learned quickly how **to** drive a car.   in   from
71. Jane loves **to** dance.   from   at
72. Jeremy does not know how **to** use a computer.   on   in
73. Jeremy went to the church **to** pray.   at   in
74. Jim broke the lock **to** gain access to the house.   from   on
75. John had **to** make a tough decision.   of   at
76. John intended **to** quit smoking.   in   from
77. John took on another degree **to** increase his chances of a good job.   for   on
78. John went to Paris **to** improve his French.   from   for
79. Ron refuses **to** leave the house.   in   of
80. Sue went to the library **to** read some books.   from   of
81. Suzanne hoped **to** win the lottery.   for   from
82. Tom intends **to** marry soon.   on   of

APPENDIX VII

PREPOSITION HOUSE PICTURES

1)

2)

3)

4)

5)

6)

7)

8)
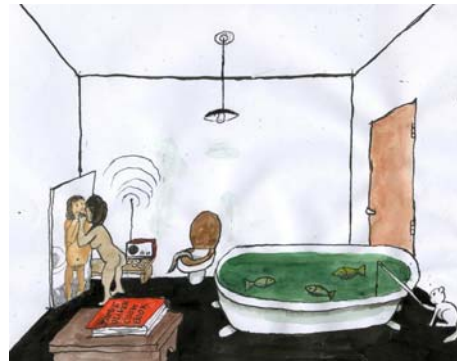
9)

APPENDIX VIII

TABLES FOR THE ANALYSIS OF SPEECH FROM DESCRIPTION OF THE *PREPOSITION HOUSE PICTURES*

Table A: Breakdown of utterances produced by individual patients and control group in description of the *Preposition House Pictures*

	Statistics of utterances						
	no. of…			**proportion of grammatical utterances**		**proportion of ungrammatical utterances**	**proportion of ungrammatical utterances that are grammatical out of context**
	utterances	MLU	LGU	all	with embeddings	all	all
BG	133	6.6	16	.38	.22	.61	.02
DC	149	4.4	7	.19	.04	.73	.08
-DOR	101	4.5	8	.18	0	.74	.08
EW	105	5.2	11	.30	.07	.65	.06
TH	113	7.9	17	.50	.38	.38	.12
NORMAL RANGE	**63-199[a]**	**9.03-13.1[a]**	**29-66[a]**	**.85-1[b]**	**.49-.72[b]**	**0-.15[b]**	**0[b]**

[a] The range of words produced by the controls.
[b] For proportions, the normal range was calculated as two standard deviations above and below the controls' mean.

Table B: Count of narrative words *correctly* produced by individual patients and control group in description of the *Preposition House Pictures*

	Breakdown of narrative words correctly produced																
	number of…	proportion of…															
	words	verbs					nouns				pronouns		prepositions		determiners		other words
	total	lexical verb tokens	lexical verb types	auxiliaries/modals tokens	auxiliaries/modals types	*is* (copula)	common noun tokens	common noun types	plural noun tokens	proper noun tokens	pronoun tokens	pronoun types	preposition tokens	preposition types	definite/indefinite articles tokens	definite/indefinite articles types	other word tokens
BG	878	.07	.52	.26	.18	.07	.28	.45	.20	.001	.08	.15	.12	.21	.17	.03	.14
DC	649	.04	.77	.52	.14	.11	.20	.55	.19	.006	.05	.27	.03	.60	.14	.05	.26
DOR	452	.04	.84	.42	.07	.09	.21	.51	.31	.002	.03	.23	.08	.29	.15	.05	.22
EW	546	.11	.62	.36	.12	.04	.24	.62	.23	0	.06	.24	.10	.38	.19	.05	.11
TH	887	.13	.35	.37	.17	.05	.11	.55	.23	0	.17	.12	.10	.23	.11	.04	.21
NORMAL RANGE	614-2476[a]	.08-.14[b]	.30-.65[b]	.18-.43[b]	0-.38[b]	.03-.08[b]	.17-.26[b]	.35-.82[b]	.15-.26[b]	0-.001[b]	.06-.12[b]	.01-.32[b]	.12-.17[b]	.07-.29[b]	.13-.20[b]	.01-.06[b]	.07-.26[b]

[a] The range of words produced by the controls.
[b] For proportions, the normal range was calculated as two standard deviations above and below the controls' mean.

Table C: Count of narrative words substituted, wrongly inserted, or omitted by individual patients and control group in description of the *Preposition House Pictures*

Breakdown of free/bound morphemes that were substituted (S) / additionally inserted (I) / or omitted (O)

number of…

	words	verbs						nouns				pronouns		prepositions			determiners	
	total	lexical verb	auxiliaries/modals	*is* (copula)	tense inflection	progressive-marker	agreement marking	nouns	plural marking	singular marking	case marking	pronouns	case marking	prepositions	substitutions within category	substitutions within subcategory	determiners	plural marking
BG	878	S 0 I 0 O 4	S 0 I 0 O 29	S 0 I 0 O 11	S 1 I 0 O 0	S 1 I 0 O 12	S 6 I 0 O 4	S 4 I 0 O 4	S 0 I 0 O 8	S 0 I 0 O 0	S 0 I 0 O 0	S 0 I 2 O 15	S 0 I 0 O 0	S 4 I 0 O 9	4	4	S 1 I 0 O 26	S 0 I 0 O 0
DC	649	S 3 I 1 O 17	S 1 I 2 O 9	S 0 I 1 O 25	S 0 I 0 O 0	S 0 I 0 O 0	S 12 I 0 O 1	S 18 I 5 O 25	S 0 I 3 O 0	S 0 I 0 O 0	S 0 I 0 O 1	S 4 I 2 O 36	S 0 I 0 O 0	S 0 I 3 O 18	-	-	S 4 I 14 O 60	S 6 I 0 O 0
DOR	452	S 4 I 1 O 7	S 0 I 0 O 12	S 0 I 0 O 17	S 0 I 0 O 0	S 0 I 0 O 0	S 10 I 0 O 0	S 15 I 2 O 8	S 0 I 4 O 3	S 0 I 0 O 0	S 0 I 0 O 0	S 14 I 2 O 29	S 0 I 0 O 0	S 3 I 1 O 8	3	3	S 5 I 6 O 19	S 0 I 0 O 0
EW	546	S 3 I 1 O 4	S 0 I 0 O 28	S 0 I 1 O 15	S 0 I 0 O 1	S 0 I 0 O 3	S 6 I 0 O 0	S 2 I 1 O 16	S 0 I 2 O 2	S 1 I 0 O 0	S 0 I 0 O 1	S 5 I 3 O 22	S 0 I 0 O 0	S 4 I 0 O 7	4	4	S 6 I 3 O 20	S 0 I 0 O 0
TH	887	S 1 I 0 O 5	S 1 I 0 O 2	S 0 I 2 O 4	S 2 I 1 O 0	S 0 I 0 O 0	S 5 I 0 O 0	S 10 I 0 O 14	S 0 I 4 O 1	S 0 I 0 O 0	S 0 I 0 O 0	S 2 I 4 O 5	S 0 I 0 O 0	S 5 I 2 O 2	5	4	S 0 I 4 O 7	S 0 I 0 O 0
CONTROL GROUP	**614-2476[a]**	**S 0 I 0 O 1**	**S 0 I 0 O 2**	**S 0 I 0 O 4**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 9 I 0 O 0**	**S 0 I 0 O 2**	**S 0 I 0 O 1**	**S 0 I 0 O 0**	**S 0 I 0 O 0**	**S 2 I 0 O 3**	**S 0 I 0 O 0**	**S 1 I 0 O 0**	**1**	**1**	**S 0 I 0 O 2**	**S 0 I 0 O 0**

