CHAPTER IV

PROCESSING OF LOCATIVE PREPOSITIONS IN APHASIA

Prior to performing a series of experiments to examine prepositions in the narrative speech of aphasic speakers, and to investigate the abilities of these speakers to use particular prepositions and implement case marking of the complement nouns of these prepositions in restricted tasks, a pilot study was performed to look at the overall comprehension and production of simple prepositions by aphasic speakers. The exploratory pilot study included two experiments: one investigated the comprehension of locative prepositions and the other probed production of the same prepositions. The main objectives of this study were to investigate whether aphasic speakers retained the ability to comprehend prepositions and use them when required. Locative meanings that relate to space are regarded as core meanings of prepositions, as opposed to time, cause, reason, and others, which are supposedly derived by metaphor (O’Keefe, 1996). Therefore, the experiments for the pilot study included simple non-derived locative prepositions that denoted spatial relationships of two objects. Below, a brief overview is given of previous cross-linguistic aphasiological findings with respect to locative prepositions. A fuller account of previous research, which provides the necessary background for this study, is presented in chapter III.

Processing of locative prepositions in aphasia: a short survey

Time and again in research, prepositions have been reported to be particularly vulnerable in aphasia in several languages, being free-standing grammatical morphemes. Production of prepositions has been reported to be impaired in English-speaking Broca’s and Wernicke’s aphasia and this impairment is believed to result in omission and substitution.
errors respectively (Friederici, 1981). It has further been claimed that the impairment of prepositions is more severe in Broca’s than in Wernicke’s aphasia (Friederici, 1981). Comprehension of prepositions has also been found to be very difficult for English Broca’s aphasic speakers (Schwartz et al., 1980). Russian Broca’s and Wernicke’s aphasic speakers had difficulties in production of locative prepositions (Leikin, 1998; 2002). Similar to English speaking Broca’s aphasic speakers (Friederici, 1981), the deficit of Russian Broca’s aphasic speakers was found to be more profound. They performed worse than Russian Wernicke’s aphasic speakers, and produced non-responses, and made omission and substitution errors either by producing other prepositions or by producing an adverb (Leikin, 1998).

**The goal of the study**

The present exploratory pilot study was administered as a preamble to the following research described in this thesis. The study included two experiments to examine the basic abilities of Russian aphasic speakers to deal with simple non-derived locative prepositions in comprehension and production tasks. Throughout this thesis these prepositions are referred to as **locative prepositions**. The main questions addressed in these experiments were as follows: (1) *Do aphasic speakers know and understand the meanings of locative (basic) prepositions?* (2) *Are aphasic speakers able to produce locative (basic) prepositions?*

From the previous research it is known that use of prepositions is impaired in aphasia but that the knowledge of prepositions is not entirely lost. The group of control speakers who also took part in the experiment was expected to perform well on both tasks, and not to experience difficulties in production or comprehension of locative prepositions. For both groups of aphasic speakers, however, prepositions were anticipated to be difficult despite being incorporated in simple tasks; this was expected to be true for both the production and the comprehension tasks. Both groups of aphasic speakers were expected to have difficulties in comprehending and producing locative prepositions.
Pilot study: Comprehension of locative prepositions

Methods

In the following work, the methods of the experiment will be described. Initially, a description of the groups of aphasic speakers who participated in the experiment is presented. The materials of the experiment, the procedure followed and the scoring techniques used will also be discussed here. The statistical tools will be explained at the end of this section.

Participants

The experiment was administered to a group of 24 Russian-native aphasic speakers and to a control group of 22 neurologically intact speakers. In the control group all speakers were volunteers; their age ranged in years from 28 to 54, with a mean age of 41.13 years. The group included 10 males. None of the participants in the control group had any previous history of neurological disease or any other major illness. Their vision was normal or corrected to normal. All participants were right-handed native speakers of the Russian language, originating from the central part of the Russian Federation; none of them displayed any accent. Individual data of the control speakers are presented in Appendix III, table I.

All aphasic speakers were tested in rehabilitation centers in Russia, during the course of neurological rehabilitation including a course of speech and language therapy. They were diagnosed in the rehabilitation centers by speech therapists on the basis of Luria’s classification (Luria, 1973). The diagnoses and speech characteristics of the aphasic speakers provided by the speech therapists and neurologists were taken into account when they were judged as fluent or non-fluent. Data of several aphasic speakers

---

22 Neurological department of the rehabilitation center “Zelenyj gorod”, Nizhnij Novgorod; Institute of the Human Brain, Russian Academy of Science, Saint-Petersburg; Federal Center of Speech Pathology and Neurorehabilitation, Moscow
were excluded from analysis for various reasons. Fluent aphasic speakers Fl5, Fl8 and Fl12 suffered from severe dysarthria, which could significantly impede scoring of the obtained data and the analysis. Non-fluent aphasic speakers Nf6 and Nf11 were unable to complete the experiments; therefore, data of 19 aphasic speakers were analyzed. In the group of fluent aphasic speakers (N=8), the age ranged in years from 17 to 69, with a mean age of 47.45 years. The group comprised three males and five females. In the group of non-fluent aphasic speakers (N=11), the age ranged in years from 24 to 58, with a mean age of 36.72 years. There were seven males and four females. Individual data of the aphasic speakers are provided in Appendix III, table II and are briefly summarized in table 4.1, below.

