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14th International Science of Aphasia Conference

Science of Aphasia

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PREFACE

Dear participants,

We are very pleased to welcome you to the 14th Science of Aphasia conference which is held in Brussels, Belgium from September 20th to September 25th 2013. The Science of Aphasia conferences are intended to bring together senior and junior scientists working in the multidisciplinary field of the Neurocognition of Language and it focuses on both the typical and atypical aspects of neurocognition. The number of participants is restricted to about 120 in order to facilitate interaction between the delegates. The focus of this year's conference is on Cognition, language and their impairments.

This year's conference is organized by the members of the research group "Clinical and Experimental Neurolinguistics" (CLIEN) of the Vrije Universiteit Brussel in cooperation with the departments of Neurology of ZNA Middelheim Hospital, Antwerp and the University Hospital of Brussels (UZ Brussel). The primary aim of the research group CLIEN is to conduct innovative clinical and experimental research in the multi-disciplinary field of brain-cognition-behaviour relationships. A close cooperation between CLIEN and the related neurosciences concentrates on a variety of clinical and experimental research topics, including awake neurosurgery, cerebellar neurocognition and affective processing, atypical cerebral organisation of linguistic and cognitive functions, aphasia, foreign accent syndrome, chronic aphasia rehabilitation, aphasia in children, Landau-Kleffner syndrome, the neurocognitive and neurobiological substrate of multilingualism and multilingual education, neurolinguistic correlates of language attrition or language loss.

The conference is held in the Academy Palace, which is the seat of the Royal Flemish Academy of Belgium for Science and the Arts. This Royal Society aims to stimulate independent and interdisciplinary reflection about societal and scientific problems and developments in the arts. The Academy Palace was built between 1823 and 1828 for Prince William of Orange: it is a fine example of neoclassicist style which is characterized by harmonious geometrical proportions and renassiance symmetry. Academy Palace is situated halfway between the Royal Palace on one side of Warandepark and the Belgian Parliament on the other side. Many Belgian ministers have their official residence in this neighbourhood. Take the opportunity to wander around the modest garden of this building because it has several interesting statues from well-known sculpturers such as Auguste Rodin.

Brussels is a city with many faces. It is well known as the Capital of Europe with the European Parliament being situated just round the corner of this conference venue. It is a historic city with origins going back to the 10th Century. Particularly

spectacular is the historic market place with its magnificent 15th century Town Hall and its beautiful Guild houses. Brussels is also the Capital of Art Nouveau with many buildings that are recognized as World Heritage by UNESCO. The brilliant designs of architects such as Victor Horta and Paul Hankar continue to amaze. But first and foremost, Brussels is a city of the good life: excellent food, cosy pubs and trendy restaurants, and of course Belgian beers some of which are unique in the world.

We wish you an intellectually stimulating conference and a most enjoyable stay in Brussels.

Jo Verhoeven & Peter Mariën

On behalf of the Local Organising Committee

Organization

The 14th International **Science of Aphasia Conference** is held in Brussels, Belgium, September 20 - 25, 2013

Local organizing committee 2013
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Conference Program

Friday, September 20, 2013

Arrival, Registration & Welcome Reception

17:30 Registration
18:00 Welcome reception

Saturday, September 21, 2013

Conference Opening

Session 1: Language and Cognition

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10:00 - 11:00 *Dan Bub:* Language and cognition
11:00 - 11:30 Coffee break
11:30 - 12:30 *David Caplan:* Language and cognition impairments

12:30 - 13:30 Lunch

13:30 - 14:30 Contributed Papers I

Djaina Satoer et al.: Long term cognitive functioning after glioma surgery in eloquent areas 1
Elke De Witte et al.: A standard neurolinguistic approach to awake brain surgery 4
Vânia de Aguiar et al.: Event related potentials of the processing of reflexives, pronouns and referential violations 8

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11:00 - 11:30 Coffee break
11:30 - 12:30 *Mieke van de Sandt:* Childhood aphasia

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Andrés Felipe Reyes& Roelien Bastiaanse: When object clitisation and climbing happen alone, and when they dance cheek to cheek: Selective impairment in Spanish agrammatism 149
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11:00 - 11:30 Coffee Break
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12:30 - 13:30 Lunch

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Departure

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32.8310/S01/1813-1

Long term cognitive functioning after glioma surgery in eloquent areas

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Introduction

Cognitive performance is an important outcome measure in treatment of low-grade gliomas (LGGs), since it is a crucial aspect of Quality of Life. LGGs are slow growing brain tumours infiltrating the central nervous system, often in the proximity of eloquent areas. During brain surgery, direct electrocortical stimulation is nowadays used to identify individual functional boundaries to prevent permanent neurological and/or cognitive damage[1]. Previous studies have shown that LGG patients have pre-operative deficits in one or more cognitive domains, such as language, memory, attentional and executive functions which may even deteriorate after glioma surgery. Most studies claim that these impairments are transient and recover within 3 months[2-4]. Our short follow-up at 3 months, however, still showed cognitive deterioration[5] post surgery. Long term follow-up is necessary to gain more insight into the course of recovery.

Methods

Cognitive functioning of 45 patients (mean age 39 y.) with presumed LGG in the left hemisphere (apart from 3 patients) was assessed before awake craniotomy (T1) and 3 months (T2), and 1 year (T3) afterwards with an extensive neuropsychological test-protocol: Aachener Aphasia Test-repetition, -reading aloud and -writing to dictation; *B*oston *N*aming *T*est; Verbal (Category and Letter) Fluency; Verbal Memory (15WT inprenting and recall); *T*rail *M*aking *T*est A,B and Stroop Colour-Word Test I-III. We compared pre- and post-operative mean scores of the patients to normal population. Within the patient group, comparisons were made to investigate the short term effect of surgery (T1-T2), the course of recovery (T2-T3) and the long term effect of surgery (T1-T3). Correlation analyses were conducted between significant change scores and tumour-characteristics, i.e. pathology (low-high grade), volume and tumour localization (language or non-language).

Results

Compared to normal population, patients were impaired at T1 on BNT, Category Fluency, Letter Fluency, 15WTinpr, 15WTrecall, TMTA, Stroop I,II, and III (p<.01, Stroop III p<.05). At T2, mean performance was disturbed on the same tasks in addition of TMTB (p<.05). At 1 year, Stroop interference was also impaired (p<.05), whereas TMTA and TMTB recovered (p>.05). Within the patient group, performance on 15WTrecall improved at T2, whereas deterioration was found on Category Fluency (p<.05). Improvements were observed between T2 and T3 on BNT and Letter Fluency ($p\leq$.05). There was no influence of tumour-related variables on cognition, apart from a positive correlation between pre-operative volume and 15WT (inprenting and recall) (Pearson r=-0.343, p=0.028; Spearman r=-0.316, p=0.047, respectively).

Discussion

This is the first study that investigated the long term effects of glioma surgery on cognition. Apart from deterioration on Category Fluency and improvement on verbal memory (recall), surgery did not induce major cognitive changes. We found that language recovery (naming and letter fluency) post surgery takes longer than 3 months, in contrast to what most studies have documented so far. The observed improvement in phonological fluency at longer term may be accounted for by bilateral frontal lobe compensation in tumour patients or by anterior/posterior compensation (both LH and RH), whereas semantic fluency, which deteriorated, may be more specific to left hemispheric functioning and thus less beneficial of bilateral compensation[6]. Selective improvement of memory and attentional functions at both short and longer term after surgery was already observed[2, 7]. Short term improvement of verbal memory may be accounted for by the release of mass effect, which remains stable due to the slow growth rate of LGGs (4 mm p/y)[8]. The long-term recovery in the executive domain could be mediated by a close connection between verbal working memory neural networks (which improved) and processes of selective attention[9]. Tumour-characteristics and localization were no additional risk-factors for cognitive change. These results underline the importance of cognitive testing at longer term, with Category Fluency as an essential task to assess, pre-, during, and post-operatively and also as a target for rehabilitation. In addition, deterioration on the sensitive language tasks, BNT and Letter Fluency, could possibly be a sign of tumour recurrence.

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A standard neurolinguistic approach to awake brain surgery

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Introduction

Intraoperative language mapping is increasingly used in patients operated on for tumours in eloquent areas. Direct electrical stimulation (DES) enables to identify critical cortical and subcortical language areas and pathways which cannot be resected without permanent language deficits (Duffau, 2007). Although a positive impact of DES on postoperative linguistic outcome is generally advocated, the literature is only scantily documented with information about the linguistic methods applied in awake surgery. Moreover, linguistic testing during DES is generally limited to object naming and counting tasks (De Witte & Mariën, 2013; De Witte et al., 2013). No studies exist in which in addition to spontaneous speech (Satoer et al., 2013) a standardised linguistic protocol, assessing different linguistics levels, is used to identify the critical language zones. For the first time we developed a standardised linguistic test battery for awake surgery in critical language areas.

Methods

The test battery, called DuLIP (Dutch Linguistic Intraoperative Protocol) includes phonological, semantic, syntactic and verbal motor production and perception tests (see Table 1) (De Witte et al., 2013). For the composition of the linguistic tests, the Dutch databases CELEX (Baayen et al., 1993) and SUBTLEX-NL (Keuleers et al., 2010) were used and the test items were controlled for the variables frequency, imageability, word length, morphological and phonological form.

A normative study was conducted in a control group of native Dutch-speaking adults (N=250). Means and standard deviations were calculated per linguistic test. In addition, DuLIP is used in a study group of patients with brain tumours (N=10) in the pre-, intra- and postoperative phase of awake surgery. Intraoperative anatomoclinical correlations were made and compared with preoperative fMRI findings to identify eloquent language areas. Pre- and postoperative (6 weeks postsurgery) linguistic test results will be compared in the patient group to study early linguistic outcome.

Table 1: Intraoperative linguistic tests from DuLIP

Timing of assessment(s)	**Linguistic level**	**Task**	**Stimuli**
START DES	Awakening phase	- counting - automatic sequences - orientation questions	- counting from 1 to 10 (over and over again) - days of the week, months of the year - Which day is it? Where are we?
DURING DES (in 4 seconds)	Phonological level	- repetition of 3-syllabic words with alternating word accents - repetition of 2-syllabic words - repetition of words with phonemic similarities - repetition of words with consonant clusters - repetition of sentences - reading with phonological odd word out*	- agénda, óliebol, hypothéék - konijn, váder s - individu - programma - De kok bakt een taart. - rek, nek, **mat**, hek (answer mat)
	Semantic level	- object naming, 100 objects* - reading with semantic odd word out* - naming with semantic odd word out* - semantic association task* - sentence completion (semantically induced sentences)*	- black and white drawings of objects - been, arm, **raam**, voet (answer raam) - pictures of '**borstel**, hond, kat' (answer borstel) - auto, fiets, … (answer e.g. bus) - Hij snijdt met een … (answer e.g. mes)
	Syntactic level	- verb generation* - action naming (3rd person singular, transitive verbs), 60 actions* (RUG-VUB, Rofes A., Bastiaanse R.)	- bal -> gooien/werpen - de man … (answer e.g. loopt) (e.g. picture of a man who is running)
	Verbal motor - praxia	- verbal diadochokinesis test	- repeat /papapa/, /pataka/, /papopu/, /pafpafpaf/, /dafnaflaf/, /pafpofpuf/, /pafpaspaf/ (5x)
NOT DURING DES DURING RESECTION	Phonological level	- phonological sentence judgment - phonological fluency	- De hokkel eet een gersie. (wrong) - Letters D, A, T
	Semantic level	- semantic sentence judgment - semantic fluency - sentence comletion (less semantically induced sentences)*	- Het stoplicht wacht op de kameel. (wrong) - animals/jobs - Om 5 uur …
	Syntactic level	- syntactic sentence jugdment - verbal fluency (verbs)	- Hij koopte snoep. (wrong) - verbs

* presented with a laptop screen and powerpoint + beep

Subjects

The control group consisted of female and male adults with different educational levels (primary, secondary, tertiary). Age distribution was selected on the basis of current statistics of the prevalence of supratentorial tumours in the general adult population (30% between 18-50 years, 55% between 50-75 years, 15% older than 75 years (Van Eycken, De Wever, 2006)). Control subjects were recruited from different Flemish and Dutch provinces. The inclusion criteria were: Dutch as mother tongue, no history of cardiovascular, neurologic, psychiatric, or developmental disorders, no drug or alcohol abuse, normal vision, normal hearing, no excessive use of medication and a Mini Mental State score higher than 24/30.

The study group included 10 patients with gliomas in the left hemisphere close to language or motor areas. Exclusion criteria were as follows: history of a medical or psychiatric condition known to affect cognitive functioning, permanent motor or language deficits as a result of prior treatment, preexisting language deficits, deafness or severe visual disorder, and mental retardation (Satoer et al., 2012).

Statistical methods

SPSS Statistics (v. 20) was used to analyse the data. All data were checked for normality through a 1-sample Kolmogorov-Smirnov test and a Shapiro-Wilk test. Non-parametric tests were used for data not normally distributed.

For the normative study, the data of 250 participants were investigated. To assess the degree of association between two variables, a Pearson product-moment correlation coefficient or Spearman correlation was calculated. The mean data between two groups (gender) were compared using an independent samples t-test or Mann-Whitney U test. The mean data among three or more groups (age, education groups) were compared using analysis of variance (ANOVA). Subsequently, Bonferroni post hoc analyses were conducted or the Kruskal Wallis Test with Mann-Whitney U test. Finally, means, standard deviations, ranges and cut-off scores were calculated for each linguistic subtest.

For the experimental study, the correlation between preoperative fMRI activations and intraoperative positive stimulation points was calculated in percentages. The pre- and postoperative data will be compared with the normative data using a 1-sample t-test or the Wilcoxon signed-rank test to determine whether they differ from the average of the normal group. Subsequently, the pre- and postoperative data will be compared with paired-samples t-tests or the Wilcoxon signed-rank test to evaluate early linguistic outcome.

Results

Analysis of control data revealed that performance on all linguistic subtests from DuLIP is significantly affected by age and years of education, resulting in distinctive age groups (18-49y; 50-74y, >75y) and education groups (primary, secondary, tertiary). Means and standard deviations are provided for each age and education

group per linguistic subtask. The intraoperative data of the study group revealed a number of unexpected anatomoclinical findings that were not predicted by preoperative fMRI findings or classic language-brain models. The correlation between fMRI and DES was only 60%. Analyses of pre- and postoperative linguistic results showed mainly impairment in fluency and naming tasks. The comparison between pre-, intra- and postoperative linguistic results will be described by means of some illustrative cases.

Discussion

With the development of a standardised linguistic test battery a valuable instrument has now become available to reliably identify linguistic functions in Dutch patients undergoing awake surgery in eloquent brain regions. Preliminary patient data indicate that application of the test battery during DES and during surgical resection of the tumour substantially increases intraoperative comfort and preservation of linguistic function. In addition, this standardised linguistic tool might be a valuable approach to enhance the scientific reliability of the neurosurgical procedure. It allows a number of additional analyses and comparisons of the data collected by means of the standardised protocols.

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Event related potentials of the processing of reflexives, pronouns and referential violations

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Introduction

Discourse level processes are often challenging for individuals with agrammatic aphasia (Avrutin, 2006; Bastiaanse, Bamyaci, Hsu, Lee, Yarbay Duman, & Thompson, 2011). Research focused on these processes can help to explain the impairment that underlies specific aphasic symptoms.

Several theories predict processing differences between reflexives and pronouns. Whereas the processing of reflexives requires highly automatic processes that occur within narrow syntax, the processing of pronouns requires the more expensive process of linking to information previously mentioned in discourse (Pesetsky, 1987; Reinhart & Reuland, 1993; Reuland, 2001; Avrutin, 2006).

The establishment of discourse dependencies was compared with syntactic dependencies using Event Related Potentials (ERPs), eliciting N400 effects (Burkhardt; 2005; Burkhardt, 2007) and an Nref effect (Leitão, Branco, Piñango, & Pires, 2009; Nref, Van Berkum, Brown and Hagoort, 1999). In these studies, the negativities were interpreted as markers of the extra processing costs required to establish discourse dependencies. A question remains: which are the extra processes that make pronouns more costly to process?

From previous ERP research we also learned that syntactic information is used both in co-indexation (number information, Harris, Wexler, & Holcomb, 2000) and co-reference (gender information, Lamers, Jansma, Hammer, & Münte, 2006). Which other sources of information are useful in the establishment of co-indexation and coreference?

Methods

Participants

Twenty-eight right handed native speakers of European Portuguese with normal or corrected to normal vision and audition (7 per list, 13 female) were included in this dataset. Mean age was 42.59 (SD=11.31) and mean educational level 9.06 years (SD=2.61).