[a] The range of words produced by the controls.

APPENDIX IX

PROPORTIONS OF PREPOSITIONS PRODUCED PER SUBCATEGORY FOR INDIVIDUAL PATIENTS AND CONTROL GROUP IN THE DESCRIPTION OF THE PREPOSITION HOUSE PICTURES

	Subcategories of prepositions…						
	spatial	*temporal*	*other theta-role assigning*	*subcategorized*	*syntactic of*	*infinitival to*	*particle*
BG	0.57	0.00	0.17	0.02	0.17	0.07	0.01
DC	0.45	0.20	0.00	0.00	0.20	0.05	0.10
DOR	0.53	0.00	0.09	0.06	0.15	0.00	0.18
EW	0.75	0.11	0.07	0.00	0.04	0.04	0.00
TH	0.63	0.02	0.08	0.02	0.15	0.09	0.00
NORMAL RANGE	**.48-.67**[a]	**0-.02**[a]	**.05-.18**[a]	**0-.07**[a]	**.08-.25**[a]	**.01-.18**[a]	**0-.04**[a]

[a] For proportions, the normal range was calculated as two standard deviations above and below the controls' mean.

APPENDIX X

RESULTS FOR INDIVIDUAL PATIENTS AND CONTROL GROUP IN SENTENCE COMPLETION

Table A: Summary of the results of the control group used for testing the predictions

Proportions/latencies for correct responses…

|	no. of prepositions correct (n = 1360) / mean latency for correct responses	spatial	other theta-role assigning	temporal	subcategorized	syntactic *of*	infinitival *to*	particles	one-syllabic	two-syllabic	high frequency	medium frequency	low frequency	governed	ungoverned
accuracy	1269	.91	.98	.90	.93	.93	.99	.90	.95	.88	.96	.94	.88	.89	.93
latency in ms	808	803	779	856	791	808	846	748	808	810	832	800	818	791	833
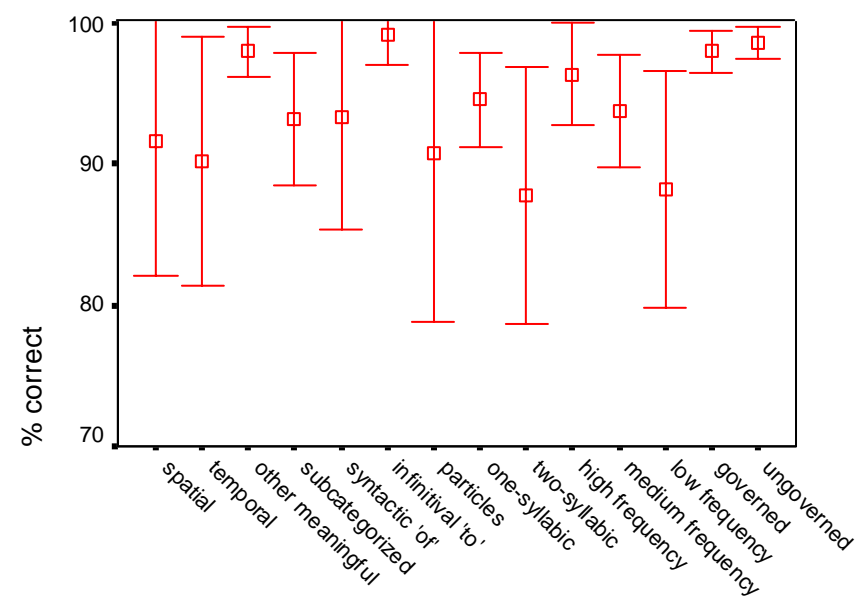
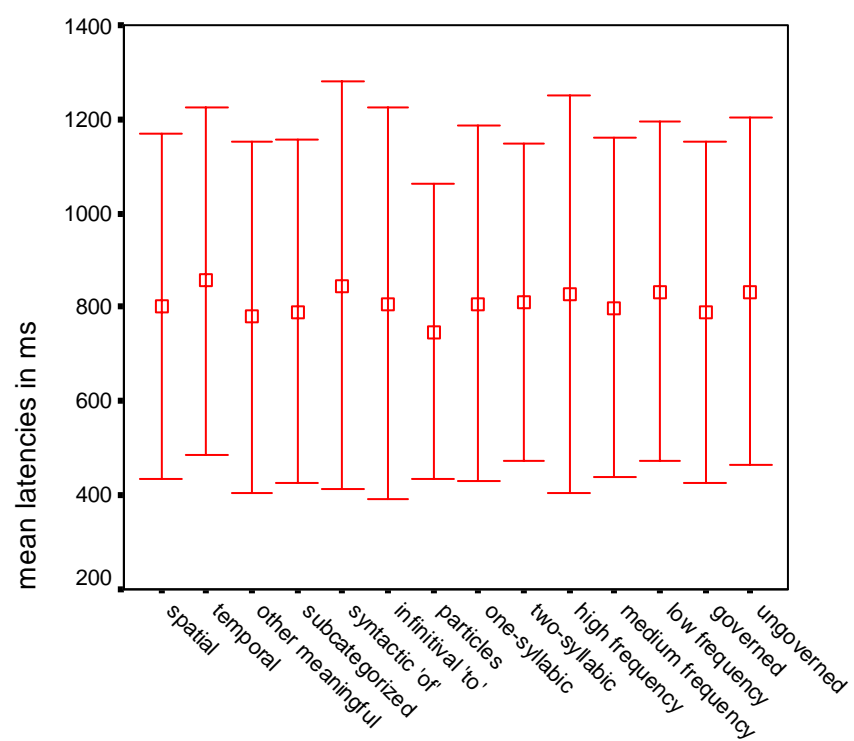Figure A: Confidence intervals (95%) for controls' accuracy data on each subcategory and contrast.