Table 4.1 Summary of the individual data of all participants of the comprehension experiment

<table>
<thead>
<tr>
<th></th>
<th>Number of participants</th>
<th>Mean age in the group in years</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control speakers</td>
<td>22</td>
<td>41.13</td>
<td>10 males</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12 females</td>
</tr>
<tr>
<td>Fluent aphasic speakers</td>
<td>8</td>
<td>47.45</td>
<td>3 males</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 females</td>
</tr>
<tr>
<td>Non-fluent aphasic</td>
<td>11</td>
<td>36.72</td>
<td>7 males</td>
</tr>
<tr>
<td>speakers</td>
<td></td>
<td></td>
<td>4 females</td>
</tr>
</tbody>
</table>

All fluent aphasic speakers were aphasic as a result of cerebrovascular accidents in the left hemisphere, except speaker Fl20, whose aphasia etiology was traumatic as the result of a firearm wound and the consequent surgical removal of subdural hemorrhage in the left hemisphere. Aphasia types established in accordance with Luria’s classification differed. Aphasic speaker Fl10 was diagnosed with amnestic aphasia; Fl19 was diagnosed with afferent motor aphasia with elements of acoustic-gnostic aphasia; Fl7, Fl14, Fl17, Fl20, and Fl24 were diagnosed with afferent motor aphasia, which all are known to be fluent aphasias.

Aphasia etiology in the group of non-fluent aphasic speakers varied; aphasic speakers Nf3, Nf13, Nf15, and Nf21 were aphasic due to cerebrovascular accidents in the
left hemisphere; other aphasic speakers Nf2, Nf4, Nf9, Nf16, Nf18, and Nf22 suffered from traumatic brain injury as the result of car accidents or trauma. The non-fluent aphasic speakers were diagnosed with efferent-motor aphasia. All aphasic speakers were at least six months post-onset. Individual data of the non-fluent aphasic speakers and their neurological data and linguistic characteristics are shown in Appendix III, table II.

**Materials**

The comprehension experiment was designed as a phrase-to-picture matching task that investigated six main types of location relations denoted by six simple non-derived prepositions: *v: “in”, na: “on”, pod: “under”, nad: “above”, pered: “in front of”, and za: “behind”*. The task included a trial session of 8 trial stimuli and 30 experimental stimuli – that is, 5 experimental sentences for each preposition. Each experimental stimulus consisted of a written sentence with four black-and-white line drawings underneath. The sentence included three constituents: two objects and a preposition. One of the objects is the one being located; it is also referred to as a “figure object” (Talmy, 1983), or as a “figural object” (Jackendoff, 1987), or as a “referent object” (Levelt, 1996). In this thesis it is referred to as ‘referent object’. The spatial disposition of the referent object is expressed in relation to another object, which is also known as a “ground object” (Talmy, 1983), or as a “landmark object” (Jackendoff, 1987), or as a “relatum” (Levelt, 1996). In this thesis it is referred to as a ‘relatum object’. However, this division of roles into a referent object and a relatum object is both arbitrary and subject to change per speaker. It was not the goal of this study to investigate the preferences of the aphasic speakers in role assignment. Therefore, the two objects depicted on each experimental picture were approximately the same size, especially on pictures which illustrated spatial relationships of proximity, either in the horizontal (behind, in front of) or vertical (above, under) dimension, as apposed to enclosure (in) or contiguity (on) relations. The prepositions used in the experimental sentences were two place predicates, which denoted the spatial relationships of the two objects, and specified the locative disposition of a referent object.
with respect to a relatum object. The experimental sentences were elliptical and did not have a verb, which is valid in Russian and does not result in an ungrammatical or unacceptable sentence. In the experimental sentences referent objects were grammatical subjects and relatum objects were objects of prepositions. The drawings depicted simple objects from daily life, such as, for example, a cup, a bag, an apple. Among the four pictures provided with each experimental sentence, there was one picture that matched the experimental sentence. This picture was (1) a ‘target’. In addition, there was (2) a reversed roles picture, and two lexical distracters. The reversed roles picture depicted the objects in reversed roles; this picture is further referred to as (2) ‘reversed roles’. One of the lexical distracters showed the objects involved in a different type of spatial relationships; this is (3) the ‘lexical distracter’. The last picture depicted the reversed roles of the objects shown on the lexical distracter; this was (4) the ‘reversed role of the distracter’. An example of the test materials is shown below in figure 4.1.

Figure 4.1 Example of test materials: “The chest is in the sack”
**Procedure**

Prior to testing, the participants were instructed by the experimenter. They were asked to look at the computer screen where they would see four pictures and a sentence above them. The participants were required to read the sentence aloud, look at all four pictures and choose the picture that matched the sentence. The stimuli were presented to the participants in a semi-randomized order, so that sentences containing the same prepositions were never juxtaposed. Moreover, the location of the target picture on the screen was also semi-randomized, and correct responses in neighboring slides never occurred in the same position on the screen. This task design attempted to prevent habituation behavior of participants and to compel them to look at all four pictures and compare them to the experimental sentence in order to select the matching picture. Presentation of each slide with experimental stimuli was followed by a blank screen. The participants were allowed to take as much time as they needed to complete the task. To familiarize the participants with the task and to make sure that they understood its demands and recognized the objects depicted in the pictures, a trial session was administered during which feedback was provided. During the actual task the examiner did not give participants any feedback on their performance. During the testing procedure, one participant and the experimenter sat in a quiet room, facing the computer. Testing started with a slide that repeated the instructions in written form, which were previously given orally by the examiner. The task was split into two parts administered in two test sessions, both of which were preceded by trial sessions and instructions.

**Scoring**

The test performance of the participants was scored on the paper score form for further analysis. At the first level of analysis, all responses were first scored as either ‘correct’ or ‘incorrect’. At the second level of analysis, error patterns were analyzed; for these purposes, all incorrect responses were assigned to one of three categories depending on
the picture chosen by the participants: 1) ‘reversed roles’, 2) ‘lexical distracter’, 3) ‘reversed role of the distracter’. During scoring it was discovered that due to test confound, three experimental stimuli were confusing for half of the control speakers and caused particular difficulties for the aphasic speakers. These were experimental stimuli testing spatial relationship denoted by the preposition *pod*: “under”. Responses of all participants to these three experimental stimuli were excluded from data analysis.