Materials

We created 80 sentence pairs including verbs that can be used with a pronoun or a reflexive in European Portuguese as in the example (1). Each participant heard 260 sentence pairs, in continuous natural speech (20 practice items, 80 experimental items and 160 fillers).

(1) The carpenter$_{[NP1]}$ is with the client$_{[NP2]}$. The carpenter$_{[NP3]}$ hurts *him/himself*$_{[NP4]}$ with a hammer.

We used a 2x2 factorial design with the factor 'sentence' (levels: 'pronominal' or 'reflexive') and the factor 'context' (levels: 'matching' or 'not mismatching'). For the 'not matching' conditions, the 'reflexive' sentence was used with the picture suitable for the 'pronominal' sentence, and vice-versa. The mismatching conditions generated referential violations, given that the picture and the sentence were incongruent in the identity of the antecedent for the reflexive and pronoun.

Procedure

For each experimental trial participants saw a picture and heard a sentence pair containing either a reflexive or a pronoun. After sentence offset, participants judged whether the sentence pair matched correctly the pictures. Continuous EEG signal was recorded with 64 pin-type electrodes. External electrodes were used for eye-movement artifact rejection and for offline referencing to the joint mastoid average.

Results

Participants responded with high accuracy (87%) to sentences with reflexives and pronouns, as well as to the referential violations. The comparison of pronouns versus reflexives in sentences correctly matched to pictures revealed a greater negativity for pronouns at anterior sites in the 200-300ms time window, larger at the midline and right hemisphere electrodes ($F(1, 27)=7.098$, p=0.013). The referential violation effect was similar for both reflexives and pronouns, consisting of a negativity over central ($F(1,27)= 6.751$, p=0.015) and posterior ($F(1,27)=10.772$, p=0.003) electrode sites from 300-500ms. For pronouns, the referential violation effect started at posterior sites from 200-300ms, extending to central sites from 300-500ms ($F(1, 27)=8.751$,p=0.006). A comparison of referential violations for reflexives and for pronouns revealed further negativity for the referential violation

of pronouns at anterior sites, from 500-800ms ($F(1,27)$=6.805, p=0.015). Figure 1 shows the ERP waveforms for each comparison.

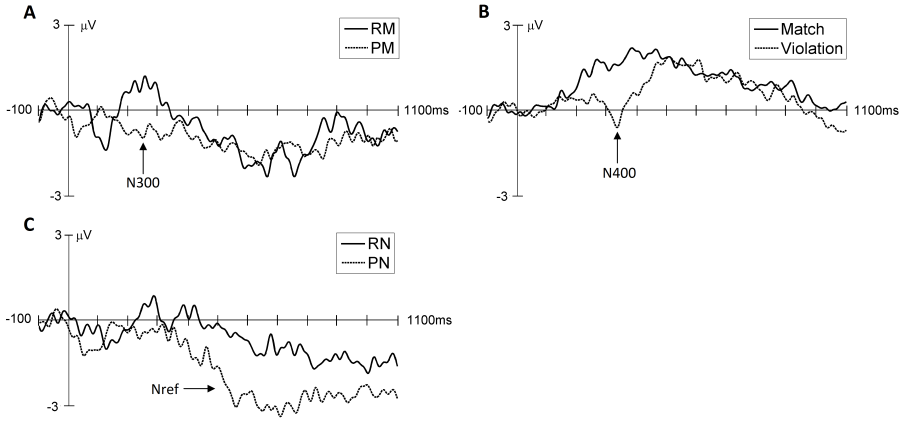

Figure 1: Summary of ERP data for pronouns, reflexives and referential violation
Panel A: anterior electrode sites; RM = sentence with reflexive pronoun, matching the picture; PM = sentence with personal pronoun, matching the picture. Panel B: central and posterior sites; Matched = sentence with reflexive/pronoun, matching the picture; Violation = sentence with reflexive/pronoun, not matching the picture. Panel C: anterior electrode sites; RN = sentence with reflexive pronoun, not matching the picture; PN = sentence with personal pronoun, not matching the picture.

Discussion

We found differences in the neurophysiological responses for pronouns and reflexives when correctly matched with pictures, consistent with an N300 effect (Barrett & Rugg, 1990). Such effect reflects the retrieval of image based representations (Gunter & Bach, 2004) and the processing of global coherence (West & Holcomb, 2002). Consider the example (1) above. Rule I (Grodzinsky & Reinhart, 1993) states that coreference with discourse objects occurs if the use of co-indexation changes the meaning of the sentence. Knowledge of this rule can be used to exclude NP3 as an antecedent of the pronoun. At this point, NP1 and NP2 are both suitable antecedents considering grammar and meaning. The retrieval of information based on context, as index by the N300 effect, may help to disambiguate between them.

The referential violation effect found both for reflexives and pronouns matches the characteristics of the N400 effect (Kutas & Hilliard, 1980). The referential violation seems to be treated as a conceptual violation. This indicates that, even if syntactic processes are used in co-indexation and co-reference, the acknowledgment of the

identity of an antecedent is achieved through conceptual and not syntactic steps. Another relevant finding is that, even though context is important to interpret pronouns, participants respond accurately when context provides misleading information. We assert that participants here use a Semantic-Pragmatic Inference that allows them to disambiguate between the possible antecedents available in linguistic discourse.

(2) If NP*x* does not co-refer with NP*y* [a pronoun], then NPs that co-refer with NP*x* do not co-refer with NP*y*.

A direct comparison of the two violation types originated a sustained anterior negativity, from 500 to 800ms after the critical word, consistent with an Nref effect (Van Berkum et al., 1999). This effect supports our claim that contextual information is particularly relevant for the processing of pronouns. The Nref denotes the controlled processes necessary to disambiguate between possible antecedents, such as the application of a Semantic-Pragmatic Inference and the selection of the correct discourse unit.

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Gender differences in neurophysiological activation patterns during phonological input processing: A contributory factor for developing normative data

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Introduction

Differences between men and women with respect to language perception have been a matter of debate for several decades (Wallentin, 2009). To date no consensus has been reached regarding structural, functional or neurophysiological brain research, showing inconsistencies in either laterality patterns or in neurophysiological measures such as amplitude and latency. With the present study we wanted to elaborate on potential gender effects in neurophysiological activation patterns during phoneme discrimination and word recognition by means of event-related potentials (ERPs). With this information we wanted to ascertain whether gender has to be considered as a contributing factor when developing normative data for use of cognitive ERPs in acquired language disorders (aphasia).

Methods

Twenty-four women and twenty men were included in the study, with an equivalent mean age in men and women ($p = 0.785$). Phoneme discrimination was investigated by means of six oddball paradigms in which we differentiated between three phonemic contrasts (place of articulation, voicing and manner of articulation) in both an automatic (Mismatch Negativity; MMN) and controlled (P300) condition. Word recognition was investigated by contrasting real words with pseudowords, but only in an automatic setting.

During the administration of the above tasks an electroencephalogram (EEG) was recorded through 24 Ag/AgCl-electrodes placed on the scalp according to the international 10-20 system. Data was analyzed using BrainVision Analyzer (Brain Products, Munich, Germany) to elicit the cognitive ERPs of interest (MMN, P300 during phoneme discrimination; N100, P200 and N400 during word recognition)

and with special attention to potential gender effects and possible interaction with phonemic contrasts, attention level or word type.

Results

On the level of phoneme discrimination, women exhibited larger P300 and MMN amplitudes (see figure 1) than men ($p < 0.01$), but only in the condition where place of articulation was the phonemic contrast. Within women larger P300 amplitudes were found for place of articulation compared to voicing and manner of articulation ($p < 0.05$) which did not occur in the MMN condition. Men did not show differences in either phonemic contrast condition or the automatic or controlled condition. Moreover, in the automatic condition women showed a trend towards a more bilateral distribution whereas men displayed a left-lateralized preference ($p = 0.068$). On the contrary, in the controlled condition a reverse pattern emerged showing more left lateralization in women in posterior regions for all three phonemic contrasts and more bilateral activation in men in posterior regions for place and manner of articulation ($p < 0.05$).

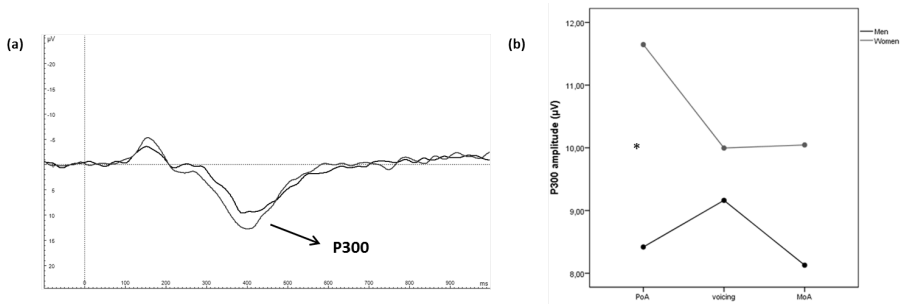

Figure 1: Gender difference during controlled PoA phoneme discrimination displayed in Pz electrode. (a) Women showed a larger P300 amplitude than men when PoA was the discriminating phonemic contrast during controlled phoneme discrimination; men = black, women = grey. (b) The interaction between Contrasts and Gender is presented graphically; * = significant difference.

Concerning word recognition, an N400 pseudoword effect was detected around 500 ms ($p < 0.001$). However, the pseudowords already displayed larger amplitudes 100 ms post-stimulus (N100; $p < 0.01$), which continued in the P200 ($p < 0.001$) and eventually N400 time window, in both men and women and with a bilateral activation pattern throughout. A gender effect did occur when we examined the processing speed (= efficiency, accuracy). In the P200 time window women appeared to be slower in processing real words (higher latency) than pseudowords ($p < 0.01$) whereas the opposite pattern arose in the N400 time window showing faster real word processing (shorter latency) than pseudoword processing ($p < 0.05$). Men showed no differentiation in speed of processing real words and

pseudowords, but in the N400 time window they processed real words much slower than women ($p < 0.01$).

Discussion

The present study further contributed to the knowledge of gender-related differences in brain activation patterns during language perception. Women displayed a larger sensitivity to spectrotemporal differences related to the phonemic contrasts during phoneme discrimination. This was evidenced by larger responses to the PoA contrast compared to the other contrasts in the controlled condition and larger responses than men in the controlled and automatic PoA condition. Men did not demonstrate such sensitivity. The degree of attention played an important role as well, which was even more ratified by the "switch" in laterality patterns in posterior regions within men and women in the automatic and controlled condition.

During word recognition the pseudoword effect was already established 100 ms after stimulus presentation, indicating that the lexical effect started early, irrespective of gender status. The difference between men and women became apparent in the processing accuracy and speed of real word-pseudoword dissociation, showing more efficiency in women. Both men and women showed a bilateral activation pattern during word recognition, arguing for a clear separation between language levels when investigating gender effects, considering the current gender differences in more basic phonological processes. In conclusion, gender should definitely be looked upon as a contributory factor when developing normative data. As such it is recommended to expand existing normative data for age (Aerts et al., 2013) in order to create a justified distinction between men and women.

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Word retrieval in aphasic Sesotho-speakers: Possible implications for current models

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Many psycholinguistic studies of naming have been informed by two models of word retrieval. The WEAVER++ and the Interactive Lexical Network models have much in common, but there are many contrasts between these two conceptualizations (Levelt, 1999). In particular, feedback is thought to operate differently under the two models. WEAVER++ proponents argue that while feedback may flow from the lexical level to the semantic conceptual level, reverse activation from the phonological level to the lexical level is not possible (Dell, Nozari and Oppenheim, in press). Conversely, the framers of the Interactive Lexical Network view feedback as being more ubiquitous; under this model, feedback may flow freely throughout the word retrieval system. Events at the phonological level can influence activity at all other levels in the system (Dell, Nozari and Oppenheim, in press).

The current study focuses on naming difficulties in two speakers of Sesotho, a Bantu language spoken by about 4 million people in South Africa (Lewis, Simons and Fennig, 2013). Sesotho is a noun class language; most nouns are members of a series of classes (Doke and Mofokeng, 1967). This study focused on singular/plural marking. In Sesotho, nouns are inflected for number through a system of prefixes (eg. *lehapu* 'watermelon' *mahapu* 'watermelons'). The two participants in this study were first language speakers of Sesotho. Both participants developed more phonologically-based anomias after CVAs. In the case of T. (Sesotho-adapted WAB Aphasia Quotient:66), anomia appeared to be the hallmark symptom, while S. (Sesotho-adapted WAB Aphasia Quotient:42) experienced anomic moments as part of a broader expressive aphasic syndrome.

The aim of this study was to determine the effects of two cueing techniques for facilitating naming in Sesotho speakers with anomia. Two cue types (treatments) were studied: cues based on the initial phoneme of the full (prefix+root) target item, and cues based on the initial phoneme of the uninflected root.

Initial phoneme cues are a widely described and used therapy technique for anomia (for example Nettleton and Lesser 1991; DeDe Parris and Waters 2003 ; Maher and Raymer 2004; Best, et al, 2002). Because of the morphosyntactic profile of Sesotho, initial phoneme cues amount to prefix-based cues or PBCs (e.g. for the target 'lehapu', PBC /l-/ would be based on the noun prefix, le-). Cues based on the initial phoneme of the uninflected root represent a novel approach. Within the parameters of Sesotho, these cues might be described as root-based cues or RBCs (e.g. for the target 'lehapu', the RBC /h-/ would be based on the first sound of the uninflected root -hapu).

Methods

The researcher developed and balanced 2X 200 item word lists using a variety of criteria. Each technique was allocated a word list. A confrontation picture naming paradigm was used to deliver the treatments. Assessment of pre and post naming abilities under the two conditions (PBC and RBC) yielded data. All participant productions and errors during the study were recorded and coded according to established guidelines found in the literature.

The Allison-MT procedure, which was developed specifically for use in single or small group treatment studies (Brossart, et al, 2006), was used to analyse the treatment data. A Chi-squared test for association procedure was used to analyse the error data.

Results

The treatment data analysis suggests that although both techniques were associated with an increase in naming ability, PBC is less effective at remediating anomia in Sesotho speakers than the provision of a cue based on the first phoneme of the uninflected form.

Discussion

The two models discussed above were examined, and the researcher attempted to select the model with the greatest explanatory power. Of the two models discussed, the Interactive Lexical Network appears to align more closely with the current findings. Participants' performance under the two treatment conditions lend further credence to the notions of widespread interactive feedback featured in this model.

The analysis of the error data was undertaken to determine if the error patterns noted might provide further support for the suggestions emanating from the treatment data. In essence, the researcher wished to ascertain if either cue condition was associated with a signficant growth in the proportions of any error type over the course of the experiment. In the case of T., PBCs appeared to be linked to an increase in the percentage of circumlocution-type errors. For participant S., there seemed to be a connection between PBCs and a growth in the percentage of semantic-paraphasia type errors. If the interpretive frameworks provided by the models are applied to the error data, the Interactive Lexical Network appears to provide a more plausible account of word retrieval in the two participants.

As the first study of this kind conducted in a non-Indo European language, this experiment provides further information about the process of word retrieval. The cumulative effect of such endeavours can help to gradually provide more detail in currently underspecified models of word retrieval.

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Clinical use of event-related potentials in diagnostic and therapeutic evaluation of phonological input processes in the acute stage of aphasia: a case study

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Introduction

Neuroanatomical imaging and behavioural language testing cannot provide enough information to disentangle underlying disturbed neurophysiological language processes in aphasic patients. Moreover, they cannot provide insight in the neurophysiological recovery patterns. Especially in the (sub) acute phase of aphasia, it is important to have a good insight in the neuroplastic changes, since different processes like spontaneous recovery and therapeutic interventions (medical and paramedical) simultaneously influence the reorganisation after stroke. Event related potentials (ERP) offer the opportunity to acquire information about the timing and amplitude of neural activity. It has been reported that there is a correlation between behavioural and electrophysiological testing (Pettigrew et al., 2005), although ERP's seem to be more sensitive (Elting et al., 2008). Electrophysiology may contribute to the development of a disorder-oriented rehabilitation approach in the acute stage and to follow-up.

Phonology is the most disturbed linguistic modality in aphasia, due to its distributed networks and its involvement in both language production and comprehension. In this study the behavioural and electrophysiological evolution of the phonological input processes of a single subject are described during the first four weeks after stroke. The electrophysiological results are compared with normative data for the Flemish population (Aerts et al., 2013)

Methods

Patient

A 46-year-old right-handed male patient, who suffered an ischemic cerebrovascular accident of the left middle cerebral artery, was included in this study. There were no signs of previous speech or language disorders and no hearing impairment. The initial language production can be described as telegraphic speech with severe word finding difficulties and phonological paraphasia. There were only mild comprehension problems in spontaneous conversations.