Figure B: Confidence intervals (95%) for controls' latency data (in ms) on each subcategory and contrast.

Table B: Summary of results of individual patients used for testing the predictions

	Proportions correct for…													
	no. of prepositions correct (n = 276)	**spatial**	**other theta-role assigning**	**temporal**	**subcategorized**	**syntactic *of***	**infinitival *to***	**particles**	**one-syllabic**	**two-syllabic**	**high frequency**	**medium frequency**	**low frequency**	**governed**	**ungoverned**
BG	212	.75	.83	.77	.60	.92	.96	.67	.78	.71	.94	.75	.67	.82	.83
DC	94	.29	.29	.32	.44	.42	.46	.21	.35	.29	.44	.34	.25	.34	.29
DOR	49	.31	.21	.17	.02	.21	.08	.25	.16	.26	.15	.17	.23	.47	.18
EW	209	.77	.75	.75	.79	.79	.92	.50	.75	.79	.85	.72	.79	.74	.74
TH	152	.63	.58	.48	.50	.63	.79	.29	.57	.43	.71	.55	.40	.68	.61

APPENDIX XI

RESULTS FOR INDIVIDUAL PATIENTS AND CONTROL GROUP IN GRAMMATICALITY JUDGMENT OF SINGLE SENTENCES

Table A: Summary of the results of the control group used for testing the predictions

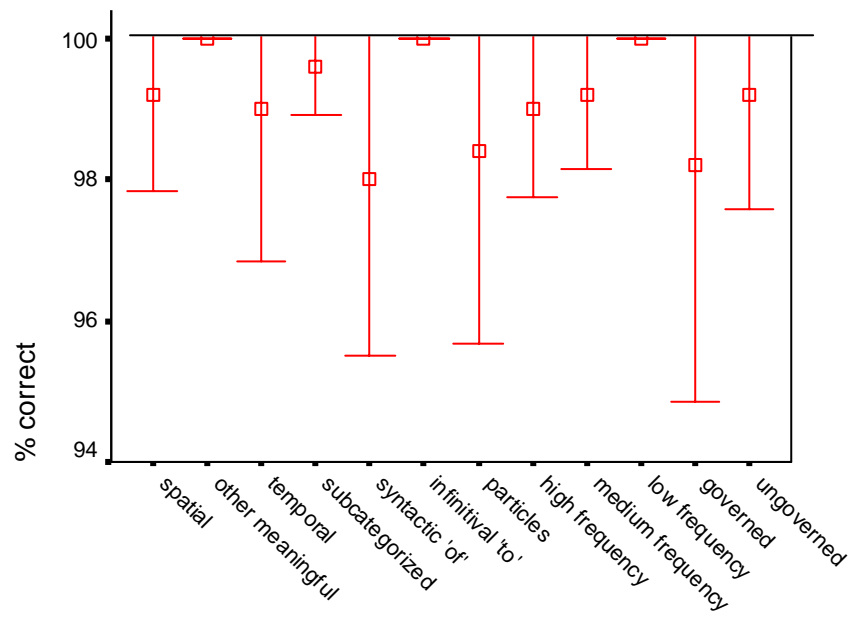| | no. of prepositions correct responses in *grammatical* condition | no. of prepositions correct times (in ms) and mean reaction responses in *ungrammatical* condition | **Proportions/reaction times correct for…** | | | | | | | | | | | |
	times (in ms) for correct (n = 895) and mean reaction	times (in ms) for correct (n = 895) and mean reaction	spatial	other theta-role assigning	temporal	subcategorized	syntactic *of*	infinitival *to*	particles	high frequency	medium frequency	low frequency	governed	ungoverned
control group – accuracy	886	889	.99	1	.99	1	.98	1	.98	.99	.99	1	.98	.99
control group – RTs	901	843	834	891	859	865	882	830	1029	856	878	929	870	843

Figure A: Confidence intervals (95%) for controls' accuracy data on
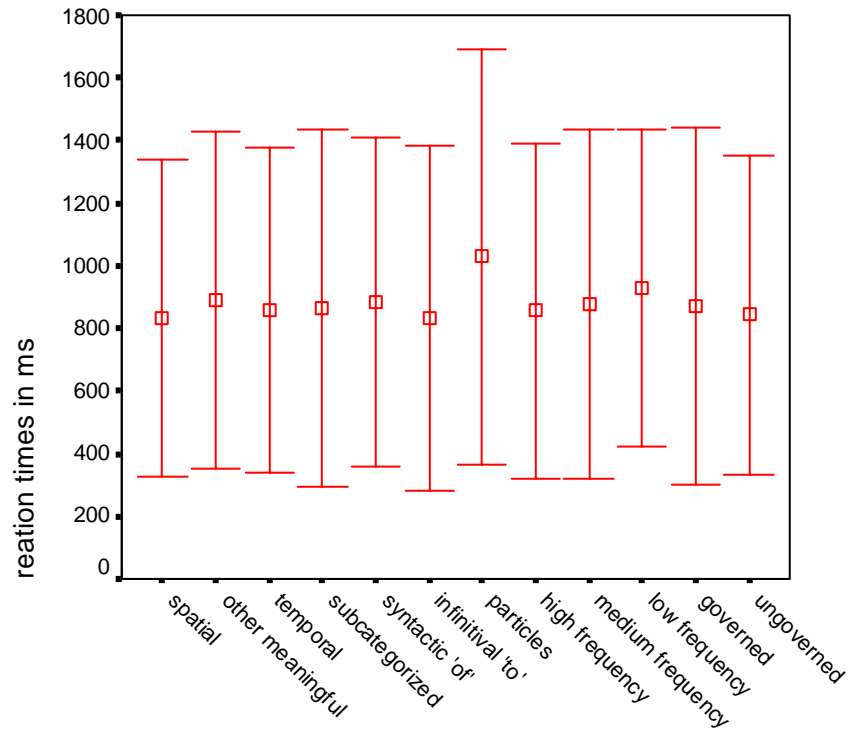
each subcategory and contrast.

Figure B: Confidence intervals (95%) for controls' reaction time
data on each subcategory and contrast.