*Statistical tools*

Results obtained from each participant were counted. To perform a statistical analysis, the raw scores of the correct responses of each participant were converted to proportions from the total number of responses. To preclude possible deviations from normal distribution of the data, an arcsine transformation was applied to the square root of all proportions. Since the number of participants in each group differed and, hence, the numbers of observations in each group were not equal, results of Welch tests will be reported where appropriate. The Welch test has been shown to be robust when the assumption of homogeneity of variance is compromised (Field, 2005). For the same reason, the Games-Howell procedure is used when doing post-hoc analyses following significant omnibus ANOVAs. Where necessary, results from the uncorrected post-hoc tests will also be reported. After arcsine transformation, the data were checked again for normality of distribution with Kolmogorov-Smirnov, which revealed normal distribution. In addition, Levene’s test showed that the assumption of homogeneity of variance was not violated.

*Results*

The results of the comprehension experiment will be presented here, starting with the overall results from the aphasic speakers, followed by an error analysis of the comprehension experiment data. A summary of the results obtained from the
comprehension experiment will also be presented. In all tables, the performance of participants will be presented as percentages.

The application of an arcsine transformation to the square root of all proportions allowed to perform one-way between groups ANOVA to check for performance differences among the groups. Since the assumption of homogeneity was compromised, the results of the Welch test will be reported. The results of the participant groups were found to differ significantly in the comprehension experiment \((F(2, 37) = 27.511, p<.001)\). Post-hoc comparison using a Bonferroni correction and the Games-Howell procedure showed that both the fluent aphasic speakers \((p=.009)\) and the non-fluent aphasic speakers \((p<.001)\) performed significantly worse in the comprehension test than did the group of control speakers, who performed very well here and their results will not be considered any further. Group results are shown in table 4.2; individual results of the fluent and non-fluent aphasic speakers are presented in Appendix IV, table I.

Table 4.2 Percentages of correct responses produced by control speakers, fluent and non-fluent aphasic speakers in the comprehension experiment

<table>
<thead>
<tr>
<th></th>
<th>Fluent aphasic speakers ((N_{items}=216))</th>
<th>Non-fluent aphasic speakers ((N_{items}=297))</th>
<th>Control speakers ((N_{items}=594))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct responses</td>
<td>72.58</td>
<td>57.91</td>
<td>98.65</td>
</tr>
</tbody>
</table>

Although the group of fluent aphasic speakers (72.68% correct responses) tended to perform better than the group of non-fluent aphasic speakers (57.91% correct responses), no difference emerged between the two groups of aphasic speakers in the comprehension experiment \((p=.084)\). Although, as was shown by statistical tests, no quantitative difference was found between the performances of the fluent aphasic speakers and the non-fluent aphasic speakers, in order to examine the error patterns of each more closely in a qualitative way, an error analysis will be done.
**Error analysis**

After all responses produced by participants in this experiment were scored as correct or incorrect at the first level of analysis, the focus was on incorrect responses. As described in the *Materials* section, the participants had to make a choice from four pictures. Responses with chosen lexical distracters (a lexical distracter and a reversed role of distracter) were taken together. All incorrect responses were assigned to one of the two categories: reversed roles or lexical distracters. Errors falling into either category were counted for each aphasic speaker and converted to percentages from the total number of errors for further analysis. Table 4.3 shows the choices of reversed roles pictures and distracter pictures, as percentages of the total number of errors. Individual patterns of aphasic speakers in the comprehension experiment of the pilot study are presented in Appendix IV, table II.

**Table 4.3 Percentages of error types of fluent and non-fluent aphasic speakers in the comprehension experiment**

<table>
<thead>
<tr>
<th></th>
<th>Fluent aphasic speakers (n_items=59)</th>
<th>Non-fluent aphasic speakers (n_items=125)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversed roles pictures</td>
<td>64.70</td>
<td>65.62</td>
</tr>
<tr>
<td>Other distracter pictures</td>
<td>35.29</td>
<td>34.37</td>
</tr>
</tbody>
</table>

An arcsine transformation was applied to the square root of all proportions to guard against possible deviations from normal distribution of the data. Normality tests with Shapiro-Wilk statistics showed that the data were normally distributed, which allowed the performance of one-way repeated measures ANOVA to check for interactions between categories of errors made and the groups of aphasic speakers. A significant main effect of the category of errors was found (Wilks’ Lambda=.695, $F(1,17)=7.450; p=.014$); however, no interaction between error category and fluency of aphasic speakers was observed (Wilks’ Lambda=.933, $F(1,17)=.118; p=.735$). Both groups of aphasic speakers chose reversed roles pictures in two-thirds of all errors.
Summary: Comprehension experiment

The first experiment of the pilot study investigated the abilities of the fluent and non-fluent aphasic speakers in comprehension of locative prepositions denoting spatial relationships of two objects. The main research question of this experiment was *Do aphasic speakers know and understand meanings of locative (basic) prepositions?* The phrase-to-picture matching task was administered to the participants. It was expected to cause difficulties for both groups of aphasic speakers, since from previous research it is known that although prepositions are not completely lost in aphasia they are still problematic. The overall results of the task showed that the group of control speakers performed at ceiling on this task. The fluent and non-fluent aphasic speakers produced significantly fewer correct responses than the group of control speakers, but did not differ from each other, neither quantitatively nor qualitatively. When error patterns were examined, a significant main effect of the category of error was found; however, no interaction between error category and fluency of the aphasic speakers was observed. Both groups of aphasic speakers chose reversed roles pictures more often than other distracter pictures. After the experiment was completed, the experimenter asked each participant their opinion about the task. Aphasic speakers evaluated the task’s complexity and explained anything they found particularly difficult. In general, aphasic speakers found it rather difficult both to process all the visual information that appeared on the computer screen (four experimental pictures depicting two objects each), and to keep it in mind while correlating pictures with the experimental sentence in order to choose the matching picture. The opinion and evaluation of the aphasic speakers were later taken into account when the main experiments of this thesis were designed and administered.
Pilot study: Production of locative prepositions

As mentioned at the beginning of this chapter, as a preamble to the following research described in this thesis, a pilot study with two experiments was performed. The first experiment of the pilot study examined the comprehension of simple locative prepositions. The present experiment investigates aphasic speakers’ ability to produce these prepositions. The objective of the experiment is to investigate whether aphasic speakers are able to use simple locative prepositions, when required to describe the spatial relationships between two objects. The research question of this experiment was *Are aphasic speakers able to produce locative (basic) prepositions correctly?* The group of control speakers was expected to show very good performance on this task. Both groups of aphasic speakers were expected to have difficulties with the production of correct prepositions.