Linguistic evaluation

The behavioural testing consisted of the Aachen Aphasia Test (AAT(Graetz, De Bleser, & Willmes, 2005)and the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA; (Kay, Lesser, & Coltheart, 1996)of which three phonological subtests (auditory discrimination of non-words, PALPA 1; auditory discrimination of minimal pairs, PALPA 2; and auditory lexical decision, PALPA 5) and the auditory memory for digits (PALPA 12) were administered.
Neurophysiologically, two different oddball paradigms were created to evaluate attended (P300) and unattended (mismatch negativity; MMN) auditory discrimination and unattended word recognition (real versus non-words). The auditory discrimination paradigm was then subdivided according to the three distinctive characteristics present in Dutch language (place of articulation (PoA), manner of articulation (MoA) and voicing)
All behavioural and neurophysiological tests were carried out within the first week after stroke and were repeated after completion of all therapy sessions.

Language therapy

An intensive tailor made training program focussing on the connection of phonological and semantic processes was developed. 30 hours of therapy were provided in a 3-week period. Each therapy session lasted 2 hours and took place at the patient's home. Therapy started one week after stroke.

Results

The results described below are preliminary results. There was substantial noise in the P300 recordings, which hampered interpretation of results.

Before therapy

The ALLOC classification of the AAT suggested Broca's aphasia without outliners in the subtests. Auditory memory was severally impaired (25/60).The patient reached maximum scores on the behavioural auditory discrimination tests. These were only partially confirmed by the neurophysiological results, since deviant auditory

discrimination MMN's were recorded for the distinctive characteristics MoA and voicing when comparing to normative data (Aerts et al., 2013).
PALPA 5 only revealed difficulties recognizing non-words (real words: 79/80; non-words 66/80). In the word recognition paradigm, the N400 was absent in the ERP signal for real words. Furthermore, no ERP could be elicited for non-words.

After therapy

AAT analyses indicated an overall significant improvement up to the level that the ALLOC classification could not assigns the problems to an aphasic syndrome.
The behavioural linguistic tests showed an overall significant improvement on the tests that had not obtained a maximum score prior to therapy (PALPA 5 and PALPA 12)
Neurophysiologically, improvements on MMN of auditory discrimination could be recorded; the latency decreased for voicing, where for MoA the amplitude increased. In the word recognition paradigm, a N400 was detectable for words and there was an ERP visible for non-words.

Discussion

The results confirm the hypothesis of a higher sensitivity of electrophysiological examination as compared to behavioural testing. The electrophysiological results are able to detect abnormalities in case of ceiling effects on behavioural testing or when therapeutic progress is not behaviourally measurable.
On the other hand, the interpretation of ERP's at single subject level remains difficult, especially for paradigms that necessitate cooperation, like P300. Even for unattended paradigms, enough trials are necessary in order to reduce noise to acceptable levels.
When cautiously used, ERP's can be clinically useful in diagnostic and therapeutic evaluation of phonological input processes in single subjects with aphasia.

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On the theoretical characterization of agrammatism: Resolving a paradox

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Introduction

This paper proposes a novel way to resolve a paradox that emerges between findings in the agrammatism literature and the cartographic hierarchy of functional projections (e.g., (1)) on which many of the agrammatism studies rely.

(1) $[_{CP}$ C' $[_{AgrP}$ Agr' $[_{TP}$ T' $[_{VP}$ [V']]]]] (Belletti 1990)

Findings from agrammatism suggest that there is a crosslinguistic pattern according to which higher nodes are more affected than lower ones. According to Friedmann & Grodzinsky's (1997) Tree-Pruning Hypothesis (TPH), T(ense) shows up as impaired while Agr(eement) is preserved. This argument has received empirical support from several languages (e.g., Friedmann & Grodzinsky 1997, 2000 and Friedmann 1998 *et seq.* for Palestinian Arabic and Hebrew, Stavrakaki & Kouvava 2003 for Greek, Martínez-Ferreiro 2009 for Catalan, Galician and Spanish). Based on what these studies propose for the impairment of T and Agr, the hierarchy of these two nodes that one expects to see is *T>Agr* (T higher than Agr, as in (2)).

(2) $[_{CP}$ C' $[_{TP}$ T' $[_{AgrP}$ Agr' $[_{VP}$ [V']]]]] (Pollock 1989)

The paradox we focus on lies in the fact that the hierarchy put forth in cartographic studies (e.g., Belletti 1990) is *Agr>T*. Relating (1) and much work since then to the TPH and to findings from studies on agrammatism, a clash is observed between what the cartographic representation predicts as impaired and what what the agrammatic literature has shown.

Methods

We bring together findings from various experiments in order to shed light to the aforementioned paradox and we comparatively discuss previous explanations that are offered for it in the literature. More specifically, Bastiaanse & Jonkers (2012) pinpoint this conflict between theory and results from agrammatism studies and discuss it also from the perspective of Wenzlaff & Clahsen's (2005) *Tense Underspecification Hypothesis*: Tense problems might be due to the fact that tense morphology conveys extrasentential information. This implies that the reason

for impaired production is related to time reference and not to the position that T has in relation to Agr on the syntactic tree. Another answer to the paradox is offered by Nanousi et al. (2006) along the lines of feature interpretability. According to their *Impaired Interpretable Feature Hypothesis*, functional categories that bear interpretable features, such as Tense, are impaired in agrammatic production because their morphological realization is dysfunctional. On the contrary, uninterpretable features are checked through Agree operations and these functional categories show up intact. These two explanations might be in conformity with the reports about the production of T and Agr in the agrammatic literature, however they do not offer insights with respect to what differentiates clitic pronouns from other Agr markers.

Results

Taking as its departure point the results generated by experimental studies that examine the production of both T, Agr and clitics (e.g., Martínez-Ferreiro 2009) and aiming to approach the T impairment/Agr preservation also in relation to the status of clitics, the present paper proposes to resolve the aforementioned paradox in a novel way by assuming feature inheritance from Agr to T in line with Chomsky (2007) and Richards (2007). More concretely, we assume that Agr features start off on C higher than T (consistent with (1)), but are below T at the time transfer occurs, due to inheritance. The reported impaired production of T in agrammatic literature entails that T is accessed post-syntactically after transfer and explains why agrammatic production seems to correspond to a structure like (2).

Discussion

Our analysis receives empirical support from the clitics vs. T difference, discussed in the agrammatic literature, along the lines of feature inheritance and interpretability. More specifically, Martínez-Ferreiro (2009) reports significantly higher percentages of impaired production of clitics compared to impaired production of T for both mild and moderate agrammatic subjects. This is expected according to our analysis: Clitics are hosted in a functional projection residing between the CP and the IP, a projection that is higher than T (Raposo and Uriagereka 2005), hence clitics are more susceptible to impairment. Being agreement markers that bear interpretable features due to their argumental nature (Roberts 2010), clitics do not lower for interpretability purposes. They remain higher than T and therefore the dissociation observed between clitics and T in the production of agrammatic subjects in terms of the former being more severely impaired than the latter can be explained by assuming that no inheritance takes place in the case of clitics precisely because of their status as interpretable markers.

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Bilateral language representation in a patient with a large porencephalic cyst

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Introduction

A unique possibility to enrich insights in the lateralization and organisation of language functions is to investigate individuals in whom an anomalous organisation of brain functions is clinically evident or might be theoretically expected, such as subjects with porencephalic cysts (PC). Naef (1958) defined porencephaly as 'cystic defects in the cerebrum communicating either with the ventricle or with the subarachnoid space or with both, due to a developmental malformation or to a destructive lesion' (p. 136). Based on an interview, Naef concluded that in more than 75% of the 32 cases neurological symptoms occur perinatally. Danckert et al. (2004) for the first time reported neuropsychological and neuroimaging findings of a left-handed man with a PC replacing a large part of the left posterior hemisphere. Their findings suggest that intrahemispheric reorganisation may take place in the presence of a PC and that language, motor and somatosensory functions are not necessarily transferred to the undamaged hemisphere.

This study investigates for the first time functional language organisation at the supra- and infratentorial level in a neurologically and psychiatrically healthy person identified with a PC. A Word Generation fMRI-paradigm was used to

determine language lateralization at both the cerebral and cerebellar level.

Methods

Participants

After an extensive manual research of the MRI databases of two neuroradiology departments, only one subject matched the selection criterion of "neurologically and psychiatrically healthy individual with an isolated, congenital PC". This subject (CI) was a 50-year-old, right-handed (EHI = +100) woman with a large PC in the left temporal lobe.

Neuropsychological assessment

Extensive neuropsychological examinations were performed to formally rule out cognitive dysfunctions: intelligence (WAIS-III), memory (WMS-R), attention (Trailmaking Test, D2 Test of Attention & Stroop Colour-Word Test) and language (Boston Naming Test & Semantic Word Fluency Task) were investigated.

Neuroimaging

fMRI data acquisition consisted of a (1) word generation task (Cai et al. 2013) and (2) as a control condition, the repetition of the letter string 'dada'. A Siemens Trio 3.0-Tesla scanner (Siemens Medical Systems) was used for anatomical (T1-weighted) and functional (T2-weighted) imaging. Data analysis was performed by means of SPM8 (www.fil.ion.ucl.ac.uk/spm/software/spm8).

Results

Neuropsychological assessment

An asymmetric distribution of IQ scores characterized the general cognitive profile. A significant discrepancy of 17 IQ-points was found between the normal verbal IQ (= 108) and superior performance IQ (= 125). Working memory (index = 134) as well as delayed recall (index = 133) was within the superior range. A consistent and symmetrical distribution of visual (index = 138) and verbal memory (index = 126) indices was found. CI obtained normal to superior scores for general attentional skills as measured by the WMS-R concentration index (= 112), visual search and sequencing capacities (Trail Making Test), sustained visuo-motor attention (D2 Test of Attention), inhibition of a competing and more automatic response set (Stroop Colour-Word Test), digit span and symbol substitution (WAIS-III). Visual recognition and naming, as measured by the BNT, was normal, as were Word fluency and the verbal subtests of the WAIS-III.

fMRI results

As demonstrated in figure 1, the fMRI language paradigm activated the supplementary motor area, the precentral and inferior frontal gyrus, the insula

and visual association cortex were bilaterally activated. Activation of the inferior frontal gyrus was more pronounced in the left than in the right hemisphere. Significant activation was found in the superior and inferior temporal gyrus, the supramarginal gyrus, the putamen, the cuneus, the inferior parietal lobe and the calcarine fissure of the left hemisphere. The superior parietal lobe, middle and medial frontal gyri were activated in the right hemisphere.
At the cerebellar level, bilateral activation was found in the posterior lobe at the level of the declive. The activation of the right declive is higher than the left, which is in accordance with the more pronounced left frontal activity. Significant activation of the left cerebellar culmen is also observed.

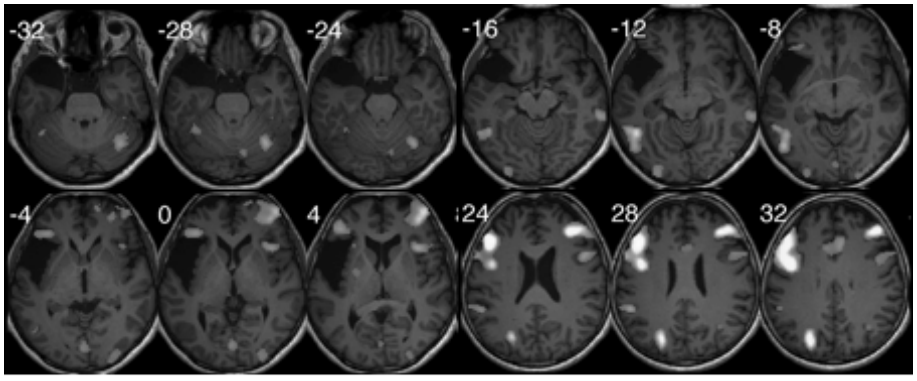

Figure 1: fMRI activations of CI showing bilateral cerebral and cerebellar activations during word generation.
Numbers represent z-coordinates.

Discussion

In this patient with a large left temporal PC, neuropsychological examinations revealed an asymmetric IQ-profile characterized by a significant discrepancy of 17 IQ points between the verbal (= 108) and performance (= 125) IQ level.
A typical pattern of fMRI language activations was not found in this patient. Activations observed during Word Generation tasks are usually restricted to the inferior and middle frontal gyri, the cingulate gyrus, the supplementary motor area, the inferior parietal lobule of the language dominant hemisphere and the contralateral posterior cerebellar lobe (Cai et al., 2013).
Due to a congenital anomaly, atypical organisation of language functions was found as reflected by a bilateral distribution of activations at the cerebral and cerebellar level. Although slightly more pronounced in the left hemisphere,

bilateral activations were found in the middle and inferior frontal gyri. This pattern of supratentorial activations was reflected at the infratentorial level by bilateral activations in the posterior lobe of the cerebellum with slightly more activity located in the right cerebellar hemisphere. Bilateral hemispheric organisation of expressive language function is probably the result of a compensatory mechanism for the lesion and might indicate operational inefficiency of the neural network subserving language in the left hemisphere (Deary and Caryl, 1997). An illustration of this inefficiency is obtained by the significant lower verbal IQ.
Lidzba et al. (2008) observed a functional language shift to the right cerebral hemisphere in a population with congenital periventricular lesions in the left hemisphere. Crossed cerebellar activation is observed as a result of this supratentorial reorganisation. The bilateral cerebellar activation pattern observed in CI confirms that the pattern of supratentorial language dominance is intrinsically reflected at the level of the cerebellum.

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Phonological and semantic registration of the subthalamic nucleus

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Introduction

Over the past two decades there has been an increasing awareness that subcortical structures such as the subthalamic nucleus (STN) not only contribute to the regulation and coordination of motor aspects of speech but are also important components in the neural circuits that regulate cognitive and linguistic function. Investigations of the impact of surgically induced functional inhibition of the STN reveal a variability in language outcome and a larger influence on higher-level language processes than on general language processes. This study aims to investigate if the STN is involved in phonological and semantic input processing on phoneme and word level. Local field potentials in the STN are obtained by registration from the implanted STN electrodes of patients with Parkinson's Disease. Event-related potentials in the STN are used in order to measure responses to linguistic paradigms . In Dutch normal controls these language paradigms evoke an activation in the temporal area. Therefore, frontal cortex ERP's are used as a control in order to exclude non-specific electrical responses. The paradigms are administered twice, with and without dopaminergic medication respectively.

Methods

Subjects

Until now seven patients with advanced Parkinson's disease have been included in this study. All patients were evaluated at one week post implantation of Deep Brain Stimulation (DBS) electrodes. All subjects were right-handed native Dutch speakers with normal hearing.

Method

During the first week after implantation of DBS-electrodes, patients are stimulated using external leads. This allows connection of the electrodes to conventional electrophysiological registration equipment in order to obtain local field potentials from the STN. Following the internationally accepted CAPSIT-protocol the patients

are tested in a random order with and without dopaminergic medication. For phonological and semantic evaluation the standardized Dutch language ERP-paradigms developed by Aerts et al. (2013) are used. The language paradigms consist of phonological tasks evaluating attended and unattended auditory discrimination for phonetic contrasts, voicing and manner of articulation and of semantic detection of action and non-action verbs.

Results

The data of all registrations are currently analyzed. Preliminary results suggest an activation of the subthalamic nucleus when phonological as well as semantic stimuli are presented in the condition without dopamine-administration. In contrast to the language-induced electrical activity in the STN, no ERP is observed in the frontal cortical area. Whether these language networks are dopamine-sensitive will become clear when the data in the on-condition are analyzed.

Discussion

Results will be discussed using current models of basal ganglia involvement in higher linguistic function. These can be related to known linguistic defects occurring in PD patients and to the effects of dopaminergic treatment and DBS-related changes in language.

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Repetitions in the connected speech of a patient with semantic dementia

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Introduction

Semantic dementia (SD) is a neurodegenerative disorder characterized by a progressive loss of semantic knowledge in both the verbal and non-verbal domain (Neary et al., 1998). In this condition, disproportionately affected naming and single word comprehension, especially for low-familiarity words, constitute early hallmark features at the linguistic level (Gorno-Tempini et al., 2011). This paper reports longitudinal follow-up findings of connected speech in a patient with histopathologically confirmed SD. In addition to typical SD features, a unique profile of repetitions and perseverations was found in connected speech. These neurolinguistic phenomena have not been reported before in SD.