Table B: Summary of the results of individual patients used for testing the predictions

| | no. of prepositions correct (n = 179) in *grammatical* condition | no. of prepositions correct (n = 179) in *ungrammatical* condition | **Proportions correct for…** | | | | | | | | | | | |
			spatial	other meaningful	temporal	subcategorized	syntactic *of*	infinitival *to*	particles	high frequency	medium frequency	low frequency	governed	ungoverned
BG	171	173	.98	1	.97	.95	.92	1	.88	.94	.97	1	.97	.99
DC	165	98	.83	.72	.81	.62	.60	.90	.71	.75	.76	.75	.81	.72
DOR	152	138	.83	.81	.83	.74	.88	.83	.79	.88	.81	.75	.72	.83
EW	162	167	.94	.92	.96	.91	.90	.94	.83	.91	.92	1	.94	.96
TH	151	126	.76	.86	.92	.67	.63	.92	.63	.64	.81	.75	.83	.88

APPENDIX XII

RESULTS FOR INDIVIDUAL PATIENTS AND CONTROL GROUP IN CONTRASTIVE GRAMMATICALITY JUDGMENT OF SENTENCE PAIRS

Table A: Summary of the results of the control group used for testing the predictions

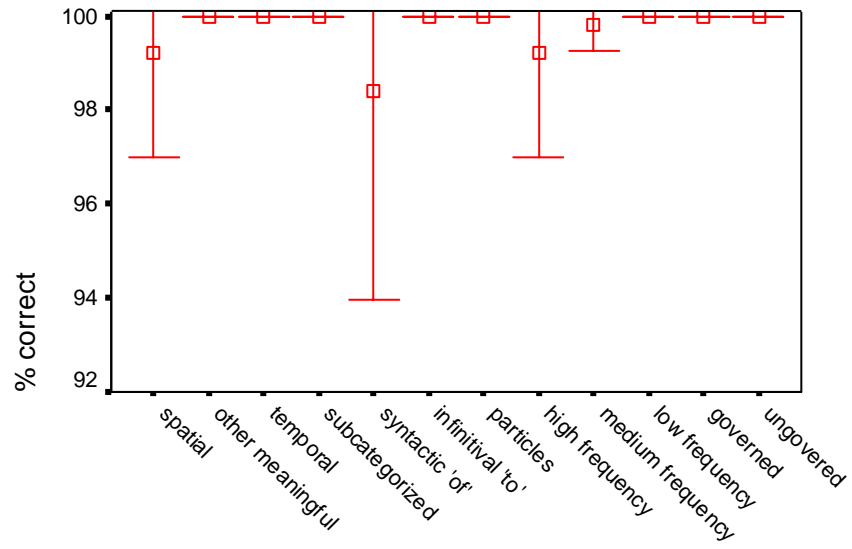| | no. of prepositions correct (n = 895) and mean reaction times (in ms) for correct responses | Proportions/reaction times correct for… | | | | | | | | | | | |
		spatial	other theta-role assigning	temporal	subcategorized	syntactic *of*	infinitival *to*	particles	high frequency	medium frequency	low frequency	governed	ungoverned
control group – accuracy	892	.99	1	1	1	.98	1	1	.99	1	1	1	1
control group – RTs	728	723	772	714	732	683	719	788	701	735	768	725	737

Figure A: Confidence intervals (95%) for controls' accuracy data on each subcategory and contrast.
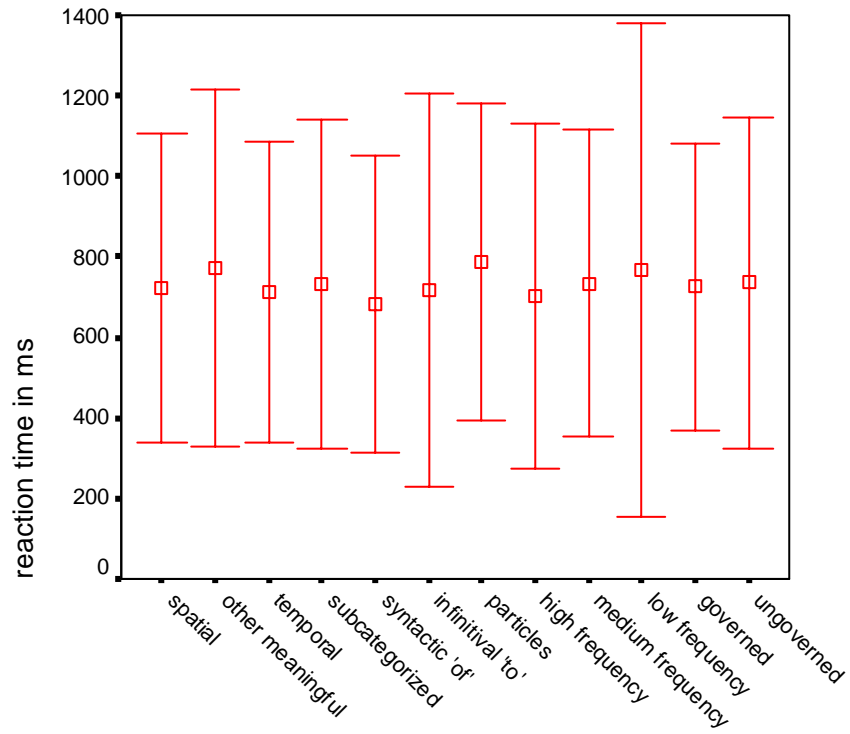
Figure B: Confidence intervals (95%) for controls' reaction time data on each subcategory and contrast.

Table B: Summary of the results of individual patients used for testing the predictions

	no. of prepositions correct (n = 179)	spatial	other meaningful	temporal	subcategorized	syntactic *of*	infinitival *to*	particles	high frequency	medium frequency	low frequency	governed	ungoverned
BG	176	1	.94	1	1	.96	.96	1	.96	.99	1	1	1
DC	162	.91	.89	.94	.88	.79	1	.92	.88	.93	1	.94	.93
DOR	161	.96	.83	.92	.93	.79	.92	.92	.79	.91	.50	1	.88
EW	163	1	.83	.94	.86	.96	.96	.75	.96	.90	1	.89	.95
TH	159	.78	1	.92	.83	.88	.92	1	.88	.90	.75	.78	.95

APPENDIX XIII

RESULTS FOR INDIVIDUAL PATIENTS AND CONTROL GROUP IN FORCED CHOICE GRAMMATICALITY JUDGMENT

Table A: Summary of the results of the control group used for testing the predictions