**Methods**

The following work provides a description of the participant groups, the materials used in the experiment, the procedure followed and the scoring techniques used in the experiment examining the production of locative prepositions. Statistical tools will be explained at the end of this section.

**Participants**

The experiment was administered to a group of 24 Russian-native aphasic speakers and a group of 22 healthy age-matched control speakers, who previously participated in the comprehension experiment of locative prepositions. Their data are presented in Appendix III, table I. However, data of several aphasic speakers were excluded from analysis for various reasons; therefore, in the end, data of 19 aphasic speakers were analyzed.
Individual data of participants is summarized in table 4.1 in the comprehension experiment section of this chapter. Neurological data and the linguistic characteristics of the aphasic speakers are shown in Appendix III, table II.

Materials and procedure

The production experiment investigated six main types of location relations denoted by six simple non-derived prepositions: v: “in”, na: “on”, pod: “under”, nad: “above”, pered: “in front of”, and za: “behind”. The task consisted of a trial session with 8 stimuli and 30 experimental stimuli – that is, 5 experimental sentences per preposition. Each stimulus depicted a black-and-white line drawing of simple objects from daily life, such as, for example, a cup, a bag, an apple. These objects were depicted in some spatial relationship; for example, a cup was placed behind a pot; an apple was located above a pear. As previously discussed, neurologically intact speakers prefer to assign the role of the referent object that is being located to a smaller object that is in the foreground; and the role of a relatum object (in relation to which the spatial disposition of the referent object is expressed) to a larger object that is in the background (Levelt, 1996). However, this study did not aim to investigate the preferences of the aphasic speakers in role assignment. Therefore, the two objects depicted on experimental stimuli were approximately the same size, particularly in pictures which illustrated proximity spatial relationships, either in the horizontal (behind, in front of) or the vertical (above, under) dimension, as opposed to in enclosure (in) or contiguity (on) relations, where it was essential for one object to be smaller than the other to be enclosed in it. Examples of the test materials are shown in figure 4.2.
Prior to conducting the production experiment, the participants were orally instructed by the experimenter. They were asked to look at the computer screen where they would see a simple black-and-white picture depicting two objects. The participants were required to look at a picture and describe it in one simple sentence; examples of possible responses were provided. The participants were informed that sentences in their responses should be grammatical but should not necessarily contain a verb, thus, they were also allowed to use elliptical constructions. For example, a sentence such as *Sumka v jashchike*: “The bag (is) in the chest”, as well as full and complete sentences such as *Sumka nakhoditsja/lezhit v jashchike*: “The bag is located/rests in the chest” were equally acceptable. The stimuli were presented to the participants in a semi-random order, each followed by a white blank screen. Pictures in which the objects involved were in the same type of location relation were never juxtaposed in the task. The task was split into two parts and administered during two test sessions, both preceded by a trial session and instructions. The participants were allowed to take as much time as they needed to complete the task. The experiment started with a slide that repeated in written form the instructions previously given orally by the examiner. To familiarize the participants with the task and to make sure that they understood the demands of the task and also recognized the objects depicted on the pictures a trial session of four items was administered in which feedback was provided. It was a self-paced experiment. During the testing procedure, a participant and the experimenter sat in a quiet room facing the computer. As soon as the participant provided a response, the experimenter pressed a
button for a new slide to appear. The examiner did not give participants any feedback on their performance.

Scoring

The responses of the participants to the production experiment were scored on the paper score form and audio taped for further transcription and analysis. At the first level of analysis, all responses were rated as ‘correct’ or ‘incorrect’. Phonemic errors were allowed; when necessary the participants were asked to repeat their response. Subsequently, at the second level of analysis, erroneous responses were analyzed. Although in their responses aphasic speakers were expected to use a preposition to denote the locative relationship between the two objects depicted in the pictures, during scoring it was clear that this was not always the case, and their responses were variable. Aphasic speakers used adverbs to describe the pictures\(^\text{23}\); they also produced sentences that did not contain any prepositions or adverbs, and produced non-responses and unanalyzable utterances. All erroneous items were grouped into the following categories:

1. responses in which aphasic speakers produced prepositions to indicate relations between two objects in the experimental pictures; for example, *Sumka na jashchike*: “The bag is on the sack” instead of the *Sumka v jashchike*: “The bag is in the sack”;
2. responses in which adverbs were used to describe the pictures – *Sumka vnutri jashchka*: “The bag is inside the sack” instead of the *Sumka v jashchke*: “The bag is in the sack”;
3. other responses which included non-responses and un-analyzable utterances.

Among incorrect responses with prepositions, aphasic speakers produced either (1) incorrect prepositions or prepositions which denoted (2) reversed roles of the objects. When aphasic speakers produced sentences in which objects were in roles that were reversed from the ones shown in the experimental picture, these sentences were of two kinds:

---

\(^{23}\) As mentioned before, meanings of some prepositions in Russian are replicated by adverbs with similar meanings; for example, a preposition *za*: “behind” and an adverb *pozadi*: “behind”; a preposition *v*: “in” and an adverb *vnutri*: “in, inside”. 
types. For example, when a picture depicted a pot in front of a book, which can be described with sentences such as “The pot is in front of the book”: Chajnik pered knigoj, or “The book is behind the pot”: Kniga za chajnikom, the aphasic speakers produced sentences like “The book is in front of the pot”: Kniga pered chajnikom, or “The pot is behind the book”: Chajnik za knigoj; such responses were placed together in the category of reversed roles of objects.