Methods

Participants

Video-taped conversational speech samples of a male patient with a diagnosis of SD were collected at the age of 55, 56 and 59 years during a face-to-face interview. Different analyses of these samples were compared to analyses of speech samples collected in an age and education matched control group, comprising 15 healthy participants: five males in each of the three age groups (55, 56 and 59).

Analyses

To identify deficits in connected speech three analyses were performed. First, a Moving Average Type-Token Ratio (MATTR) was used to determine lexical diversity in the speech samples of the patient and the control group. Secondly, the number of repetitions and perseverations in connected speech was counted. Thirdly, speech rate, defined as the total number of words per minute and total number of syllables per second was calculated.

Results

In the analyses the data were collapsed across the three control groups, as one-way Analysis of Variance (ANOVA) showed no significant difference between these groups on any measure ($p > 0.10$). In comparison with the control group, MATTR results confirmed poor lexical diversity in the patient's speech. Lexical diversity was significantly different with the control group at the age of 55 (= 0.26; Mean = 0.39, SD = 0.02) and 56 (= 0.28; Mean = 0.39, SD = 0.02) and extremely low at age 59 in the context of a restricted verbal output. These findings reflect the progressive decay of semantic memory in SD. Analysis of repetitions and perseverations in the three speech samples revealed a unique pattern at different linguistic levels (words, constituents, parts of utterances and utterances). Self repetitions were found in more than 50% of the patient's utterances. At age 55 years the patient produced 75 self repetitions out of 145 utterances (Score = 51.72; Mean = 19.76; SD = 15.92). At the age of 56 years, 49 self repetitions out of 96 utterances were found (Score = 51.04). The progression to verbal mutism was reflected at age 59 years by a total number of only 4 self repetitions out of 13 utterances. The number of perseverations was abnormal as well (at age 55 years = 7.59; at 56 years = 4.17; at 59 years = 0; Mean = 0.09; SD = 0.33) and the number of echo answers was abnormal at the age of 56 and 59 years (at 56 years = 2.08; at 59 years = 53.85; Mean = 0.43; SD = 0.59). Speech rate was consistent with a diagnosis of logorrhea at 55 (209.27 words/min.) and 56 years of age (215.75 words/min.; Mean = 158.21 words/min.; SD = 24.44). At the age of 59 years speech rate became extremely low (24 words/min.) and entirely consisted of echolalic responses. Within the next year oral-verbal output evolved to mutism.

Discussion

In this study, a linguistic analysis of spontaneous speech production of a patient with SD confirms some typical linguistic features of the disorder. Indeed, MATTR results and speech rate data support the view that patients with SD produce fluent, but empty speech with an evolution to verbal mutism. However, this study also provides novel findings. To the best of our knowledge, perseverative linguistic behavior, as reflected by a high proportion of repetitions and perseverations in connected speech, has not been reported in SD before. A possible explanation might be that these repetitions reflect a compensatory strategy. The patient repeats himself and the interlocutor in an attempt to improve oral-verbal comprehension. Alternatively, the verbal repetitions may result from frontal lobe dysfunction. A more general frontal desinhibition disorder might explain why the patient is not able to suppress his own speech and speech stimuli produced by the interlocutor. These findings may be useful when refining the diagnostic criteria for linguistic behavior in SD.

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Atypical language dominance in a right-handed patient: An anatomoclinical study with Direct Electrical Stimulation (DES) and functional Magnetic Resonance Imaging (fMRI)

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Introduction

Surgical resection of brain tumours near or within the dominant Broca area is still a controversial issue because of the high risk of postoperative linguistic disturbances. Consequently, when resecting tumour tissue in the dominant Broca area, the localisation and preservation of language function is of crucial importance. Intraoperative DES during surgery allows to identify the essential language areas and pathways in a more accurate way than non-invasive mapping techniques such as preoperative fMRI, PET (Positron Emission Tomography) and DTI (Diffusion Tensor Imaging) (Giussani et al., 2010; De Witte & Mariën, 2013). As such, the use of DES has extended the indications for surgery of gliomas located in eloquent areas that were previously considered 'inoperable' (Duffau, 2007). A number of recent studies showed that surgical resection around so-called eloquent Broca's area can be performed with good functional outcome if DES is used (Benzagmout et al., 2007; Duffau et al., 2008; Lubrano et al., 2010; Sanai et al., 2008). In this study unexpected neurolinguistic findings are reported in a right-handed patient with a left prefrontal-temporal brain tumour.

Methods

Subject

The patient is a 39-year-old right-handed woman with a history of gliomas in the left prefrontal lobe. She worked as a hairdresser for 15 years and had an educational

level of 12 years. A strong right hand preference was confirmed by means of the Edinburgh Handedness Inventory (EHI) (Oldfield, 1971), which yielded a laterality quotient (LQ) of +100. In 1999, a left frontal tumour was surgically resected under general anaesthesia. Anatomopathological analysis of a tumour specimen showed an astrocytoma grade II and radiotherapy was administered. In April 2007, the patient again underwent surgery under general anaesthesia because of regrowth of the tumoural mass anterior to the resection cavity. Chemotherapy was started. Three years later, tumour regrowth with evolution to an anaplastic astrocytoma grade III-IV was found affecting the lower part of the resection cavity in the posterior frontal-temporal conjunction near the left precentral gyrus. Between 1999 and 2011 formal neurolinguistic investigations did not reveal any linguistic abnormalities. However, given the fact that in this right-handed patient the tumour was located in the left prefrontal region near Broca's area it was decided resection the tumour under awake conditions with DES.

Neuropsychological assessments

Extensive neuropsychological and neurolinguistic investigations were carried out before and after surgery on the basis of standardised test batteries. The neuropsychological assessments included the Mini Mental State Examination (MMSE) (Folstein et al., 1975), the Stroop Colour-Word Test (Lezak, 1983), the Wisconsin Card Sorting Test (WCST) (Grant & Berg, 1993), the Trail Making test (TMT) (Lezak, 1983), the Nederlandse Leestest voor Volwassenen (NLV) (Schmand et al., 1992), and the Weschler Memory Scale - Revised (WMS-R) (Weschler, 1984). Language was formally investigated by means of the Akense Afasie Test (Graetz et al., 1992), the Comprehensive Aphasia Test – NL (CAT-NL) (Visch-Brink et al., in press) and the Boston Naming Test-NL (Mariën et al., 1998). Intraoperatively, naming, reading, repetition and verb generation tasks from the Dutch Linguistic Intraoperative Protocol (DuLIP) (De Witte et al., 2013) were assessed.

Neuroimaging

Exact localisation of the tumour was determined by means of 3D T1-weighted Magnetic Resonance Imaging (MRI) in the pre- and postoperative phase. Functional MRI (fMRI) was performed postoperatively on a 1.5T scanner (Sonata, Siemens, Erlangen, Germany), equipped with 40 mT/m gradients and a standard CP head coil. The fMRI experiment was performed using a block-designed paradigm consisting of two conditions, each lasting for 30 seconds: a resting period and the noun-verb association task (as in Baillieux et al., 2009). Diffusion Tensor Imaging tractography (DTI) was also performed in the postoperative phase. Axial diffusion tensor images were obtained on a 3 Tesla (T) MR scanner (Siemens, Erlangen, Germany) using a single-shot SE-EPI sequence.

Surgical procedure

An asleep-awake-asleep procedure was used in which the patient is asleep during craniotomy and during closing of the skull but awake during language mapping with DES (Klimek & Vincent, 2011). Cortical and subcortical stimulation were performed.

Results

In the preoperative phase, in-depth cognitive testing revealed an executive syndrome as reflected by defective results on the Stroop, the TMT and the WCST. Except for defective results on the verbal fluency task of the CAT-NL extensive examination of linguistic functions was entirely normal. No articulation problems were noted. During the awake procedure, repeat cortical stimulation of Broca's area and the fronto-temporal junction did not induce any speech and language deficits.. Subcortical stimulation was used and the tumour was removed until the corticospinal tract was reached.

Postoperative MRI showed that a large part anterior to Broca's area was surgically removed. Formal linguistic assessments, however, did not reveal any language or speech problems. Repeat neuropsychological investigations showed persistent executive problems. Given the absence of linguistic symptoms, a postoperative fMRI and DTI were conducted. fMRI analyses showed activations in the right precentral gyrus, the right anterior insular gyrus at the supratentorial level. In addition, significant activations were found in the contralateral left cerebellum. On the DTI images the arcuate fasciculus (AF) was significantly more pronounced in the right cerebral hemisphere than in the left cerebral hemisphere.

Discussion

We hypothesize that a favourable linguistic outcome in this patient is likely due to atypical language lateralisation in the right cerebral hemisphere. Crossed dominance in this case might be due to brain plasticity mechanisms or maturational variation. A number of arguments favour the latter explanation:

1) no language problems (even transient language problems) were ever observed, 2) no positive stimulation sites were found during DES. 3) the Arcuate Fasciculus was clearly more pronounced in the right hemisphere than in the left hemisphere (DTI), 4) a crossed route between the right cerebrum and the left cerebellum was detected (fMRI).

To conclude, this case shows that surgery in and around Broca's area can be safely conducted using awake craniotomy and intraoperative mapping. In addition, the findings indicate that although fMRI is currently considered not to be sensitive enough to identify the eloquent brain areas it can be an important adjunct in the pre- and postoperative phase of patiens with atypical language lateralisation.

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Subcortical lesions and agrammatic aphasia: A case study in a highly inflected language

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Introduction

It has been argued that agrammatic aphasia derives not only from cortical but also from subcortical lesions (Damasio et al., 1982; Ullman, 2001) involving the basal ganglia that are connected to Broca's area and other cortical language areas (Caplan et al., 2007; Ullman, 2006). The basal ganglia have been suggested to be involved in aspects of semantic integration, such as assignment of thematic roles (Kotz et al., 2003), in linguistic/syntactic sequencing (Chan et al., in press), and in combinatorial processes (occurring, for example, in regular verbs or nouns) (Ullman, 2001), among other things. Lesions in subcortical structures other than the basal ganglia may also cause language problems. Thalamic lesions, for example, can cause sentence comprehension problems (De Witte et al., 2011), while it has been found that the thalamus is also involved in sentence production (Brown et al., 2006).

Against this background, I will examine the linguistic profile of a Greek-speaking individual with a lesion predominantly in the basal ganglia. The relevant data that will be discussed here have already been reported elsewhere (Fyndanis et al., 2006, 2010, 2012, 2013).

Methods

Participants

A Greek-speaking brain-damaged individual, GT, and a healthy control participant, AK, participated in this study. An initial CT scan revealed a left intra-ventricular haemorrhage (most probably from the anterior cerebral artery) for GT, which did not affect the cortex but rather the basal ganglia (in particular, the putamen and caudate nucleus), the thalamus and the adjacent white matter of the left hemisphere (GT's dominant hemisphere). He was diagnosed with agrammatic aphasia. Information on diagnosis procedure and language testing data are reported in Fyndanis et al. (2013).

Experiments

Participants were tested on five constrained tasks tapping (morpho)syntactic abilities: a wh-question elicitation task, two anagram tasks (one with pictures and one without pictures, both based on Rispens et al., 2001), a sentence completion task, and a grammaticality judgment task. The last two tasks investigated

participants' ability to produce and comprehend/judge subject-verb agreement, tense, and aspect, while the anagram tasks explored their ability to construct negative and affirmative sentences. The sentence completion task included both regular and irregular verbs. Information about the design of these tasks is provided in Fyndanis et al. (2006, 2010, 2012, 2013).

Results

GT performed significantly worse than AK in all cases except for affirmative sentences in the anagram task I and for agreement in the sentence completion task (see Table 1). GT was found severely impaired in the production of wh-questions, and significantly more impaired in constructing negative sentences, compared to affirmatives. He performed significantly worse on aspect than

Table 1: Participants' raw and percent accuracy scores, and statistical comparisons (by Fisher's exact test for count data).

	GT	AK	GT vs. AK
Wh-question elicitation task	14/36 (39%)	36/36 (100%)	p = .000
Anagram task I			
Negative sentences	2/16 (13%)	16/16 (100%)	p = .000
Affirmative sentences	13/13 (100%)	13/13 (100%)	p = 1
Anagram task II			
Negative sentences	1/18 (6%)	18/18 (100%)	p = .000
Affirmative sentences	13/18 (72%)	18/18 (100%)	p = .045
Sentence completion task			
Agreement	53/56 (95%)	56/56 (100%)	p = .243
Tense	24/56 (43%)	52/56 (93%)	p = .000
Aspect	10/56 (18%)	49/56 (88%)	p = .000
Grammaticality judgment task			
Agreement	39/56 (70%)	55/56 (98%)	p = .000
Tense	35/56 (63%)	50/56 (89%)	p = .002
Aspect	23/56 (41%)	43/56 (77%)	p = .000
Anagram I: neg. vs. affirm.	p = .000	p = 1	n.a.
Anagram II: neg. vs. affirm.	p = .000	p = 1	n.a.
Compl.: Agreement vs. Tense	p = .000	p = .118	n.a.
Compl.: Agreement vs. Aspect	p = .000	p = .013	n.a.
Compl.: Tense vs. Aspect	p = .007	p = .527	n.a.
Judgm.: Agreement vs. Tense	p = .550	p = .113	n.a.
Judgm.: Agreement vs. Aspect	p = .004	p = .001	n.a.
Judgm: Tense vs. Aspect	p = .037	p = .130	n.a.

he produced agreement significantly better than tense. No significant dissociation emerged between regular and irregular verbs in any of the three conditions of the sentence completion task. (For a detailed presentation of the results, see Fyndanis et al., 2006, 2010, 2012, 2013.)

Discussion

The poor performance of GT on the five tasks shows that he has severe difficulties with (morpho)syntax. That his deficit in processing verb related functional categories is morphosyntactic (and not morphophonological) in nature is evidenced by the lack of dissociation between regular and irregular verbs in the sentence completion task (see Badecker, 1997). GT's results, thus, confirm his previous diagnosis as agrammatic speaker, which is consistent with the view that agrammatism may arise not only from lesions in cortical structures, but also from subcortical lesions affecting the basal ganglia (Ullman, 2006).

GT's data on the anagram tasks are consistent with Chan et al.'s (in press) finding that linguistic/syntactic sequencing is subserved by the basal ganglia (among other brain structures). (Note that in Greek, a language with a relatively flexible word order, sequencing skills are critically involved in constructing negative sentences rather than affirmatives.)

GT's selective morphosyntactic deficit in comprehension/judgement could be attributed to his difficulty judging the compatibility of adverbials (particularly, aspectual ones) with verb forms, which seems to be a type of semantic integration deficit. These data, therefore, support the proposal that the basal ganglia are partly responsible for aspects of semantic integration (Kotz et al., 2003).

More general integration problems (i.e., *not strictly semantic* integration problems) are possibly the source of GT's selective difficulties in the sentence completion task, where he performed on aspect and tense significantly worse than on agreement. Unlike agreement, which only involves implementation of morphosyntactic knowledge, aspect and tense require processing and integration of information from two distinct levels of representation, morphosyntactic and extralinguistic/conceptual (see Fyndanis et al., 2012). It seems, thus, that the basal ganglia are *generally* involved in integration processes and not only in semantic integration. Given past evidence (Brown et al., 2006; De Witte et al., 2011), a contribution of GT's thalamic lesion to his poor performance on the sentence completion and grammaticality judgement tasks could not be ruled out.

Finally, one would tend to interpret the lack of dissociation between regular and irregular verbs, in any of the three conditions of the sentence completion task, as challenging the hypothesis that the basal ganglia are critically involved in combinatorial processes (Ullman, 2001). In particular, on Ullman's hypothesis, one would likely expect GT to perform better on irregular rather than on regular verbs. The above finding, however, does not contradict Ullman's hypothesis, because, although regular and irregular verbs in Greek differ in terms of ±involvement of an

allomorph's retrieval, both verb types involve combinatorial/affixation processes. This is so, because verb stems cannot stand alone in Greek. Therefore, given affixation processes are required in both regular and irregular verbs, and following Ullman's assumption that such processes are subserved by the basal ganglia system, it is expected that a lesion in this system can cause equal impairments in producing regular and irregular verbs. Affixation processes being constant in both verb types, we would expect only individuals with lesions confined to temporal cortex—assumed to subserve retrieval processes (Ullman, 2001)—to exhibit dissociation between regular and irregular verbs. Specifically, we would expect them to perform better with regular verbs, since these do not involve retrieval of allomorphic stems.