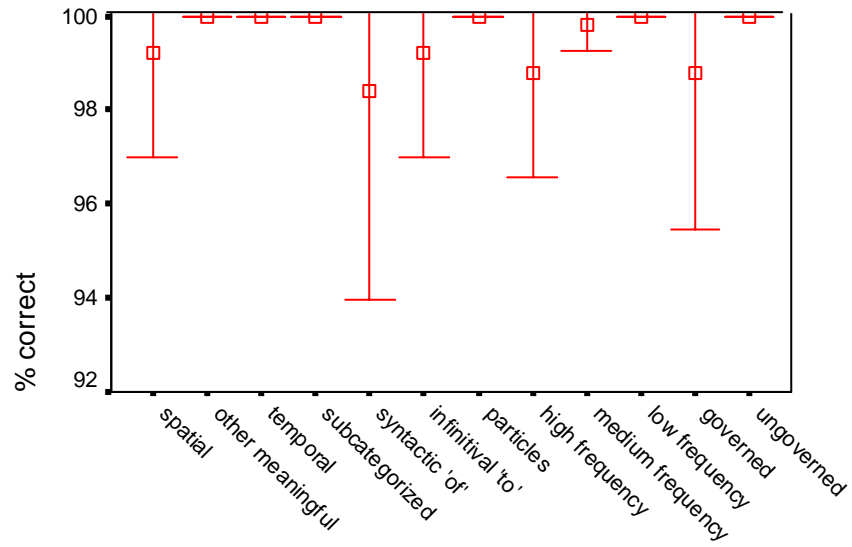|	no. of prepositions correct (n = 895) and mean reaction times (in ms) for correct responses	**Proportions correct for…**											
		spatial	other meaningful	temporal	subcategorized	syntactic *of*	infinitival *to*	particles	high frequency	medium frequency	low frequency	governed	ungoverned
control group – accuracy	891	.99	1	1	1	.98	.99	1	.99	.99	1	.99	1
control group – RTs	999	1048	1033	957	938	1020	866	1112	943	973	1074	1029	999

Figure A: Confidence intervals (95%) for controls' accuracy data on each subcategory and contrast.
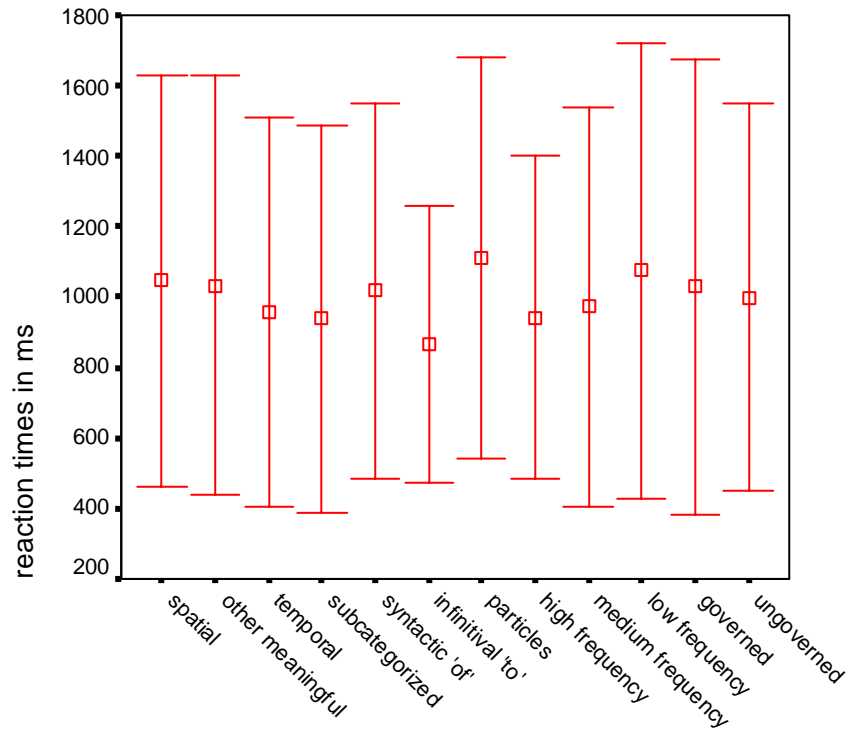
Figure B: Confidence intervals (95%) for controls' reaction time data on each subcategory and contrast.

Table B: Summary of the results of individual patients used for testing the predictions

	no. of prepositions correct (n = 179)	spatial	other meaningful	temporal	subcategorized	syntactic *of*	infinitival *to*	particles	high frequency	medium frequency	low frequency	governed	ungoverned
Proportions correct for…													
BG	165	1	1	.97	.81	.88	.96	.92	.90	.93	1	1	.98
DC	129	.78	.67	.78	.69	.58	.79	.75	.69	.72	1	.78	.71
DOR	69	.39	.50	.47	.41	.08	.33	.58	.19	.43	1	.44	.43
EW	99	.78	.56	.50	.50	.42	.54	.75	.48	.58	.50	.67	.50
TH	142	.78	.83	.94	.57	.71	1	.83	.80	.80	.75	.83	.91

APPENDIX XIV

RESULTS FOR INDIVIDUAL PATIENTS AND CONTROL GROUP FOR THE ADDITIONAL COMPARISONS

SPATIAL AND TEMPORAL PREPOSITIONS

Table A: Summary of the results of the control group used for testing the predictions

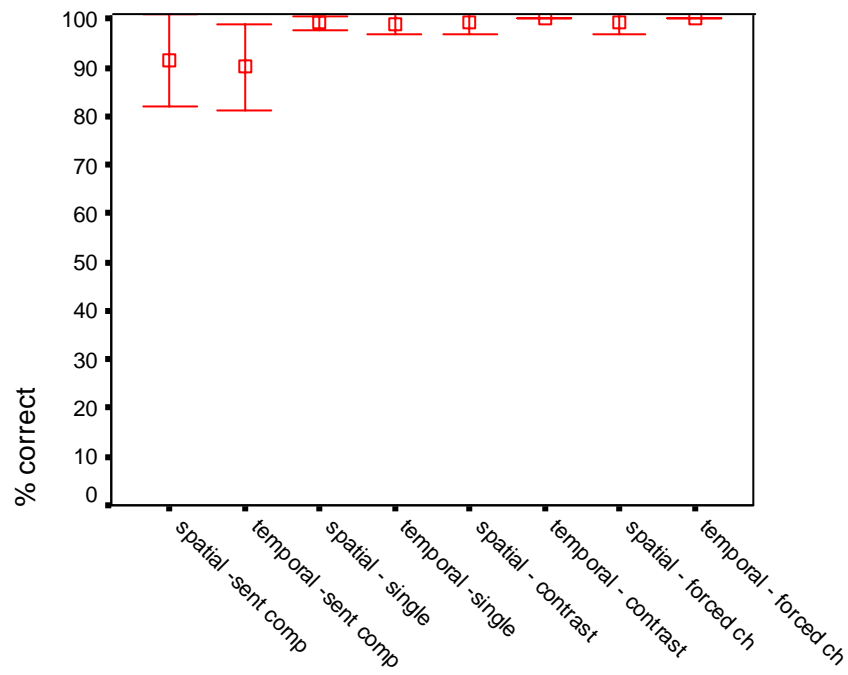|	Proportions correct for…							
	Sentence completion		Gramm. judgm. of single sentences		Contrastive gramm. judgment of sentence pairs		Forced choice gramm. judgment	
	spatial	temporal	spatial	temporal	spatial	temporal	spatial	temporal
accuracy	.91	.90	.99	.99	.99	1	.99	1
latency/RTs	803	856	834	859	723	714	1048	957