Usage of prepositions to describe location and space does not exhaust the possibilities for talking about location. Among the responses with adverbs, the range of adverbs used was broader. As was explained in the Materials and procedure section, in the instructions and also during the trial session the participants were provided with examples of possible responses and feedback on their performance. Thus, it was made clear which responses were acceptable and which were not. All responses in which the aphasic speakers used adverbs to express the spatial relationships between the objects were rated as incorrect, since none of the control speakers produced similar utterances; all control speakers responses included prepositions as required. The aphasic speakers used adverbs that denoted correct relationships between objects in a picture: for example, the adverb vnutri: “inside”, instead of the preposition v: “in”, both mean inclusion or enclosure of one object by another. In addition, they also produced adverbs that do not allot any precise relationships between objects; for example, the adverb rjadom: “near”, which can be used to describe practically any type of relation except inclusion, as denoted by the preposition v: “in”, or attachment, indicated by the preposition na: “on”. The aphasic speakers also produced adverbs that did not relate to the spatial relationship shown in the picture, and adverbs that described the reversed roles of objects: for example, the adverb vverkhu: “above” in place of the preposition pod: “under”.

Statistical tools

For the analysis of the production experiment data the same statistical tools were used as for the previous comprehension experiment. Again, an arcsine transformation was applied to the square root of all proportions to guard against possible deviations from the
normal distribution of the data. The Games-Howell procedure and the Bonferroni correction were used in the post-hoc analyses following significant omnibus ANOVAs. In the following sections the results of the Welch test, which is rather robust when the assumption of homogeneity of variance is compromised (Field, 2005), will be reported where appropriate.

**Results**

In the following sections the results of the production experiment will be presented, starting with the overall results of the two groups of aphasic speakers, followed by the error analysis of the production experiment data. Finally, the results of the production experiment will be summarized. Henceforth, in all tables, the performance data of participants for the test will be presented as percentages.

In order to preclude possible deviations from a normal distribution, the arcsine transformation was applied to the square root of all proportions. This was allowed to run one-way between groups ANOVA to check for possible performance differences among the groups. Because the assumption of homogeneity was compromised, the results of the Welch test will be reported. For the same reason the Games-Howell procedure will be applied in the post-hoc comparisons. The results for the participant groups in the production experiment were found to differ significantly from one another ($F(2, 37) = 22.546, p < .001$). To guard against type-I errors, post-hoc comparisons were made using a Bonferroni correction, which showed that both the fluent aphasic speakers ($p = .015$) and the non-fluent aphasic speakers ($p = .001$) performed significantly worse in the production experiment than the group of control speakers, who performed at ceiling and their results will not be considered further. No difference emerged between the two groups of aphasic speakers in the production experiment ($p = .402$). Group results are shown in table 4.4.
CHAPTER IV

Table 4.4 Percentage of correct responses produced by control speakers, fluent and non-fluent aphasic speakers in the production experiment

<table>
<thead>
<tr>
<th></th>
<th>Fluent aphasic speakers (N_{items}=216)</th>
<th>Non-fluent aphasic speakers (N_{items}=297)</th>
<th>Control speakers (N_{items}=594)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct responses</td>
<td>51.67</td>
<td>36.33</td>
<td>99.11</td>
</tr>
</tbody>
</table>

The group of fluent aphasic speakers produced 51.67 percent of correct responses out of the total number of experimental items; whereas the group of non-fluent aphasic speakers produced 36.33 percent of correct responses. Individual patterns of the aphasic speakers in the comprehension experiment of the pilot study are presented in Appendix IV, table II. Error patterns of the aphasic speakers will be examined further in the error analysis.

Error analysis

After all responses produced by participants in this experiment were scored as correct or incorrect, the focus was on the incorrect responses. Although participants were expected to produce a simple (elliptical) sentence with a preposition to describe a picture, the responses were varied. As well as prepositions, adverbs were used, but a number of non-responses, and illegible, un-analyzable utterances were also produced. All incorrect items were grouped into (1) responses in which aphasic speakers produced prepositions to indicate relations between two objects in the experimental pictures, (2) responses in which adverbs were used to describe the pictures, and (3) other responses, which included non-responses and illegible un-analyzable utterances. These incorrect responses in each category were counted and converted to percentages of the total number of errors made in each group of aphasic speakers; the error patterns are shown in table 4.5. Individual scores of the aphasic speakers in the production experiment of the pilot study are presented in Appendix IV, table III.
Table 4.5 Percentage of types of error made by the aphasic speakers in the production experiment

<table>
<thead>
<tr>
<th>Error Type</th>
<th>Fluent aphasic speakers (n_items=104)</th>
<th>Non-fluent aphasic speakers (n_items=189)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect responses with prepositions</td>
<td>32.76</td>
<td>61.78</td>
</tr>
<tr>
<td>Erroneous responses with adverbs</td>
<td>51.72</td>
<td>24.61</td>
</tr>
<tr>
<td>Non-responses, un-analyzable utterances</td>
<td>15.52</td>
<td>13.61</td>
</tr>
</tbody>
</table>