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Facilitating word retrieval in people with aphasia: an exploration of the relationship between language and wider neuropsychological processing

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Introduction

The challenge of understanding word retrieval is one that has long been the subject of investigation in aphasia therapy research, with Nickels (2002, page 4) noting that 'part of the approach to understanding the impact of aphasia on an individual's life is understanding word retrieval'. Progress has been made in predicting an individual's response to naming therapy but there are still inconsistencies across studies in the relationship between language profile and therapy outcome. Consideration has now turned to additional factors when planning intervention, with clinicians and researchers recognizing the need to address the relationship between language and wider cognitive processes in order to advance 'our understanding of the dynamic nature of language impairment in aphasia and also for directly informing its treatment' (Martin and Reilly, 2012, page 254). For example, Lambon Ralph, Snell, Fillingham, Conroy and Sage (2010) found that both cognitive factors (reasoning, problem-solving, attention, and visual recall) and language factors (naming severity as measured by the Boston Naming Test (Kaplan, Goodglass and Weintraub, 1983)) were the best predictors of therapy outcome in an analysis of the assessment and therapy results from thirty-three people with aphasia .

In addition the cognitive skill of self-monitoring, the on-line tracking of ability (Toglia and Kirk, 2000), has come under scrutiny. For example, self-monitoring ability has been found to be negatively related to the amount of jargon produced by people with aphasia (Sampson and Faroqi-Shah, 2011) but when targeted in therapy, can lead to generalized improvement in naming performance (Franklin, Buerk and Howard, 2002).

The aims of the current study were:

- to identify a group of neuropsychological assessments, from a larger battery, that can be administered to people with aphasia, without language impairment confounding the interpretation of results.
- to investigate the relationship between underlying neuropsychological processing and response to intervention as measured by facilitation.

Methods

Eight adults with aphasia, aged between 25 and 81, participated in a case series design. A novel battery of language and neuropsychological assessments was administered. Language assessments were primarily focused at the single word level, examining input and output processes. Neuropsychological assessments were standardised assessments across the domains of attention, memory and executive function, and a non-standardised assessment of self-monitoring ability. Facilitation studies were carried out, in which the effect on word retrieval at a later point in time was investigated for 6 different linguistic cues.

For each of the domains, attention, memory and executive function, a number of different assessments was selected and the relationships within and between these assessments were analysed. It was hypothesised that assessments within specific areas of each cognitive domain would show strong, positive correlations if measuring the same, or overlapping, processes.

The relationship between neuropsychological assessment scores and response to facilitation was investigated using non-parametric correlations, all 2-tailed.

Results

There were large, significant correlations identified between the neuropsychological assessments of recognition memory $rho = 0.77$, $n = 8$, $p = 0.03$ and attention $rho = 0.76$, $n = 8$, $p = 0.03$. The relationship between assessments of executive function was non-significant, $rho = -0.27$, $n = 8$, $p = 0.52$. With regards to the relationship between neuropsychological assessments and response to facilitation (combined score across facilitation studies), there was no significant relationship with attention (as measured by the total score on the subtests of the Test of Everyday Attention (Robertson, Ward, Ridgeway and Nimmo-Smith (1994)), $rho = 0.22$, $n = 8$, $p = 0.61$, or with executive function (as measured by the time taken to complete Trail Making part B), $rho = -0.29$, $n = 8$, $p = 0.49$.However, there was a significant correlation between response to facilitation and both recognition memory (as measured by Wechsler Memory Scale-III (Wechsler, 1997) subtests: Faces I, Faces II and design visual recognition), $rho = 0.76$, $n = 8$, $p = 0.03$, and self-monitoring ability (as measured by self-judgment score on a naming task), $rho = 0.84$, $n = 8$, $p = 0.009$.

Discussion

Neuropsychological assessments were sensitive to specific domains of cognition in people with aphasia, with participants able to carry out assessments without being impeded by their language impairment. This is especially true for assessments in the domain of memory and attention. Measures of executive function were less straightforward, due in part to its multifaceted nature; assessments of this

domain should therefore be considered on an individual basis with regards to the underlying processes measured.

Recognition memory and self-monitoring ability were found to strongly correlate with naming improvements following facilitation. The indication is that ability to self-monitor may be an important prerequisite in order to benefit optimally from language intervention.

The findings from the current study support the use of neuropsychological assessments by speech and language therapy clinicians as an essential component of a screening battery, helping inform understanding of cognitive processing and guide selection of appropriate therapy methods. Specifically, assessments of recognition memory and self-monitoring were found to show potential for use within a wider battery administered by clinicians to help predict response to therapy.

These extra-linguistic cognitive processes have great potential for further investigation, especially as presently research has not found language skills alone to be predictive of response to therapy or functional communication skills.

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Phonological similarity between target and semantic errors in picture naming: Are aphasic patients a homogeneous group? A study of 31 cases

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Introduction

In the aphasia literature many studies on picture naming have reported that the phonological similarity between targets and semantic errors is higher than expected by chance (Martin et al., 1996; Rapp et al., 2000). However, some single case studies are not in line with this claim (Best, 1996). This invites to investigate if patients are indeed homogeneous, and to identify clinical or linguistic variables that influence the phonological similarity rate of semantic errors.

Methods

Participants

We report a series of 31 aphasic patients who completed a picture naming test based on 80 stimuli from the Snodgrass and Vanderwart (1960) set that are exemplars of 10 semantic categories (Battig and Montague, 1969). Twenty-eight patients suffered from cerebro-vascular damage, 2 from traumatic brain injury and 1 from brain abscess. They were examined 3 times within a 1-2 day period, during which their clinical status was stable.

Response Classification

We defined the chance level of the target/response phonological similarity for the single stimulus. We considered incorrect responses corresponding to a real word that was semantically related to the stimulus. We analysed only errors that were semantic coordinates, and excluded responses consisting of the superordinate category name (for example, we retained the response “orange”, but not the response “fruit” to the stimulus “apple”). Operatively, we considered as a reference the Phonological Overlap Index (POI), obtained by considering each target name and the name of the 15 most typical exemplars of the same category reported

in Battig and Montague (1969). For each pairing between the stimulus and a semantically-related response, the POI was the ratio between (a) the number of phonemes shared by the two words and (b) the total number of phonemes that appeared in the two words. A POI of zero means that the two words have no phonological overlap at all.

Statistical Methodology

The statistical distribution of POI is typical of a given target word. On the 15 ranked POI values related to each target, we estimated the 80th centile value: the "high overlap" region is above that value. Consequently, only 20% of the semantic associates of each target word are expected to fall in the "high overlap" region. A semantic error was scored as having "high POI" when its phonological overlap with the target fell in this upper 20% region.

In data analysis, we excluded stimuli with a derivational/compounding relationship resulting in semantic and phonological similarity, for instance "lampada" (lamp) and "lampadina" (light bulb). For each patient the rate of semantic errors in the high-POI region was calculated. A rate significantly higher than 20% indicates that semantic errors show greater- than-chance phonological similarity with the target.

Results

The data of the 31 patients were analyzed by means of a logit-linear model with binomial error. The logistic parameter for the whole set of patients corresponded to a binomial probability of 0.241. The lower confidence limit of this parameter (alpha= 0.05) was 0.210: as this limit does not include 0.200, we can reject the null hypothesis that the observed rate of high-POI semantic errors merely conforms to the basic phonological similarity between each target word and its semantic matches.

Figure 1 shows the distribution of high-POI semantic errors in our sample.

On logistic regression, the deviance of a model that only includes the mean was 48.318. A chi-square of 48.318 with df=30 corresponds to p=0.018, and this indicates that a model based purely on the mean does not completely explain the data. This could be accounted for in 3 ways: (i) the group might include a few outliers; (ii) some variables not introduced in the model might influence results (eg, naming deficit severity, or relative severity of phonological impairment); (iii) the tendency to produce semantic errors with increased phonological similarity might be in itself a randomly distributed and scarcely predictable variable.

The POI-rate distribution of our patients (Figure 1) seems smooth. The last hypothesis (random POI-rate variation between subjects) should be considered only after studying the logistic regression models aimed to check the relevance of the available predictors for each patient: (a) the overall accuracy of each patient, (b) the number of phonological errors corresponding to a real word; (c) the number

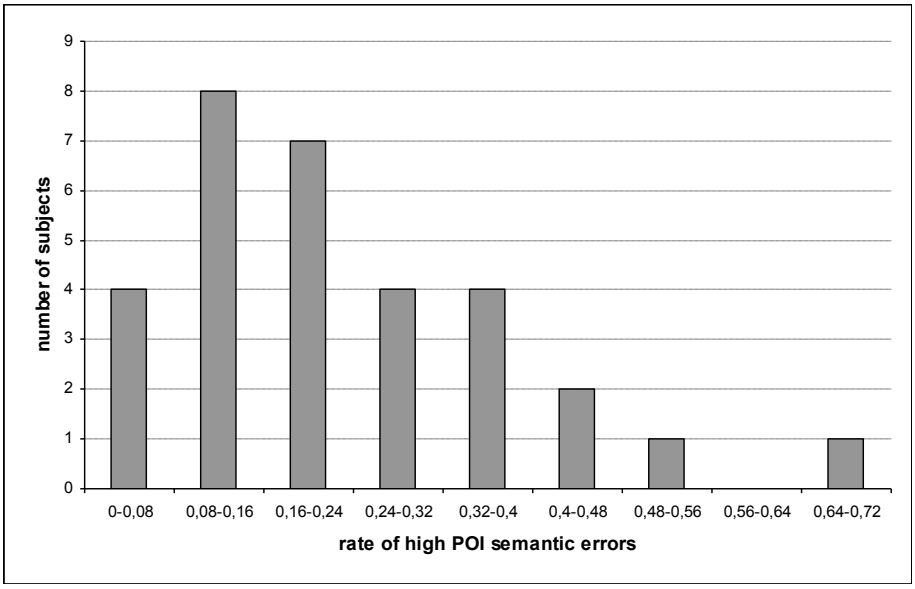

Figure 1: Distribution of the rate of high-POI semantic errors in our sample. In the histogram, the height of each column represents the number of patients with a given value (in abscissa) of the rate of high-POI semantic errors.

of phonological errors resulting in non-existing words, (d) the overall number of phonological errors, and (e) the ratio between the overall number of phonological errors and the overall number of naming errors. None of the considered predictors influenced the tendency of each patient to present with a given rate of high-POI responses, and the corresponding chi-square values always fell far short of significance (chi-square <1, df=1).

Discussion

Our findings confirm that the increased phonological similarity of semantic errors is not uniform in an unselected group of aphasic patients. More interestingly, the increase of phonological similarity of semantic errors seems to depend neither on overall severity, nor on the degree of phonological impairment. The increased phonological similarity of semantic errors has been taken as a support to interactive models of the functional interplay between lexical representations and phonology (Martin et al., 1996; Rapp et al., 2000). The independence of this effect from the level of phonological impairment seems an interesting constraint for a more precise definition of the interaction between lexicon and phonology.

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Eye movements tell us more about the underlying reading strategy in lexical readers

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Introduction

Patients with acquired dyslexia do not show the well coordinated interaction of lexical and segmental reading procedures known from normal skilled readers (Radach & Kennedy, 2013). Instead, they pathologically rely predominantly on one of the two reading routes. A psycholinguistic error analysis of dyslexic responses in various reading tasks provides a basis for clinically discriminating subtypes of pathological reading and for evaluating the respective recovery processes (Coltheart, 1980; Greenwald, 2000). Phonology-related errors are indicative of a sequential word processing strategy, whereas lexical and semantic errors are associated with a lexical processing strategy. Despite the large number of published intervention studies, there are only a few studies on changes in error distributions during recovery in dyslexic patients. More specifically, to our knowledge only two cases of a change from lexical to segmental reading have been reported in the literature (DePartz, 1986; Nolan, Volpe, & Burton, 1997).
In the present study we assessed the impact of a specific therapy intervention on the underlying reading strategy over the time course of recovery in patients with acquired dyslexia. An innovative aspect of our work is not only to focus on reading responses to evaluate the recovery process, but also to include online eye tracking methodology (Ablinger et al., in preparation; Ablinger et al., 2012; Schattka, Radach, & Huber, 2010) to get detailed information about the process of word identification in real time.

Methods

Participants

We report data of five aphasic patients with acquired dyslexia. The etiology was vascular in four patients, one suffered from a craniocerebral injury. On the basis of oculomotor behaviour all subjects had been classified as lexical readers (see Schattka et al, 2010, for details). In all participants oral word and pseudoword reading was poor before therapy intervention. Errors were classified as omissions, neologisms, phonological, lexical and semantic errors.

Materials and procedure

All five subjects were included in an eye movement based reading intervention, where lexical and segmental reading was facilitated (Ablinger et al., in preparation). As a result of the individual baseline performance 150 individual items were selected for therapy and diagnostic assessment. All 150 target nouns varied in word length from 6 to 9 letters and were balanced for frequency and semantics. Reading performance was assessed before (T1) and after (T2) therapy intervention via recording of eye movements (EyeLink 1000, SR Research, see Inhoff & Radach, 1998, for general methodology). We developed a novel way to examine the spatio-temporal dynamics of word processing, based on dividing the total number of fixations per target word into three equal bins and computing the resulting distributions of fixation positions. Comparing these sub-distributions reveals the gradual shifting of fixation positions over the time course of word processing, providing an adequate metric for objective classification of reading strategies. Verbal expressions were digitally recorded for subsequent linguistic error analysis.

Results

Overt reading behaviour

While word reading accuracy improved significantly in all participants, there were no changes in pseudoword reading. At T2 lexical and phonological errors were dominant in two participants (DH, KM), while the other patients predominantly exhibited one error type, lexical errors in SHJ, phonological errors in WS, and no responses in ST.

Word fixation patterns

Therapy intervention led to a significant decrease of total reading time and total number of fixations per word in three of five subjects (DH, ST, WS). Interestingly, in two subjects (SHJ, KM) total reading time and total number of fixations increased significantly from T1 to T2. Both subjects showed a relatively high proportion of no responses before the beginning of reading intervention

Evaluation of the reading strategy

At T2 in three of five subjects (DH, SHJ, ST) the spatio-temporal analysis of fixation positions revealed a restructuring in the underlying reading mechanisms from predominantly lexical to more segmental word processing. More specifically, subdistributions of fixation positions for early, medium and late time bins clearly exhibited three spatially distant peaks indicating a transition towards sequential word processing. In contrast, two subjects (KM, WS) maintained their lexical reading procedures, as indicated by spatially overlapping subdistributions with maxima near the target word centre.

Discussion

Therapy intervention led to improved reading accuracy in all subjects. However, neither changes in error distribution nor standard eye movement parameters were indicative of a possible change in the underlying reading strategy. The assumption that predominant phonological errors may refer to a segmental word processing routine, while the production of lexical errors is indicative of a holistic strategy could not be verified. Instead, detailed analyses of fixation position distributions provided detailed information about the time course of underlying word identification processes. To conclude, our results indicate that despite general improvements in reading performance, only some patients reorganized their word identification process after therapy intervention. These findings raise doubts on the validity of psycholinguistic error analysis as an indicator of changes in reading strategy.

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The subject-object asymmetry in aphasic argument question comprehension: Eye-tracking reveals the role of morphology

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Introduction

Patients with agrammatic Broca's aphasia show difficulties in producing and comprehending wh-question structures (e.g., Grodzinsky, 2000). It is still a matter of debate, to which extent different types of questions (e.g., referential vs. non-referential, subject-extracted vs. object-extracted wh-questions) can be selectively impaired in aphasia. Specifically, it is an open question whether for argument wh-questions the same subject-object extraction asymmetry exists as has been reported for declarative sentences. While some studies failed to show diverging effects for these structures (Fyndanis et al., 2008; Hickok & Avrutin, 1996), others have reported dissociations between subject-extracted wh-questions as compared to object-extracted wh-questions (Neuhaus & Penke, 2008; Thompson et al., 1999). The picture is even complicated by the fact that some patients in these studies showed a reversed asymmetry with better comprehension of object-extracted as compared to subject-extracted wh-questions (e.g., Kljajevic & Murasugi, 2010). This pattern would not be expected by representational accounts on sentence comprehension deficits in aphasia (e.g., the Trace-Deletion-Hypothesis / the Trace Based Account by Grodzinsky, 1995) as these predict deficits in processing non-canonical (i.e. object-extracted) compared to canonical (i.e. subject-extracted) syntactic structures.

So far, studies investigating argument question comprehension have focused on offline tasks and little is known about online processing of question structures in aphasia.

Aim

The goal of our study is to systematically investigate *offline and online* processing of subject-and object-extracted argument wh-questions in German patients with aphasia. We ask whether different subgroups of patients exist who show individual asymmetric or non-asymmetric question-comprehension patterns. Most importantly, we aim to explore how eye-tracking can help to identify these subgroups and, moreover, to identify the source of their individual impairment.