Figure A: Confidence intervals (95%) for controls' accuracy data for spatial and temporal prepositions.
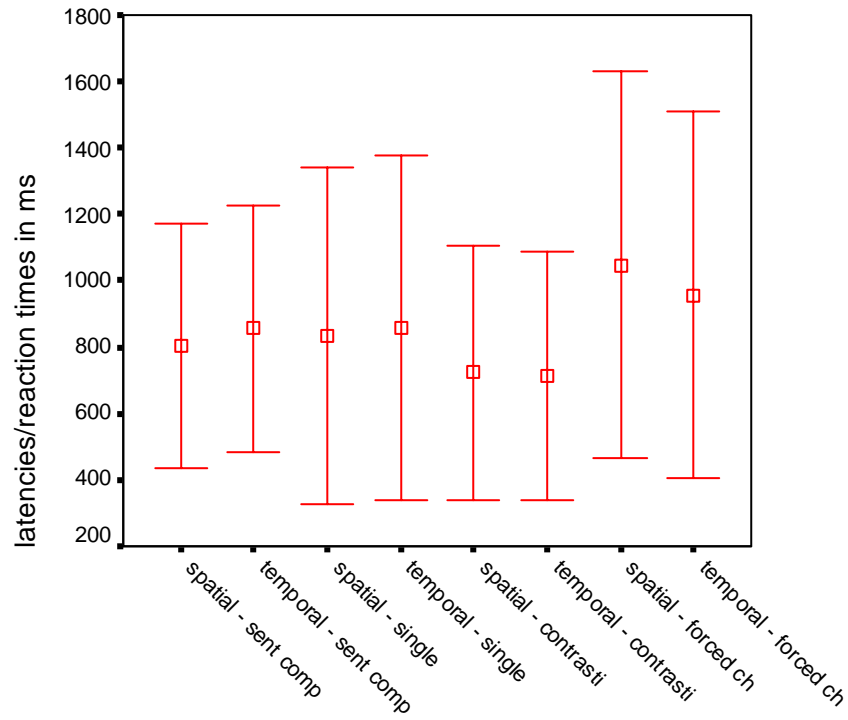
Figure B: Confidence intervals (95%) for controls' latency/reaction time data for spatial and temporal prepositions.

Table B: Summary of the results of individual patients used for testing the predictions

	Proportions correct for…							
	Sentence completion		**Gramm. judgm. of single sentences**		**Contrastive gramm. judgment of sentence pairs**		**Forced choice gramm. judgment**	
	spatial	temporal	spatial	temporal	spatial	temporal	spatial	temporal
BG	.75	.77	.98	.97	1	1	1	.97
DC	.29	.32	.83	.81	.91	.94	.78	.78
DOR	.31	.17	.83	.83	.96	.92	.39	.47
EW	.77	.75	.94	.96	1	.94	.78	.50
TH	.63	.48	.76	.92	.78	.92	.78	.94

MORE AND LESS COMPLEX PREPOSITIONS

Table C: Summary of the results of the control group used for testing the predictions

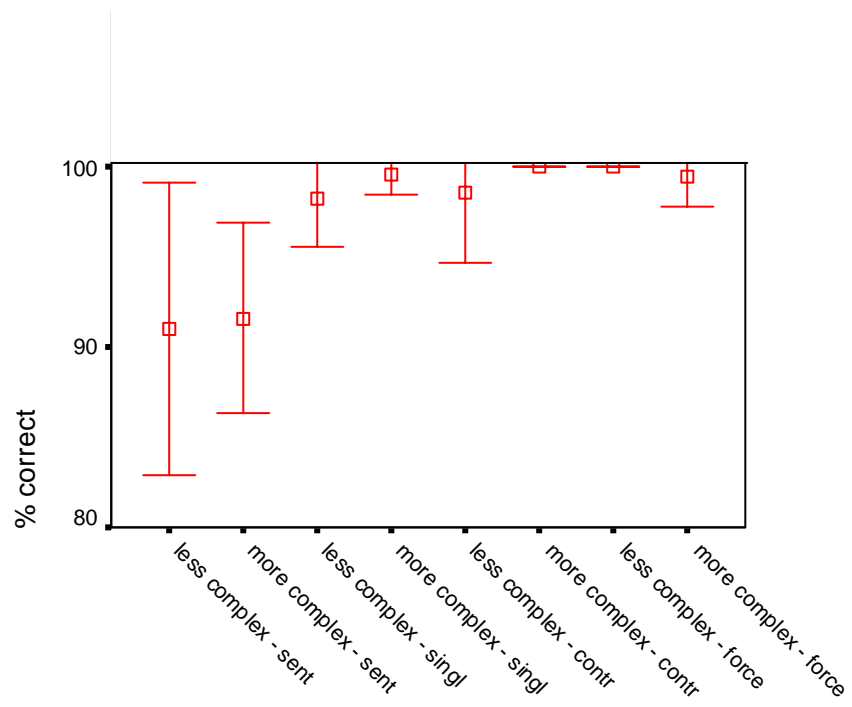|	Proportions correct for…							
	Sentence completion		Gramm. judgm. of single sentences		Contrastive gramm. judgment of sentence pairs		Forced choice gramm. judgment	
	less complex	more complex	less complex	more complex	less complex	more complex	less complex	more complex
accuracy	.91	.91	.98	1	.99	1	1	.99
latency/RTs	842	828	813	872	705	727	1012	993