To protect the data from possible deviations from a normal distribution the arcsine transformation was applied to the square root of all proportions. Normality tests with Shapiro-Wilk statistics showed that the data are normally distributed, which allowed the performance of one-way repeated measures ANOVA to check for interactions between error categories and the groups of aphasic speakers in terms of fluency. A significant main effect of the category of error was found (Wilks’ Lambda=.333, $F(2,15)=15.029; p<.001$); however, there was no interaction between error category and the fluency of aphasic speakers (Wilks’ Lambda=.767, $F(2,15)=2.281; p=.136$). Here, 32.76 percent of erroneous responses produced by the fluent aphasic speakers contained a preposition; 51.72 percent of their erroneous responses included an adverb to denote the spatial relationship of the two objects shown in the experimental pictures, and 15.52 percent of their erroneous responses were non-responses or un-analyzable utterances. In the group of non-fluent aphasic speakers, out of all incorrect responses, erroneous responses with prepositions were produced in 61.78 percent of cases, erroneous responses in which adverbs were used were produced in 24.61 percent of the responses, and other incorrect responses made up 13.61 percent of all errors.
CHAPTER IV

Error analysis: incorrect responses with prepositions

Incorrect responses with prepositions and adverbs are now examined in more detail. In the group of fluent aphasic speakers, out of all erroneous responses in which prepositions were produced, prepositions denoted reversed roles of the objects in 42.7 percent of cases; and in 57.3 percent of cases they described spatial relationships different from those presented in the pictures. In the group of non-fluent aphasic speakers, out of all incorrect responses in which prepositions were produced, in 52.3 percent of cases prepositions denoted reversed roles of the objects and in 47.7 percent of cases the spatial relationships were different. Error patterns of the aphasic speakers are shown in table 4.6.

Table 4.6 Distribution of errors with prepositions (as percentages) of the fluent and non-fluent aphasic speakers in the production experiment

<table>
<thead>
<tr>
<th>Prepositions denote reversed roles of objects</th>
<th>Fluent aphasic speakers (n_items=34)</th>
<th>Non-fluent aphasic speakers (n_items=117)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepositions denote incorrect spatial relationships of objects</td>
<td>57.3</td>
<td>47.7</td>
</tr>
</tbody>
</table>

The arcsine transformation was applied to the square root of all proportions to preclude possible deviations from the normal distribution of the data. Shapiro-Wilk normality tests showed that the data are normally distributed, which allowed the performance of one-way repeated measures ANOVA to check for interaction between categories of errors and the groups of aphasic speakers. Neither a significant main effect of the category of error (Wilks’ Lambda=.994, F(1,16)=.095; p=.762), nor an interaction between the error category and the fluency of the aphasic speakers was found (Wilks’ Lambda=.973, F(1,16)=.449; p=.512).

There are two possible reasons why aphasic speakers produced incorrect prepositions. Either they failed to identify the correct spatial relationships of the two
depicted objects, or they failed to denote these relations correctly with an appropriate preposition; in both scenarios an incorrect preposition was used. As for the production of sentences in which prepositions indicated the reversed roles of the depicted objects, it could be assumed that the spatial relationship of the two objects were identified correctly, but the assignment of referent-relatum roles was impaired. For example, the experimental picture depicted a cup in front of a glass. Taking into account the preference of neurologically intact speakers to assign the role of a referent object A, which is being located in relation to a smaller and/or to a more foregrounded object, and the role of a relatum object B to a larger and/or to a more backgrounded object (Levelt, 1996), “a cup” is more likely to be interpreted as a referent object A, because it is located in the foreground, and “a glass” as a relatum object, which is a more remote object located in the background. If aphasic speakers produced responses like, *Chashka za stakanom:* “A cup is behind the glass”, instead of *Chashka pered stakanom:* “A cup is in front of a glass”, they preserved the referent-relatum roles, because they located a cup with respect to a glass. Thus, the cup is still a referent object A, and the glass is a relatum object B; however, the location of the two objects is reversed by means of an incorrect preposition. If they produced responses such as *Stakan za chashkoj:* “A glass is behind a cup”, instead of *Chashka pered stakanom:* “A cup is in front of a glass”, they reversed the referent-relatum roles; now the glass is a referent and the cup is a relatum, and they used a correct preposition. Since it would go beyond this study to investigate referent-relatum role assignment preferences of aphasic speakers, these two types of preposition errors were taken together in the analysis – hence, they were not contrasted. However, the general observation was that aphasic speakers tend to keep the referent-relatum roles of the objects and made errors with the production of a preposition.
Error analysis: responses with adverbs

The use of prepositions to describe spatial relationships of objects does not exhaust the possibilities for talking about location; therefore, the responses with adverbs produced by aphasic speakers are now examined in more detail. It should be noted, however, since the total number of items in the experiment was not very large, and in the error analysis diverse errors were encountered in the responses of both groups of aphasic speakers, the raw numbers were converted to fractions and, thus, each error category comprised just a small number of responses. Therefore, no statistical analysis was performed on these data; instead, only the most frequent type of responses, with adverbs produced in each group of aphasic speakers, are discussed briefly.

When the group of fluent aphasic speakers produced responses containing adverbs instead of the required prepositions to denote spatial relationships, about half of these adverbs indicated incorrect spatial relationships of the depicted objects. In the group of non-fluent aphasic speakers, among all erroneous responses in which adverbs were produced, more than half of them described the correct spatial relationship, and thus were equivalent to the required prepositions. For example, instead of the required preposition \( v: \) “in”, the adverb \( vnutri: \) “inside” was used.

Summary: Production experiment

The second experiment of the pilot study examined the abilities of fluent and non-fluent aphasic speakers to produce simple locative prepositions denoting spatial relationships. The main question of this experiment was Whether aphasic speakers are able to produce locative (basic) prepositions? The participants were required to describe a black-and-white picture depicting two objects from daily life in one simple sentence. From the precedent research, prepositions are known to be vulnerable in aphasia and subject to omissions and substitutions. The overall results of the present production experiment showed that production of prepositions is indeed problematic for both groups of aphasic speakers. Whereas the group of control speakers performed very well in the task, both
groups of aphasic speakers, fluent and non-fluent, produced significantly fewer correct responses than the group of control speakers. However, there was no quantitative difference between the groups of aphasic speakers. In the error analysis all erroneous items were grouped into three categories: (1) responses in which aphasic speakers produced prepositions to indicate the relations of the two objects in the experimental pictures, (2) responses in which adverbs were used, and (3) other responses, which included non-responses and illegible, un-analyzable utterances. A significant main effect of the category of error was found; however, no interaction between the error category and fluency of the aphasic speakers.