Furthermore, as studies have shown that deficits in syntactic comprehension are not restricted to one single aphasia syndrome (Dronkers et al., 2004), we include Broca's as well as anomic patients in our study.

Methods

Design and Procedure

We conducted a visual-world study in which participants performed an auditory sentence-picture matching task while their eye-movements were being measured. The target structures comprised subject-extracted and object-extracted who-questions (n=20 each), derived from simple semantically reversible declarative sentences. All noun phrases (NPs) in the target sentences were masculine and, hence, the wh-element as well as the determiner in the post-verbal NP were unambiguously and overtly marked for case (nominative/accusative). In addition, 20 semantically irreversible what-questions served as fillers. Examples are given in (1)-(3).

(1) Subject-extracted who-question: Wer_{NOM} kneift den_{ACC} Vater? (Who is pinching the father?)

(2) Object-extracted who-question: Wen_{ACC} kneift der_{NOM} Vater? (Who is the father pinching?)

(3) Filler: Irreversible what-question: Was küsst der Mann? (What is the man kissing?)

For each trial, participants saw two pictures on a screen (a target picture and a foil displaying a theta-role reversal) for a fixed preview time (15.000 ms) and simultaneously the persons depicted in the pictures as well as the action were being mentioned auditorily. This preview was followed by an asterisk shown for 600 ms to centre participants' eye fixations. Afterwards, both pictures re-appeared on the screen and the question was played. The task was to identify the picture that correctly answers the question. Participants responded by button press. Each participant received one of four different pseudo-randomized presentation lists. Picture position as well as action direction within the pictures were balanced across trials.

We measured accuracy and reaction times (RTs) in the sentence-picture matching task as well as eye-movements in terms of proportions of fixations on the target and the foil picture.

Participants

We collected data from 14 control subjects (5 male, 9 female; mean age: 62 years, age range: 38-77 years) and, so far, 3 patients with aphasia (2 male, 1 female; 1 Broca's, 2 amnesic; age range: 41-58 years; 9-12 years post-onset) have been investigated. All participants were native speakers of German and (pre-morbidly) right-handed. Patients with aphasia suffered from a unilateral lesion in their dominant hemisphere and presented with preserved auditory analysis as well as retained auditory single-word comprehension. In addition, comprehension of semantically irreversible sentences and simple canonical sentences (subject-verb-object structures) was relatively unimpaired.

The experiments are still ongoing and we intend to test at least five more patients with aphasia.

Results

Controls' accuracy was at ceiling in both conditions (98% correct), and, interestingly, RTs were higher for subject-extracted who-questions than for object-extracted who-questions. This advantage of the non-canonical question type was also evident in controls' eye-movements, as there were significantly more fixations to the target picture during the post-verbal noun phrase for object-questions as compared to subject-questions.

The preliminary results from patients revealed three different patterns with respect to accuracy: P01 performed above chance in both conditions, P02 was at chance with object-extracted questions and above chance with subject-extracted questions, and P03 performed at chance in both conditions. As in controls, patients' RTs were higher for subject-extracted than for object-extracted questions. However, a distinct analysis of patients' correct and incorrect responses revealed that this was only the case for their incorrect responses, whereas for correct responses the pattern was opposite to controls with higher RTs for object- as compared to subject-questions.

Patients' eye-movement data so far reveal that, contrary to controls, processing of the wh-element and the verb alone does not provide them with sufficient information in order to show a fixation advantage for the target picture. Instead, patients heavily rely on the case-marking cue of the post-verbal NP and, thus, show a delay in fixation patterns. Moreover, errors in comprehension of object-extracted who-questions are not associated with a breakdown in non-canonical word order processing, but rather seem to arise from deficient processing of the morphological cue provided at the post-verbal NP.

Discussion

Overall, the results point to the existence of heterogeneous, individually distinctive patterns in argument wh-question comprehension in aphasia. Moreover, the eye-tracking data reveal deficits in morphological cue processing in the light of at least partially retained syntactic processing of non-canonical word order.

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Object naming may overestimate patient's language performance after neuro-oncological surgery: A case study

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Introduction

Before and after neuro-oncological surgery, patients are starting to be assessed with more complex language batteries (Miceli et al., 2012; Papagno et al., 2012). Despite that, during surgery, object naming is the only task typically used to map overall language capacities (De Witte & Mariën, 2012). Object naming is a relevant task, as damage in the semantic and lexical levels is known to affect language performance and quality of life (Goodglass & Wingfield, 1997). However, object naming alone may not be enough to assess overall language capacities as the lexical-grammatical or syntactic level and many other semantic and lexical properties of language that can be assessed with verbs but not with nouns are left aside (Vigliocco et al., 2011).

Given that patients that undergo neuro-oncological surgery present mild language deficits that allow them to perform demanding tasks (Bizzi et al., 2012; Santini et al., 2012; Satoer et al., 2011; Satoer et al., 2012; Talacchi et al., 2012), we may consider using relevant language tools that allow mapping as much language processes as possible. We compared the type of object naming task typically used in neuro-oncological surgery and a new task that uses finite verbs in sentence context before and after surgery (Rofes et al., 2012). Our predictions favor the use of tasks with verbs.

Methods

Participant

ADB is a 41-year old, right-handed, Dutch-speaking male from West Flanders, Belgium. He graduated in informatics and has worked as an IT project manager. In 2008, ADB underwent surgery for a glioblastoma multiforme (WHO IV) in the right occipital lobe. In 2012, he underwent a second intervention in the right temporal lobe, due to a recurrence of the tumor. ADB had an extensive vocabulary and often used low-frequency words. He had some difficulties staying focused and talked excessively. However, he was understanding and cooperative during the assessments.

Materials

We assessed ABD using two tasks: an object naming task and a task that uses finite verbs. The object naming task assesses the semantic and the lexical level of language. Participants read an introductory sentence and produce the name of the object that is in the drawing (e.g., *Dit is een... paard* 'This is a... horse'). The task with finite verbs in sentence context assesses the semantic and the lexical level as well as the lexical-grammatical or syntactic level of language. Participants read the subject of the sentence and produce the name of the action depicted, using the correct inflected form (e.g., *De man... fietst* 'The man... bikes').

The stimuli of both tasks consist of black-and-white line drawings with more than 80% of picture agreement, as previously measured. Each drawing is shown in a computer screen for 4000ms with a specialized software and it is preceded by a beep 500ms before stimulus presentation. The items are controlled and pseudo-randomized for relevant semantic and lexical variables (e.g., frequency, age of acquisition, imageability, length in phonemes, transitivity, number of internal arguments).

Procedure

We administered the two tasks three times: one week before surgery (before), one week after surgery (early after), and one month and three weeks after surgery (late after). All responses were recorded and transcribed. Accuracy and oral reaction times were collected for each of the items. Responses were marked as correct when the target lexical item was produced. Responses out of time (>4000ms) and, in the test with verbs, non-inflected forms and responses in tenses other than the third person present were marked as incorrect.

Results

ADB responded to the object naming task 90% correct before surgery, 80% early after and 97% correct after surgery. To the task with finite verbs, he responded 87% correct before surgery, 68% correct early after and 89% correct after surgery (Figure 1).

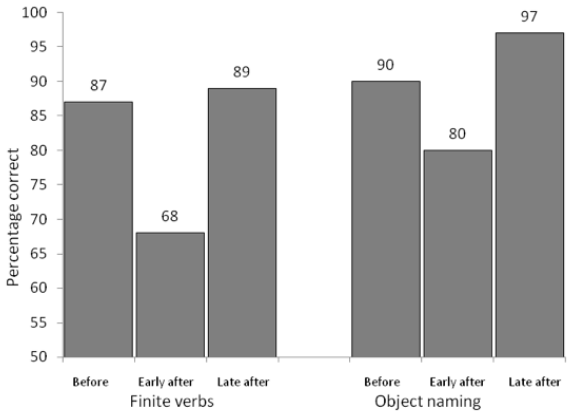

Figure 1: Percentage correct over time (Finite verbs and Object naming)

We compared the performance in each test across the three testing moments ('before' vs. 'early after' vs. 'late after'). A Cochran's Q test revealed significant differences in object naming (Q(2)=29.200;df=2; *p=0.000*) and in the task with finite verbs (Q(2)=26.000;df=2; *p=0.000*). For the object naming task, post-hoc McNemar tests with Bonferroni corrections ($\alpha < 0.0167$) revealed significant differences between the three assessments ('before' vs. 'early after': Q(1)= 0.008; 'early after' vs. 'late after': Q(1)= 0.000; 'before' vs. 'late after': Q(1)= 0.003). For the task with finite verbs post-hoc analyses revealed significant differences between the assessments 'before' and 'early after' surgery (Q(1)= 0.000) and between 'early after' and 'late after' surgery (Q(1)= 0.000). However, for the test with finite verbs, we did not find significant differences between the assessments 'before' and 'late after' surgery (Q(1)= 0.754).

We compared the two tests in each assessment moment (object naming 'before ' surgery versus task with verbs 'before ' surgery; object naming 'early after ' surgery vs. task with verbs 'early after ' surgery; and object naming 'late after ' surgery vs. task with verbs 'late after ' surgery). Mann Whitney U tests with Bonferroni corrections ($\alpha < 0.0167$) did not reveal significant differences 'before' surgery (Z= -0.735; p= 0.462) and 'early after' (*Z*= -2.148; p= 0.032). However, they revealed significant differences between tests 'late after' surgery (*Z*= -2.713; p= 0.007).

Discussion

Among other things, ADB was overall better in object naming as compared with the task with finite verbs. This is expected given that the task with verbs not only assesses the semantic and the lexical level but also the lexical-grammatical or syntactic level of language. The differences may also accrue due to the natural variance in the semantic features of nouns and verbs. Interestingly, ADB significantly improved in object naming after surgery although he remained the same in the test with finite verbs.

This raises the point that if we were to take object naming as the only outcome of ADB's language capacities, we would be overestimating his performance. We interpret these results as an indication that the language assessment of patients in neuro-oncological surgery should be revisited and that relevant language tasks such as the one we used with finite verbs may be a relevant complement.

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Proper and common noun learning: Same or different?

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Introduction

Proper (e.g. John) and common (e.g. person) names form two different categories of nouns with distinct features that characterise them. The data from studies on normal healthy population, elderly people and speakers with brain damage show that retrieval and learning of proper and common nouns might not evolve in similar ways. Convergent data from diary and laboratory studies on word retrieval as well as learning for young adults, elderly speakers and people with aphasia demonstrate that proper nouns are more vulnerable to tip-of-the tongue phenomena (Young, Hay, & Ellis, 1985; Seamon & Travis, 1993) and impairment in brain-damaged speakers (Semenza & Zettin, 1988; Harris & Kay, 1995). In learning (for both young and elderly healthy participants), subsequent recall of a learnt proper name(e.g. a personal name) is often found to be poorer than recall of a learnt common name (e.g. occupation) when associative learning techniques are used (Stanhope & Cohen, 1993).

There are two hypotheses regarding the underlying cause of differences between proper and common noun learning and processing. On the one hand, such divergence might be due to different logical properties, i.e. nature of proper and common names as word classes. Common nouns refer to a category of beings or objects that share certain semantic properties, while proper names designate specific individual beings or objects with their unique features. Proper nouns are also sometimes called 'pure referring expressions' (e.g. Kripke, 1980) as they refer us to an individual entity but do not convey any semantic features, any meaning. On the other hand, proper and common nouns can be considered to be on a 'continuum of word retrieval difficulty' as suggested by Kay, Hanley, and Miles (2001) on the basis of a number of statistical properties such as frequency, familiarity, and age of acquisition.

We had two aims:

1. Theoretical : By using novel stimuli the statistical properties of the to-be-learnt proper and common nouns are equal. We aimed to test the hypothesis that logical properties underpin differences in proper and common noun retrieval and learning.

2. Clinical: To determine whether people with aphasia show disproportionate impairments in learning proper nouns compared to common nouns relative to age-matched unimpaired speakers.

Methods

Participants

Three experimental groups are to participate in the study: young subjects with no history of brain damage (n=16), elderly subjects with no history of brain damage (n=10) and elderly subjects with mild-moderate aphasia as a result of a stroke (n=5). Thus far we have tested the young adult group.

Stimuli and Design

Twenty bisyllabic phonologically plausible non-words, 5-8 letters in length (e.g. cheskel) were created and matched to pictures of imaginary creatures. All the items were divided into two sets of 10 items each. Across the two sets verbal items were matched for length, initial phonemes/cluster of phonemes, written bigram frequency, phonological and orthographic neighbourhood and phonotactic probability. Each set was presented in either the common or proper noun condition. Items were shown as representatives of a number of species (10 in total) in the common noun condition and as individual creatures (10 in total) in the proper noun condition.

Following the procedure used in Tuomiranta et al. (2011) our experiment was conducted within eight sessions: four learning sessions and four follow-up sessions one day, one, four and eight weeks after the last learning session. During learning sessions participants were presented with the full set of items twice. In the common noun condition participants were given three representatives of each species, whereas in the proper noun condition they saw three depictions of each individual. Training was followed by naming and word-picture verification tasks (feedback was given to enhance learning).

During the naming task participants were asked to recall the name of a species/individual name of a creature shown. Irrespective of whether naming was successful or not, participants were given a phonological cue (the first phoneme and schwa). Participants saw and heard the correct response after presentation of each item.

During the word-picture verification task participants were asked to say if a presented word was the right label for a presented picture. This task was designed among all to verify if participants learnt items as members of respective noun classes rather than pure labels.

Follow-up sessions started with word (written and auditory) and picture recognition tasks which were followed by naming and verification tasks (no feedback was given).

Results

The preliminary analysis of the naming task performed by young adults showed no significant difference in the rate and extension of learning of common and proper names ($F(1)=2.65$, $p > .05$). Full data on the naming and word-picture verification tasks for all three participant groups will be reported at the conference. Further analysis is to demonstrate whether elderly participants show similar learning patterns to young adults: if learning and retention of common and proper nouns are impaired to the same extent, this will serve as another evidence for them being processed similarly. Data from people with aphasia is to reveal whether any disproportionate impairments in learning and retrieval of proper and common nouns are to be found provided statistical properties of the items from both word classes are equal.

Discussion

According to the preliminary analysis of the young adult data, there is no difference in the rate of learning and retention between common and proper nouns. Such results are in favour of the account that statistical properties have a dominating role in learning and retrieval of common and proper names. Thus, the fact that proper names are more prone to failure or delay in retrieval and learning are most likely due to the fact that common nouns are more frequent and familiar, and acquired earlier in life in comparison to proper nouns. The data from people with aphasia and their age-matched controls will be discussed at the conference.

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Broca meets Wernicke in one single case

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Introduction

Detailed clinical descriptions of language disorders date back to the mid 1800s - early 1900s, when clinicians started to identify lesion-aphasia correlates. Early investigators also established that written language symptoms in aphasia typically mimic the type of distortions found at the oral-verbal level. Indeed, as a rule the nonfluent aphasias are characterized by expressive language disturbances at both the oral and written language level. Fluent aphasia symptoms in expressive and comprehensive speech are present in reading and writing as well.

Methods

We present the neurolinguistic follow-up findings in an exceptional, right-handed patient who following traumatic brain injury to the left temporal and left frontal brain regions presented with a marked dissociation between oral and written language. In-depth neurolinguistic and neurocognitive assessments were performed at 5, 15 and 27 weeks posttrauma.

Results

Five weeks after the trauma in-depth neurolinguistic investigations identified a marked discrepancy between oral and written language. A neologistic paragrammatic output at the oral level sharply contrasted with a superior and relatively spared agrammatic written output. As demonstrated by the test results (table 1) oral and written language comprehension as well as speech production significantly improved after 15 weeks and the dissociation resolved. However, the correct use of function words remained problematic and difficulties with tense agreement persisted. Phonological jargon resolved but phonological errors still intruded speech and writing. Repeat investigations at 27 weeks posttrauma showed a further improvement of auditory comprehension skills.

Neuropsychological investigations performed five weeks after the trauma showed attention disturbances, memory problems and executive dysfunctions. Repeat examinations disclosed a significant improvement at 15 and 27 weeks postonset but attentional deficits persisted: tempo remained reduced and attention span was variable. Due to aphasia verbal memory problems were found. Executive

functioning improved but planning and organisation skills remained distorted. The patient solved problems in a highly atypical, inefficient and often complex way.