Figure C: Confidence intervals (95%) for controls' accuracy data for semantically less and more complex prepositions.
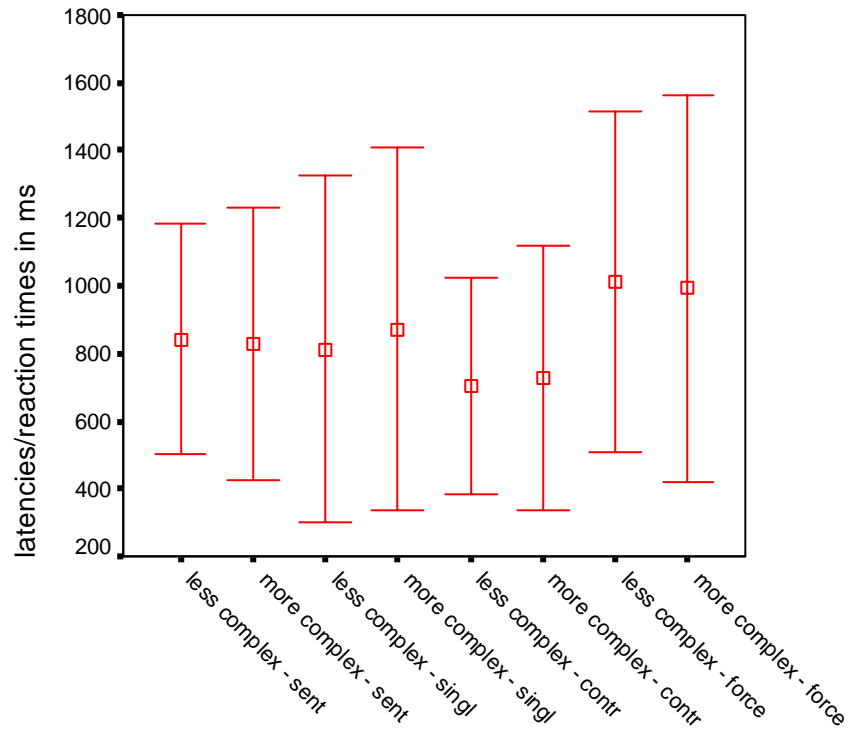
Figure D: Confidence intervals (95%) for controls' latency/reaction time data for semantically less and more complex prepositions.

Table D: Summary of the results of individual patients used for testing the predictions

| | Proportions correct for… | | | | | | | |
| | Sentence completion | | Gramm. judgm. of single sentences | | Contrastive gramm. judgment of sentence pairs | | Forced choice gramm. Judgment | |
	less complex	more complex	less complex	more complex	less complex	more complex	less complex	more complex
BG	.78	.74	.98	.96	1	1	1	.96
DC	.32	.30	.82	.80	.94	.93	.74	.82
DOR	.24	.22	.82	.84	.94	.93	.26	.64
EW	.78	.74	.95	.95	1	.93	.55	.68
TH	.61	.48	.89	.82	.90	.82	.90	.86

SYNTACTIC PREPOSITIONS

Table E: Summary of the results of the control group used for testing the predictions

|	Proportions correct for…							
	Sentence completion		Gramm. judgm. of single sentences		Contrastive gramm. judgment of sentence pairs		Forced choice gramm. judgment	
	bare infinitival to	*in order to infinitival to*	*bare infinitival to*	*in order to infinitival to*	*bare infinitival to*	*in order to infinitival to*	*bare infinitival to*	*in order to infinitival to*
accuracy	.98	1	1	1	1	1	.98	1
latency/RTs	820	867	770	890	752	685	842	900
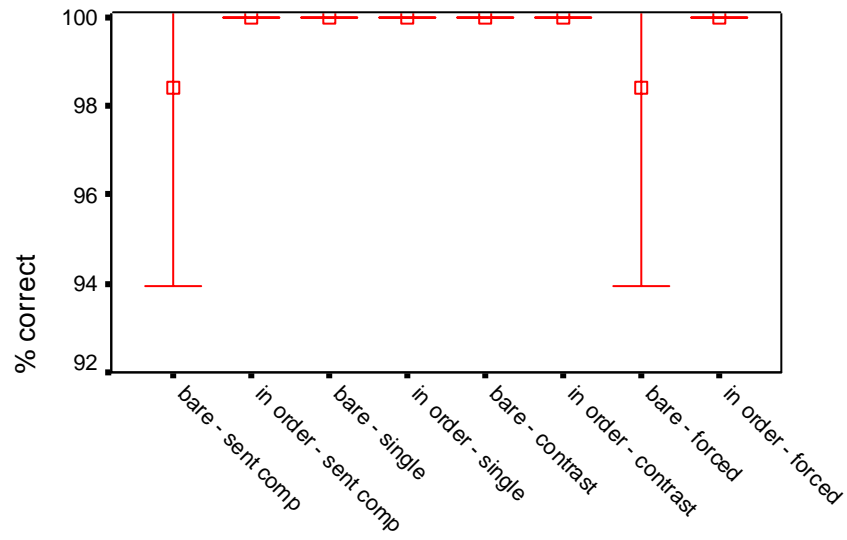
Figure E: Confidence intervals (95%) for controls' accuracy data for comparison of

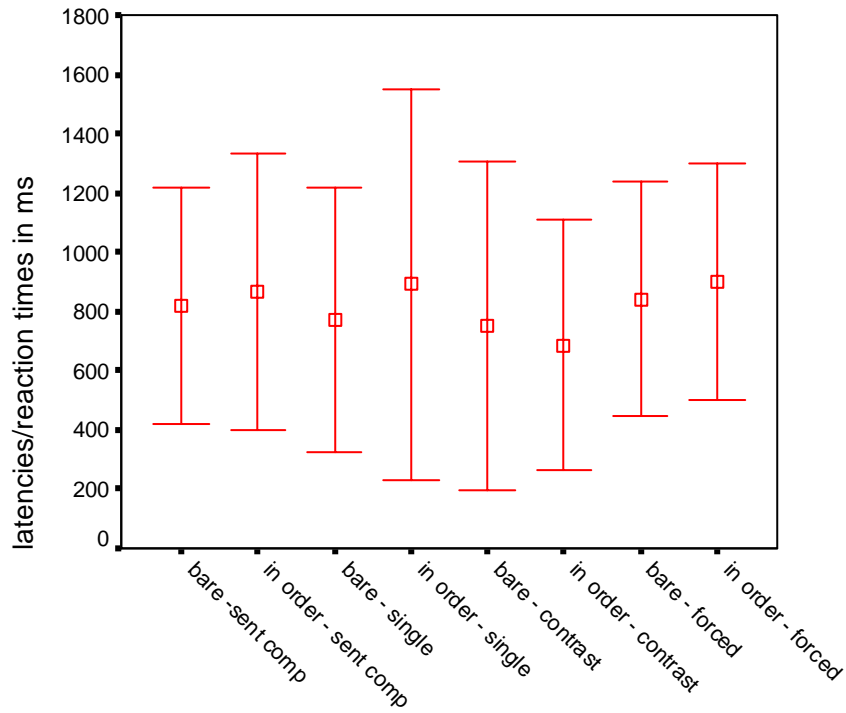bare and *in order to* infinitival *to*.