Furthermore, when the erroneous responses with prepositions were examined in more detail, the responses were divided into (1) responses with prepositions denoting reversed roles of objects, and 42) responses with other incorrect prepositions. However, neither a significant main effect of the category of error with prepositions, nor an interaction between error category and fluency of the aphasic speakers were found. Finally, the responses with adverbs produced by aphasic speakers were examined. Whereas the non-fluent aphasic speakers mostly chose an adverb that expressed an appropriate spatial relationship between the two objects, the fluent aphasic speakers’ choice of an adverb was incorrect in more than half of these items. This means that the chosen adverb indicated other spatial relationships of the objects depicted. In the group of non-fluent aphasic speakers, among all responses with adverbs, more than half of adverbs signified relations correctly and were equivalent to the required prepositions.

**Production and comprehension compared**

For both groups of aphasic speakers, performances on the comprehension and the production experiments were compared, which is shown in figure 4.3, below. A one-way repeated measures ANOVA with a between-group factor of fluency (fluent vs. non-fluent aphasic speakers) and a within group factor of experiment (production vs. comprehension) was run to check for interaction between experiment performance and type of aphasia. A significant main effect of the experiment was found (Wilks’
Lambda=.670, $F(1,16)=7.894; p=.013$), but no interaction between experiment and fluency of the aphasic speakers emerged (Wilks’ Lambda=1, $F(1,16)=0.004; p=.948$). Both groups of aphasic speakers performed better in the comprehension experiment than in the production experiment.

![Figure 4.3 Percentage of correct responses by the fluent and non-fluent aphasic speakers in the comprehension and production experiments](image)

**Figure 4.3** Percentage of correct responses by the fluent and non-fluent aphasic speakers in the comprehension and production experiments

**Conclusions and discussion**

The research reported in this chapter was an exploratory pilot study, which was a proem to a series of subsequent experiments to examine prepositions in the narrative speech of fluent and non-fluent aphasic speakers. This was undertaken to investigate the abilities of aphasic speakers in the use of particular prepositions and the implementation of case marking of the complement nouns of these prepositions.

The pilot study assessed by means of two experiments whether aphasic speakers are able to comprehend the spatial relationship between two objects denoted by a locative...
preposition, and whether aphasic speakers are able to use prepositions to express the spatial relationship between objects. In other words, the two experiments were conducted to explore whether the abilities of the aphasic speakers to comprehend prepositions and use them when required are preserved. The experiments of the pilot study investigated simple non-derived locative prepositions that denoted the spatial relationships of two objects, because locative meanings of prepositions are considered to be their core meanings comparable, for example, to time, cause, and reason.

In previous studies carried out on several languages, prepositions were found to be particularly susceptible to damage in aphasia; however, there are similarities as well as discrepancies in the aphasiological studies. Wernicke’s and Broca’s aphasic speakers of American English were reported to be impaired in processing prepositions that denote location and direction (Friederici, 1981). Broca’s aphasic speakers were found to omit prepositions in production tasks; they rarely substitute them, either across or within categories. In the same study, Wernicke’s aphasic speakers were reported to show the opposite pattern and substituted prepositions within the category quite often. The results of the production experiment carried out on Russian and reported in this chapter also showed that production of locative prepositions denoting spatial relationships is impaired in both groups of aphasic speakers, since they both performed significantly worse than the group of control speakers. That is, the production of locative prepositions in aphasia was found to be impaired, albeit not impossible. However, contrary to the findings of Friederici (1981), the Russian non-fluent aphasic speakers did not omit prepositions in production, but substituted prepositions fairly often. It should be noted that the participants of the production experiment were required to describe experimental pictures in one simple sentence. Prior to the actual testing a trial session was administered, during which feedback and examples of possible responses were provided. In Russian, it is possible to produce elliptical sentences deprived of verbs which are still grammatically correct; thus, the participants were allowed to produce utterances like Chajnik pod knigoj: “The teapot under the book”, which lack a verb, but have obligatory prepositions. Omission of a preposition in such a sentence would render a sentence consisting of two nouns not only grammatically incorrect and unacceptable, but also incomprehensible and semantically void. Probably this fact prevented the non-fluent aphasic speakers from
preposition omissions and provoked substitutions of prepositions across and within the
category, when production of a correct preposition was either difficult or impossible for
them. The substitution errors made by the non-fluent aphasic speakers were more
numerous within category than across category, which is partially in line with the
findings of Leikin (1998, 2001), who claimed that Russian Broca’s aphasic speakers
substituted prepositions either with other prepositions or adverbs. The non-fluent aphasic
speakers tested in the production experiment not only substituted the required
prepositions for other prepositions denoting other spatial relationships, but they also
produced adverbs to describe the experimental pictures. More than half of these adverbs
denoted the spatial relationships correctly and were, thus, equivalent to the required
prepositions. For example, instead of the required preposition \textit{v}: “in”, the adverb \textit{vnutri}: “inside” was used.