Table 1: Neurolinguistic Data (AAT and CAT-NL) 5, 15 and 27 weeks posttrauma

	Results 5w/15w/27w	**Percentile (Cut-off)**	**Max**	**Mean**	**± 1SD**
AACHEN APHASIA TEST					
Comprehension	87/104/115	55/86/99	120	108.5	10.24
auditory: words	25/29/30	77/95/98	30	26.49	3.30
auditory: sentences	15/24/28	20/69/91	30	26.79	3.41
Total	40/53/58		60	53.28	6.08
written: words	26/26/29	67/67/90	30	28.30	2.29
written: sentences	21/25/28	63/82/95	30	26.91	3.39
Total	47/51/57		60	55.21	4.90
Token Test (errors)	50/16/13	6/75/81	50	2.28	2.75
Spontaneous Speech					
Communicative behaviour	2/3/4	-	5	4.63	0.54
Articulation and prosody	2/3/4	-	5	4.63	0.67
Automatisms	2/3/5	-	5	4.59	0.65
Semantic structure	2/3/5	-	5	4.59	0.53
Phonematic structure	2/2/3	-	5	4.54	0.56
Syntactic structure	3/3/4	-	5	4.41	0.55
Imposed Speech					
Total repetition	2/112/128	2/55/73	150	144.1	8.07
Phonemes	0/30/30	1/88/88	30	28.91	2.09
Monosyllabic words	2/28/29	5/68/80	30	29.22	1.32
Loan- &foreign words	0/24/27	3/53/71	30	28.94	2.31
Compounds	0/12/20	5/34/57	30	28.45	2.22
Sentences	0/18/22	5/59/70	30	28.55	1.90
Total naming	12/109/113	15/94/98	120	109.3	8.42
Simple nouns	1/27/30	13/74/97	30	27.92	2.90
Colour names	6/29/30	18/93/98	30	27.69	1.99
Composed nouns	0/28/28	8/91/91	30	28.04	2.61
Sentences	5/25/27	27/91/97	30	25.69	3.72
Written Language	23/82/87	26/87/95	90	85.52	7.63
Reading aloud	10/28/30	22/79/96	30	28.95	1.93
Composing	9/28/29	32/89/93	30	28.57	2.75
Dictational writing	4/26/28	31/83/91	30	28	3.67
COMPREHENISIVE APHASIA TEST-NL					
Comprehension	100/122/124		128		
Auditory: words	28/ 30/ 30		30		
Auditory: sentences	11/27/30		32		
Auditory: paragraphs	2/4/4		4		
Total	41/61/64		66		
Written: words	28/30/30		30		
Written: sentences	31/32/30		32		
Total	59/62/60		62		
Spontaneous Speech					
Spoken picture description					
Written picture description					

Table 1: *continued*

	Results 5w/15w/27w	Percentile (Cut-off)	Max	Mean	± 1SD
Imposed Speech					
Total repetition	0/34/56		74		
Words	0/16/26		32		
Complex words	0/0/6		6		
Nonwords	0/8/8		10		
Digit strings	0/4/8		14		
Sentences	0/6/8		12		
Total naming	0/39/54		58		
Objects	0/30/44		48		
Actions	0/9/10		10		
Written Language					
Total reading	2/56/62		70		
Words	0/34/40		48		
Complex words	0/6/6		6		
Function words	2/6/6		6		
Nonwords	0/10/10		10		
Total writing	49/78/78		82		
Copying	31/31/31		31		
Picture names	17/23/23		23		
Dictational writing	1/24/24		28		

Legend: w = weeks; - = data not available; * = significant (z = >2)

Discussion

To the best of our knowledge only a handful of cases have been reported in which the aphasia profile is characterized by a marked typological contrast between oral and written language (Lhermitte & Derousné, 1974; Hier & Mohr, 1977; Basso, Taborelli & Vignolo, 1978; Assal, Buttet & Jolivet, 1981; Ellis, Miller & Sin, 1983; Saffran, Coslet & DeSalme, 2000; Kemmerer, Tranel & Manzel, 2005). In this patient oral output contained all typical characteristics of Wernicke aphasia, i.e. neologistic jargon and severely impaired auditory comprehension. Written output on the other hand consisted of all the typical features of Broca's aphasia, i.e. impaired, though comprehensible written language production with relative intact written comprehension. Several interesting dissociations characterise the patient's profile. The most striking dissociation relates to non-fluent and relatively correct written output and severely disrupted fluent jargonic speech. In addition writing was characterised by agrammatic symptoms while paragrammatic disturbances affected speech. Phonological jargon disrupted speech but at the written level phonological processing was correct. This pattern of linguistic deficits did not allow classification in terms of a neurological aphasia taxonomy.

A significant improvement occurred during follow-up at 15 weeks posttrauma and the dissociations resolved: the patient's oral output became intelligible. In writing as well as in speech more morphological variability occurred and syntactically

more complex structures were used (with many clauses but with an overuse of auxiliary verbs). Problems with the correct choice of function words and tense agreement persisted. Phonological jargon resolved but phonological paraphasias remained in speech. Phonological paragraphias were observed in writing. Following remission of the oral-written language dissociations, the patient's aphasic symptom complex corresponded to a diagnosis of conduction aphasia (CA): a fluent aphasia syndrome, characterized by a deficit at the phonological processing level. Spontaneous speech was marked by frequent phonemic paraphasias, conduite d'approche, word-finding difficulties, and paraphrasing. Spontaneous writing was characterized by more complex grammatical structures and phonological paragraphias were observed as well.

Anatomoclinical studies have causally related CA to damage of the left superior temporal gyrus (STG) and the left supramarginal gyrus, which play a crucial role in phonological processing (Graves et al., 2008). The left STG is crucially implicated in the modulation of phonological complexity such as word length and frequency rather than regularity (Tomasina et al., 2011). Phonemic paraphasias are the result of a disruption of the sensory-motor integration circuit which leads to an impairment in the capacity for auditory representations of speech to constrain and guide the corresponding articulatory representations thought to be stored in the inferior frontal gyrus (IFG) and ventral premotor cortex (Hickok & Poeppel, 2004). The morphosyntactical errors of this patient may be linked to the small traumatic lesion in the left frontal lobe. The IFC plays a role in grammatical processing, moreover in allowing morpho-phonological properties of the verb (Tomasina et al., 2011).

The exceptional typological contrast between nonfluent written and fluent oral language in this patient implicates the use of different anatomical areas for different aspects of language processing. For example his phonological intact writing might be able to a preserved medial occipital gyrus whereas his phonological jargon might be due to a structural damage to the left IFG, STG and the primary auditory cortex (Booth et al., 2002). Significant improvement in language processing is modified by functional repair of the right temporal area that is responsible for sustained attention, motor planning and response inhibition (Hagoort, 2005). The contrast underlies the over-simplification of the Geschwind-Wernicke model where CA was interpreted as the expression of the inability of temporal regions to monitor Broca's area speech output through subinsular connections resulting in identical aphasia (Geschwind, 1965). Moreover the contrast founds the hypotheses of Martino et al. (2013) and Catani & Mesulam (2008) who describe the tripartite role of the subcortical superior longitudinal fasciculus, which in addition to the deep and long direct segment, namely the arcuate fasciculus (FA), consists of two superficial short tracts, an anterior segment linking Broca's area with the inferior parietal lobe and a posterior segment linking the inferior parietal lobe with Wernicke's area.

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The WORD project: a case series study on intervention for developmental word-finding difficulties

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Introduction

Children with developmental word-finding difficulties (WFD) can experience problems in retrieving words, which can usefully be compared and contrasted to those of adults with anomia as part of acquired aphasia. WFD can influence a young person's relationships, self-esteem and education.

There is controversy in the literature on both the source of WFD (e.g. Constable, et al., 1997; Messer & Dockrell, 2006) and the most effective intervention (e.g. Ebbels et al., 2012). The WORD (WOrd Retrieval and Development) project investigates the development of lexical retrieval in children and explores the outcomes of contrasting treatment strategies for those who have WFD.

The ongoing study has three strands. The first involves collecting data from children with typically developing (TD) language and a clinical WFD group. Naming speed and accuracy are compared for children at different stages of development, alongside their performance on related tasks tapping semantic and phonological processing.

The second strand entails computational modelling of the processes involved in word retrieval. Constraints within the model can be varied to reflect the patterns shown by children with TD language and with WFD.

The final strand is an experimentally controlled intervention in which a sub-set of the children with WFD take part in one form of therapy most appropriate to their difficulty and one building on their relative strengths to determine which approach is more effective. Therapy protocols were devised taking account of techniques used successfully with adults with anomia as part of their aphasia (semantic and phonological feature analysis, e.g. Coehlo et al, 2000; Leonard et al., 2008; Boyle & Coelho, 1995). The results of each intervention are explored in relation to the primary outcome measure: picture naming. We also consider participants' own views of change.

Methods

Primary data collection

In the first stage of our project, we aim to better understand word-finding difficulties by placing them in the context of typical development. Thus far we have assessed 66 children with TD language (4;0 - 8;4 years) and 9 children with WFD (6;0 - 8;7 years).
Assessments include:

- Naming (accuracy, RT, errors)
- Word-picture verification
- Semantics (picture judgement)
- Non-word repetition (CN Rep)

Additional assessments for the clinical population include:

- Test of Word Finding in Discourse
- Clinical Evaluation of Language Fundamentals (R) - 4

Data collected from TD children are used to construct a trajectory of normal development for naming (Thomas et al., 2009). We compare these with the profiles of WFD participants to establish individual differences and try to identify clinical sub-types, which can be compared with those of adults with aphasia, e.g. children who are primarily impaired on measures of semantic processing versus those with primarily phonological difficulties.

Intervention

Children from the WFD group are invited to take part in the intervention stage, in which we contrast different approaches using a tightly-controlled case series design. Each child participates in 2 treatment conditions and acts as his/her own control. They receive a 'model appropriate' therapy, e.g. semantic elaboration for a child whose difficulty appears to be rooted in word meanings, and a 'model inappropriate' intervention, e.g. the same child also receives phonological therapy, targeting an area of relative strength.

Results

The results from the first strand suggest the following:
a) Children, like adults with aphasia, can exhibit specific difficulties in retrieving words that are in their vocabulary as assessed by word-picture verification. This is illustrated in figure 1, below.

b) Different profiles are emerging that can be related to those found in adults with anomia as part of their aphasia

Intervention:

Children's naming can be improved by the intervention. The effects are largely limited to treated items. Importantly, the first children through the study show differential effects for the semantic and phonological intervention.

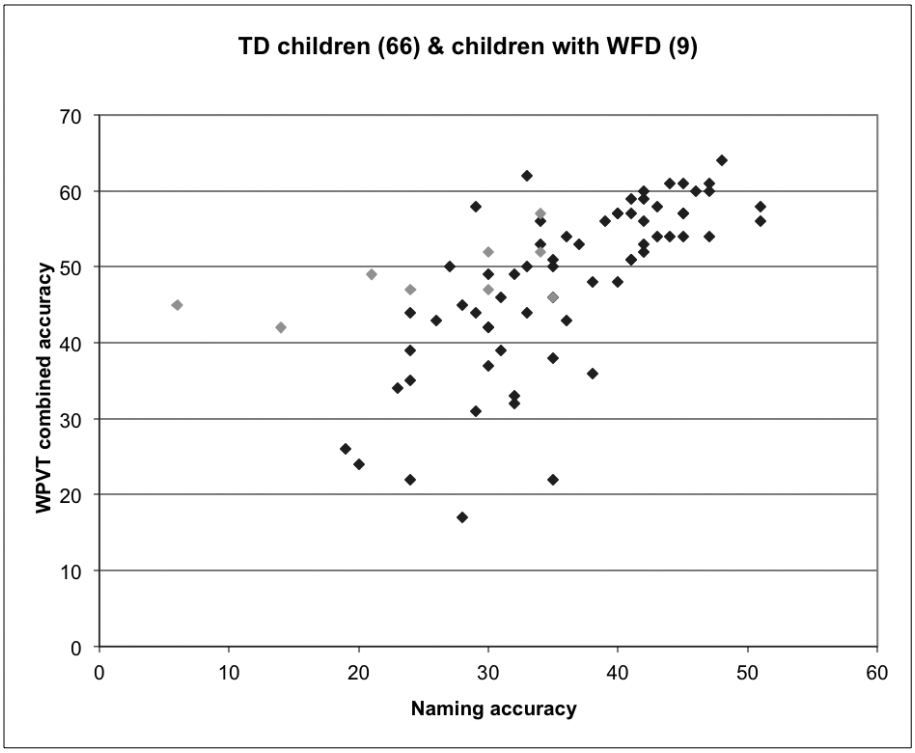

Figure 1: A comparison between word comprehension (as measured by word-picture verification) and word finding (as measured by picture naming) for children with TD language and with WFD.

Discussion

It has been established that both phonological components analysis (PCA) and semantic features analysis (SFA) can improve adults' naming and generalize (Van Hees et al. 2013). However, the relationship between the level of deficit and outcomes of intervention is not straightforward (Lorenz & Ziegler, 2009).

It is important for research on adults with aphasia to inform studies of children with

language needs and vice versa. Initial findings from our ongoing WORD project help deepen our understanding of word-finding difficulties by placing them in the context of typical development.

Results from our assessment phase suggest word-picture verification is a sensitive measure for word comprehension, which may be considered as an alternative to word-picture matching tasks, traditionally used for adults with aphasia.

Meanwhile, preliminary outcomes from the intervention strand suggest that targeting areas of relative weakness may be the optimal approach for improving word-finding.

WFD - whether developmental or acquired - are not a unitary phenomenon and can have different sources. This highlights the importance of comparing interventions within individuals, as well as across groups.

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First data from constraint induced aphasia therapy for Hungarian patients

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Introduction

Our aim with this presentation is to show how could we make a special adaptation of constraint induced aphasia therapy (Pulvermüller et al., 2001; Pulvermüller & Berthier, 2008) for Hungarian aphasic patients. It is a very important and current field in Hungary, because of the medical, social and therapeutical attention of this population. Focusing on the theoretical basis of the original conception of constraint induced procedure, we also claim that intensity, abstraction and generalization of linguistic rules are able to improve patients' language skills even if they had a stroke some years before. On the basis of neuroplasticity and language processing it seems to be a more successful way in reorganization, as it was emphasized by Leon, Maher & Gonzalez Rothi (2011, 222).

Methods

Following the theoretical principals of constraint induced aphasia therapy (Pulvermüller et al., 2001; Pulvermüller & Berthier, 2008) we have made the first Hungarian version in 2012. It means 540 pairs of cards including nouns, verbs, numbers, adjectives (some predicative adjectives), sentences. Noticing language specific rules of Hungarian grammar we have made a special adaptation of the model. Regarding on semantic, syntactic and phonological features of Hungarian it was obvious to create a complex matrix for drawing patients' attention to these generative rules.

Left hemisphere damaged patients with agrammatic aphasia were patients of the Center for Neurorehabilitation of the Department of Neurology at the University of Szeged.

We worked with groups including three patients. The first group arrived in October 2012. Now we have data from 6 groups, from 18 agrammatic aphasic patients who had suffered from stroke. Most of them had chronic aphasia, but none of them were diagnosted with dementia or depression. All groups had been practiced 3 and 4 hours (depending on their physical capacity) per ten consecutive days. Before

and after the intensive therapy all of them were tested by Boston Naming Test, Hungarian adaptation of Western Aphasia Battery, Token Test, PragmaComp and a special picture test (specially for frontal lobe executive functions), CIALT test (using selected cards from the package for the therapy), and their relatives were interviewed by the questionary CAL. All of the patients and their relatives were informed of the clinical trial of the new adaptation.

Results

Practicing language abality with intensive grammatic and pragmatic communicative stimuli has developed patients' grammatic competence. Their success was honoured by the other members of the group, as well as by their caregivers at the Department. After the statistical analysis of data we should claim that patients had very high score in picture stories beause of their intact executive functions. Tests of capacity for verbal communication from Boston Naming Test, Token Test and the WAB were analyzed in a very detailed way. Concentrating on the patients intact cognitive functions we differentiated between semantic and phonological properties of the verbal forms, so data were subcategorized depending on the types of false or missed answers. Comparing data from pretherapeutic time and the post we can conclude that most of the patients have been more sensitive to the grammatically relevant semantic, phonological features of verbal stimuli after the therapy (Tabor Connor, 2012, 227-8). Their pragmatic competence was intact, they understood jokes well, they interpreted conversational norms and were able to differentiate between the proper forms of politeness but they were not able to use these forms as well. Playing with the cards of the therapy they were asked to use some pragmatically relevant utterances for asking people something, or suggesting, requesting or refusing something. Based on the questionary CAL they became motivated to use these kinds of communicative verbal forms in their everyday language use after they left the Department.