Figure F: Confidence intervals (95%) for controls' latency/reaction time data for comparison of bare and *in order to* infinitival *to*.

Table F: Summary of the results of individual patients used for testing the predictions

| | **Proportions correct for…** | | | | | | | |
| | **Sentence completion** | | **Gramm. judgm. of single sentences** | | **Contrastive gramm. judgment of sentence pairs** | | **Forced choice gramm. judgment** | |
	bare infinitival to	*in order to infinitival to*	**bare infinitival to**	*in order to infinitival to*	**bare infinitival to**	*in order to infinitival to*	**bare infinitival to**	*in order to infinitival to*
BG	.92	1	1	1	1	.92	1	.92
DC	.75	.17	.88	.92	1	1	.83	.75
DOR	.17	0	.83	.83	1	.83	.42	.25
EW	1	.83	.92	.96	.92	1	.42	.67
TH	.92	.67	.96	.88	.83	1	1	1

PARTICLES

Table G: Summary of the results of the control group used for testing the predictions

|	**Proportions correct for…**									
	Sentence completion		**Gramm. judgm. of single sentences**		**Contrastive gramm. judgment of sentence pairs**		**Forced choice gramm. judgment**		**Sentence completion**	
	resultative	**non-resultative**	**resultative**	**non-resultative**	**resultative**	**non-resultative**	**resultative**	**non-resultative**	**attached**	**non-attached**
accuracy	.88	.92	1	.97	1	1	1	1	.92	.92
latency/RTs	713	785	1007	1047	755	821	990	1233	782	711
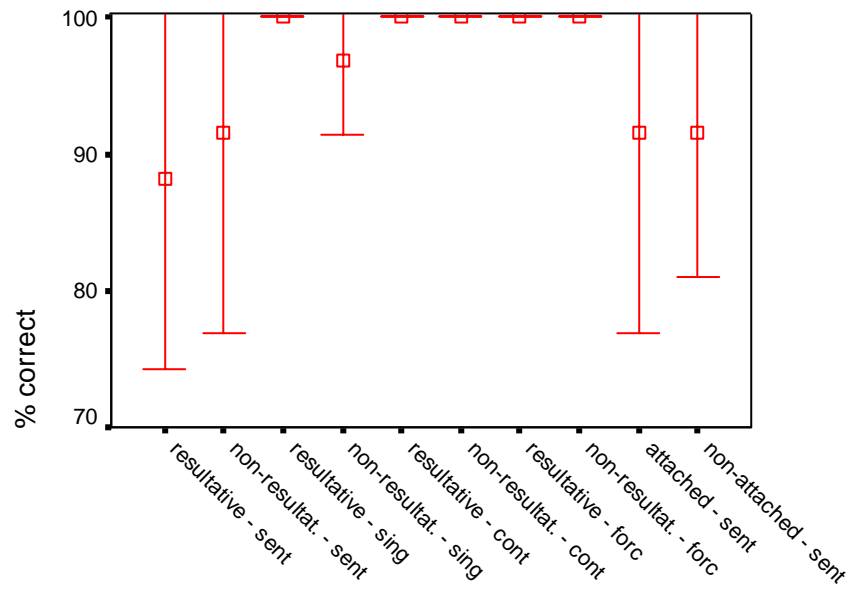
Figure G: Confidence intervals (95%) for controls' accuracy data for resultative and
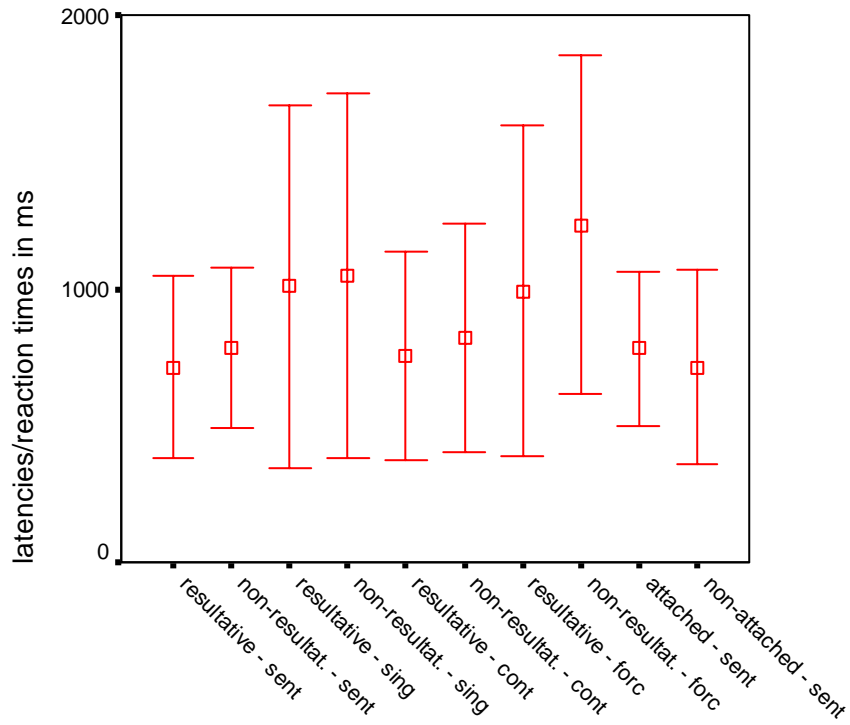non-resultative and attached and non-attached particles.

Figure H: Confidence intervals (95%) for controls' latency/reaction time data for resultative and non-resultative and attached and non-attached particles.

Table H: Summary of the results of individual patients used for testing the predictions

	Proportions correct for…									
	Sentence completion		**Gramm. judgm. of single sentences**		**Contrastive gramm. judgment of sentence pairs**		**Forced choice gramm. judgment**		**Sentence completion**	
	resultative	non-resultative	resultative	non-resultative	resultative	non-resultative	resultative	non-resultative	attached	non-attached
BG	.92	.42	.83	.92	1	1	1	.83	.67	.67
DC	.33	.08	.83	.58	1	.83	.67	.83	.25	.17
DOR	.42	.08	.92	.67	1	.83	1	.17	.17	.33
EW	.58	.42	.83	.83	1	.50	1	.50	.75	.25
TH	.42	.17	.67	.58	1	1	.83	.83	.25	.33