In Friederici’s work (1981), Wernicke’s aphasic speakers of American English
tended to substitute prepositions within the category, which was interpreted as a selection
disorder within a correct category which, according to the author, proved a semantic
disorder of this aphasia type. The Russian fluent aphasic speakers who participated in the
production experiment substituted prepositions across the category more often than they
did within the category. They produced adverbs quite often; about half of these adverbs
denoted incorrect location of the two objects depicted in the experimental pictures.
Although the pictorial stimuli used in the experiment were very simple and did not cause
difficulty for the control speakers, for some aphasic speakers the pictures seemed to be
too schematic. Most difficulties were caused by those pictures in which the two objects
were not in direct contact. For example, if a bag was located above a box, some aphasic
speakers would comment on these pictures, claiming that the two objects cannot be
spatially located in such a way. However, when aphasic speakers had to describe a
picture on which a sack stood on a drawer, which is visually similar to the previously
described pictures, the only difference being that the two objects are in direct contact
with each other, this picture did not cause any complaints.

In several studies, non-fluent (Broca’s) aphasic speakers were found to be more
impaired in production and comprehension of prepositions than fluent (Wernicke’s)
aphasic speakers (Friederici, 1981; Leikin, 1998, 2001). Other studies reported finding no
difference between the two groups either in quantitative or qualitative terms (Mack, 1981). In this study, it was found that production and comprehension of prepositions is problematic for both groups of aphasic speakers. When the performance of the groups of aphasic speakers in production and comprehension experiments were compared, a significant main effect of the experiment was found, but no interaction between the experiment and the fluency of the aphasic speakers emerged. In other words, the comprehension experiment was easier to perform for both groups of aphasic speakers. Based on the results of the experiments, it could be claimed that production of locative prepositions is difficult for fluent and non-fluent aphasic speakers. However, prepositions are not lost completely in aphasia. Even though both groups of aphasic speakers performed worse than the group of control speakers in the comprehension experiment, the aphasic speakers still performed above chance. It is possible that although the test design was straightforward and the experimental stimuli did not cause any difficulties for the control speakers, it was still demanding for the aphasic speakers. Some aphasic speakers claimed that the visual information they saw on the computer screen was too complex with four pictures depicting two objects. All this was difficult to conceive and memorize while performing the task. Both groups of aphasic speakers often chose pictures depicting reversed roles of objects. On the one hand, this is definitely an incorrect choice, whereas it can also be interpreted in favor of preservation of locative relations in aphasia. When aphasic speakers pointed to a picture with reversed roles of objects, they chose the same spatial relationships of the two objects as in the target picture, but the assignment of the referent-relatum roles to the objects failed. In other words, if the experimental sentence was Stakan za tarelkoj: “A glass is behind a plate”, and the aphasic speakers pointed to the picture where a plate was behind the glass, the spatial relationship was defined correctly – an object A was located behind an object B – but the assignment of the referent-relatum roles was incorrect. In both cases the location of objects was correct, but their orientation in relation to each other was incorrect. These results could be interpreted as proof that both groups of aphasic speakers are able to perceive spatial relationships correctly, and that spatial relationships denoted by locative prepositions are still preserved in aphasia, but the interpretation of these prepositions is
impaired, and aphasic speakers have difficulties employing prepositions to denote these relations.

**Codicil**

These two experiments constituted an exploratory pilot study administered prior to other experiments that aimed to investigate aphasic speakers’ abilities to produce and comprehend prepositions. Moreover, there were complementary aims that were not insignificant. On the one hand, this study performed the role of a screening device for the aphasic speakers, on the basis of which they were included (or not) in the following experiments. On the other hand, it also allowed the experimenter to see what technical problems aphasic speakers might face in the experiments, such as, for example, difficulties with experimental pictures, or with procedure and instructions, which could be precluded in further experiments. After the experiment was completed by each aphasic speaker, they were again asked to judge the task’s complexity and explain their specific difficulties with it. The results of these two experiments are deliberately not taken as a basis for substantial claims concerning patterns for aphasic speakers in comprehension and production of simple locative prepositions. In the framework of this project, the main goal of the pilot study was to ensure the possibility of performing other experiments examining prepositions in the narrative speech of aphasic speakers, and to investigate their ability to use particular prepositions and implement the case marking of the complement nouns of these prepositions. After this pilot study showed that production and comprehension of locative prepositions in aphasia is not completely lost (although it is impaired), it was decided to examine prepositions in the narrative speech of aphasic speakers, which will be discussed in the following chapter. In a broader sense, the results of these two experiments can serve as guidance for possible future research: for example, of aphasic speakers’ preferences in referent-relatum role assignment and the influence of aphasic disturbances on the patterns of these roles.
CHAPTER V

CASE, CASE ASSIGNMENT AND PRODUCTION OF PREPOSITIONS IN NARRATIVE SPEECH

This study aims to provide an analysis of the production of prepositions and prepositional phrases in relation to case marking in the narrative speech of Russian aphasic speakers. The narrative speech corpus of six fluent and six non-fluent aphasic speakers and ten neurologically intact speakers was collected in three ways: a semi-conducted interview was carried out according to the guidelines of the Aachen Aphasia Test (AAT; Huber et al., 1983), a description of the ‘Cookie Theft’ picture from the Boston Diagnostic Aphasia Examination Test (BDAE; Goodglass & Kaplan, 1983), and a narration of the ‘Little Red Riding Hood’ fairy tale. The entire narrative speech corpus was transcribed and analyzed and this chapter discusses methods, details of participants, transcription procedure, scoring, analysis, and results acquired.

Analysis of narrative speech

Ferdinand de Saussure was the first to distinguish between langue, langage and parole. He regarded language (langage) as a system of signs used to express ideas, which has two components – langue and parole. Langue is an abstract system of language functions and relations that is accepted in a given speech community. Parole is an individual act of speech that puts langue into action: “Dans le langage; la langue a été dégradée de la parole; elle réside dans l’aime d’une masse parlante, ce qui n’est pas le cas pour la parole” (de Saussure, 2002 [1907-1911]: 333). The ability to communicate through verbal signs is “a purely human a non-instinctive method of communicating ideas, emotions, and desires” (Sapir, 2005: 7). As a result of brain damage this ability can be impaired in any language modality; language production and/or comprehension can be