Discussion

Therapeutic language games could regain some of patients' lost linguistic functions in a very short time with a quite intensive guided practice not to avoid the problematic forms of verbal stimuli but with the help of corporation and motivation. The indicators of this activity and intensity based therapy focus on both the production and the comprehension of speech in an appropriate communicative context. This experience makes them able to use this severally confirmed form of generating linguistic abstract rules to use their reinforced grammar productively in an adequate situation after the therapeutical work.

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The influence of working memory on the inflection of verbs in Alzheimer's and Parkinson's disease: a case study

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Introduction

Memory loss is the characteristic feature of dementia of the Alzheimer type (DAT) and can be considered as the beginning of a complex and degenerative process of cognitive functions. Language problems, a result of deteriorating cognitive functions, also occur in the early stages of Alzheimer's disease and have received a relatively little attention despite its clinical importance.

Several authors argue that all DAT-patients have language problems (e.g. Obler & Albert, 1981). Some assume that the existence of language problems can play a central role in diagnosing DAT and the severity of the disease (e.g. Cummings & Benson, 1986). The presence of language problems has also been described as a preclinical marker and main feature of the Alzheimer's disease (Cuetos et al., 2007).

According to Prins and colleagues (2002), language comprehension, grammatical and phonological processing are relatively unimpaired in the early stages of DAT. However, they mention that it is difficult to assess these linguistic functions, because it is hard to judge sentence comprehension in discourse and because the influence of probable cognitive deficits, such as impaired working memory during language processing, is difficult to identify.

Several studies mention that grammatical processing is intact in DAT (e.g. Rochon et al., 1994; Waters et al., 1995). Others, however, suggest that it is already impaired in early stages of the Alzheimer's disease (e.g. Bschor et al., 2001). This contrast may be the result of the heterogeneity of the mental disorder, being caused by individual degenerative neuroanatomical spreading patterns, leading to the impairment at distinct linguistic levels. Another explanation for these divergent results is the fact that grammatical impairments are hidden in deeper underlying structures of language processing and that these deficits can only be explored by using particular assessment conditions.

Although poor performance on language tests has been observed in Parkinson's Disease (PD) as well, it has been argued that these deficits are not cause by a language problem per se, but rather by impaired executive functioning (see Bastiaanse & Leenders, 2009, for an overview).

Methods

Participants

One female patient with probable DAT, 75 years old, MMSE-scores 21 (2011) / 16 (2013); One female patient with Parkinson Disease (PD), without depression and dementia, 86 years old, MMSE-scores 30 (2011) / 29 (2013); 5 non-brain-damaged speakers (NBDs), 4 female persons, 1 male person, mean age 84.

Materials

The German Version of the *Test for Assessing Reference of Time (TART*; Bastiaanse, Jonkers, & Thompson, 2008; German version Jalvingh & Bastiaanse, 2011) was used. This test was developed for a cross-linguistic project to examine production and comprehension of grammatical morphology associated with time reference (Bastiaanse et al, 2011). The following verb forms were elicited: past imperfect (e.g. *schälte* 'peeled'), present perfect (*geschält hat:* 'has peeled), present imperfect (*schält:* 'peels') and future imperfect (*schälen wird:* 'will peel').
Responses were scored both quantitatively and qualitatively. A response was considered correct when both the required verb form and the object were correctly produced.

Procedure

The female patient with DAT and the female patient with PD were tested with the digital version of the German TART twice, in Spring 2011 and approximately two years later. Here the results of the production test are presented.

Results

The results are given in Table 1. The non-brain-damaged-participants all scored at ceiling.

Table 1: Number of correctly produced items on the German TART of the individuals with DAT and PD.

	Past imperf.	Pres. imperf.	Pres. perf.	Fut. imperf.	total
DAT 2011	4	8	19	20	51/80
DAT 2013	0	0	15	19	34/80
PD 2011	19	20	19	19	77/80
PD 2013	18	20	20	19	77/80

The individual with PD scored outside the normal range, but only makes a few errors on both occasions.
The individual with DAT has severe problems producing finite forms of lexical verbs (past and present imperfect), whereas the periphrastic verb forms (present perfect

and future imperfect) are relatively intact. This difference is significant (Fischer's exact p<0.0001). There is a significant decline over the years (Fisher's exact p<0.0110), which, interestingly also affects the periphrastic categories, although not significantly.

Discussion

The person with DAT hardly produced any errors and there is no perceivable difference between the categories. However, the errors that she produced are interesting: she changed the required base word order (object-verb in German) to derived word order (verb -object).

Cue:	*Hier könnte man sagen: Das ist der Mann der gerade...*	***die Milch***	*trank*
		object	*verb*
Answer:	*Here one could say: That's the man who just...*	*drank*	***the milk***
		verb	***object***

However, her deficit is very mild and has not declined during the past two years. Finite lexical verbs are difficult to retrieve and inflect for the individual with DAT. We suggest that this is the consequence of problems integrating lexical and grammatical information. A similar phenomenon with finite lexical verbs compared to periphrastic forms was observed in individuals with fluent aphasia. Bastiaanse (2011) found that the finite lexical verbs produced by these speakers have less variation and are of higher frequency than normal, whereas the participles of the periphrastic verb form have normal variation and frequency. Here we see the same in the person with DAT. Interestingly, when she produces a finite verb, i.e. in the past and present imperfect conditions, she often omits the object. Apparently, producing both a finite verb and an object is too complex. Further research is needed to show whether these parallels in the production of verbs between fluent aphasia and DAT can be explained by similar pathological linguistic processes or should be considered as having a different cause, leading to the same surface problems in retrieving and inflecting finite verbs.

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Verb comprehension in aphasic speakers of Standard Indonesian

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Introduction

Studies on comprehension of single verbs are scarce, and there was only a case study (Postman, 2003) looking at verb comprehension at the sentence level in Standard Indonesian (SI). Kim and Thompson (2000) showed that comprehension of verbs of agrammatic speakers is relatively spared and Jonkers and Bastiaanse (2006) showed that instrumentality and name relation with a noun may influence verb comprehension in non-fluent and fluent aphasia in a different degree.
The aim of the current study is to provide additional crosslinguistic data on verb comprehension in aphasic speakers. We collected data from Standard Indonesian (SI) aphasic speakers with a test adapted from Verb and Sentence Test (VAST; see Bastiaanse, Edwards, Maas, and Rispens, 2003). In this test, verbs are controlled for several factors that may influence verb production and comprehension in aphasia: frequency; age of acquisition; imageability; transitivity; argument structure, instrumentality; name relation to a noun; length.
SI verbs are morphologically simple: there is no inflection for Tense, Aspect or Agreement. The only possible inflection is an (optional) accusative marker on the verb. However, many verbs are compounds. Verbs, particularly instrumental verbs can be noun-based or verb-based (see 1).

(1a) a noun based verb
sapu → *menyapu*
broom$_N$ → to sweep$_V$

(1b) a verb based verb
hapus → *menghapus*
to erase$_V$ → to erase$_V$

Noun- and verb-based verbs differ in the sense that the word class of the base is different. The prefix of a verb-based verb does not have any function apart from enforcing well-formedness (Sneddon, 1996). In the noun-based verbs, the prefix interacts with the noun-base to form new meaning. In the example of 'to sweep', *meN-* means to apply or use the base-word.
The aim of the current study is to find out whether instrumentality, name relation

and the nature of compound verbs influence comprehension of aphasic individuals in SI.

Methods

Participants

Six participants (3 transcortical motor, 1 Broca's, 1 Anomic, and 1 Wernicke's aphasia) were included in the study. Their aphasia type was determined by *Tes Afasia untuk Diagnosis, Informasi, dan Rehabilitasi* (TADIR, Dharmaperwira-Prins, 1996), except for the Wernicke's aphasic speakers who only completed the TADIR partially and was evaluated by their speech therapist to belong to this aphasia type.

Test Construction

The verbs included in the test were controlled for verb morphology, transitivity, instrumentality, name relation with a noun, imageability, age of acquisition, name agreement, length, thematic roles, frequency, and visual complexity. This Indonesian adaptation of the VAST verb comprehension task uses a set of four pictures per item. The picture of the target verb is paired with a semantically related verb as a distractor. Then the target and the distractor are each paired with a semantically related noun as additional distractors. For instrumental verbs, the paired noun distractor is its instrument (e.g. target 'hammering', distractors 'sawing', 'a hammer' and 'a saw'). The test consists of 48 items, 17 non-instrumental verbs, 31 instrumental verbs of which 16 were name-related and 15 were not name-related. Within the category of name-related instrumental verbs, there are 8 noun-based and 8 verb-based target verbs.

Participants were shown the four pictures and were instructed to point at the picture that best matches the target (spoken) verb. The answers were recorded manually on the scoreform.

Results and Discussion

Twelve non-brain-damaged individuals (NBDs) were initially tested. All NBDs performed at ceiling (mean correct percentage of group=99%, range=47-48 out of 48). The results of the aphasic individuals are given in Table 1.

The group is yet small and, therefore, it is hard to do any reliable statistical testing. What can be seen from this table is that the largest individual discrepancy is in the scores of the individual with Broca's aphasia: the difference between scores on instrumental and non-instrumental verbs is close to significant (Fisher's exact: $p=0.07$). This is in line with the findings of Bastiaanse and Jonkers (2006). They argued that the poor performance of non-fluent aphasic individuals is due to the fact that when the instrumental verb is activated, the name of the instrument is co-activated. On a test where this instrument is one of the alternatives, this is confusing and this results in poor performance.

Table 1: Proportions correct for the aphasic individuals (A1-A6). Mpo: months post onset; tcm: transcortical motor aphasia;non-instr: non instrumental verbs; instr: instrumental verbs; instr + name: instrumental verbs are related in name with the instrument; instr-name: instrumental verbs are not related in name with the argument.

	age	mpo	type	total correct	non-instr	instr	instr +name	instr -name	verb-based	noun-based
A1	29	3	tcm	0.90	1.00	0.84	1.00	0.67	0.00	0.00
A2	52	3	tcm	0.90	1.00	0.84	0.88	0.80	0.13	0.13
A3	72	5	tcm	0.63	0.59	0.65	0.56	0.73	0.25	0.13
A4	48	4	Broca	0.58	0.77	0.48	0.50	0.47	0.38	0.63
A5	56	56	Wernicke	0.85	0.94	0.81	0.88	0.73	0.13	0.13
A6	55	4	Anomic	0.92	1.00	0.87	0.88	0.87	0.13	0.13
mean	52	12.5		0.80	0.88	0.75	0.78	0.71	0.17	0.19

With respect to verb- and noun-based verbs there is no clear difference in this small group. Apparently, the problems of these patients are not cause by how the verb is composed, but by the fact that it is a verb.

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VAST-App - testing verbs and sentences with the iPad

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Introduction

In order to treat aphasia efficiently, a thorough diagnosis is needed. The results of a general aphasia test, such as the Aachen Aphasia Test for Dutch (*AAT ;* Graetz et al., 1993) can only provide an overall idea of the syndrome and the particular problems of an aphasic speaker but does not inform about the underlying disorder. Therefore, model-oriented diagnostics are needed to provide information about the underlying disorder. While the Dutch version of the PALPA (Bastiaanse et al., 1995) can provide this for single noun processing, many aphasic individuals have (specific or additional) problems with verbs and sentences (Bastiaanse & Bol, 2001; Jonkers & Bastiaanse, 2006). These can be diagnosed with the "Werkwoorden en Zinnen Test (WEZT)" ("Verb and Sentence Test") by Bastiaanse and colleagues (2000). The WEZT is controlled for various linguistic variables and allows for a diagnosis based on a psycholinguistic model of sentence processing (Bastiaanse, 2010). The analysis and interpretation of this test, however, are rather complicated and require a thorough understanding of the underlying linguistic theory. Furthermore the administration is time-consuming and involves several testing booklets. Therefore the WEZT has not been broadly used in the clinical field. While therapists agree that determining the underlying deficit is an essential step to beneficial treatment, they cannot find the necessary time and do not have the necessary skills to administer the test and interpret the results as required.

The use of modern technology, such as a tablet computer, can help to overcome the issues raised above. Administration of the test is more straight-forward and the scoring can be done automatically. Even the interpretation of the results can be aided by the application, by making use of machine learning.

The aim of the current project is therefore to develop a new aphasia test for verbs and sentences, which will be administered, scored and analyzed with a tablet computer. Initially the focus is on the iPad, but later on it is planned to make this tool available for all kind of tablets. The project consists of three phases: (1) the development of the linguistic materials and pictures, (2) the programming of the iPad application and (3) the standardization and validation of the test. The data collected in this last phase will be used to gain insight in the interaction between all factors that may influence performance of language-impaired individuals.

Methods

Test construction

The first test bundle consists of four subtests, “verb comprehension”, “action naming”, “filling in infinitives in sentences”, and “filling in finite verbs in sentence”. These tests are carefully constructed taking into account various relevant linguistic variables, such as lexical frequency, age of acquisition, imageability, name relation (to a noun), and number of arguments. For each of the used words black and white line drawings are created by an artist. The complexity of these drawings is also one of the variables taken into account. For variables that cannot be looked up in existing corpora, ratings are obtained. This is for example the case for “visual complexity” and “imageability”. Based on the ratings it is decided which items are included in the final task. Furthermore the values of ratings and obtained from corpora are used in the diagnosis in order to determine whether a particular variable influences the performance of an aphasic individual.

Application development

The development of the application consists of programming on the one hand, but on the other hand also procedural choices have to be made. For instance, it needs to be technically implemented how often participants can listen to a pre-recorded word or sentence and how self-corrections are handled. Next to the testing interface, there are two additional interfaces: one for scoring the spoken responses in the naming subtests and one for viewing the results.

Validation

For the first phase of validation, 100 adults (aged 20-80), male and female, from different social backgrounds and different parts of the country will be tested in order to acquire norms. Later on a group of 50 aphasic individuals (Dutch and Flemish) will be tested. The Token Test will be used to measure the construct validity of the test. Item response theory will be used to analyze the data in order to determine the reliability and internal validity of the test. A selection of the language impaired adults will be tested again after 4 weeks, to measure test-retest reliability. For inter-rater reliability of the production tests (that will not be scored automatically), two independent professional aphasiologists will rate the answers and the correlations will be calculated.

Results

Currently the first two phases of the test construction have been carried out. The items for the different subtasks have been developed and were controlled for various linguistic features. These items have been incorporated in a first version of the application. A preliminary version of the application has been developed (see Figure 1). It provides facilities for displaying the material (visually

and auditorily) and recording of the results. This application can already be used in the validation phase, which will start soon. The results of the non-brain-damaged control participants will be presented at the conference.

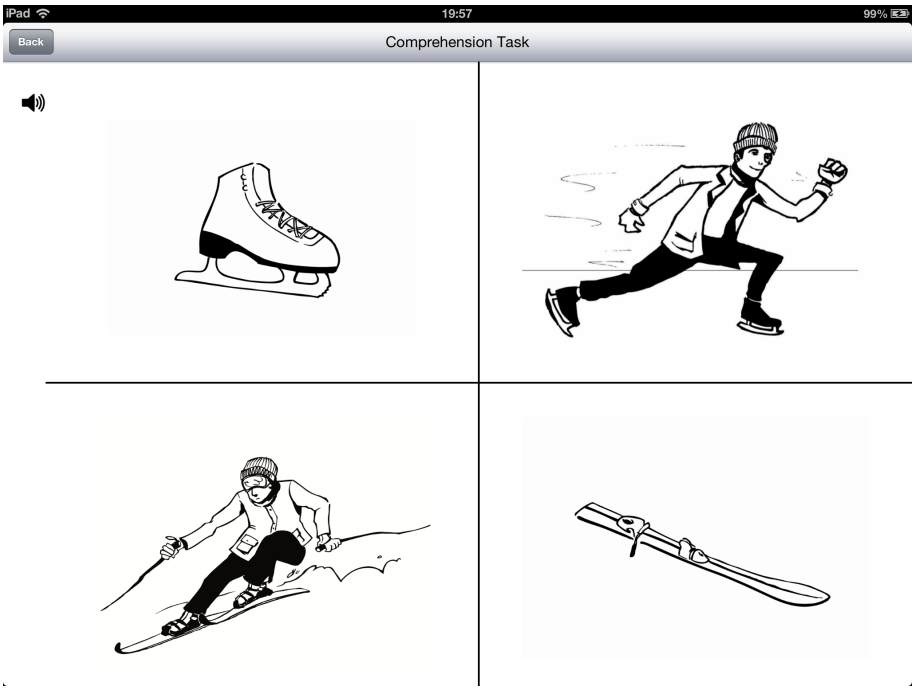

Figure 1: Screenshot from the task 'Insertion of finite verb forms'.

Discussion

Language testing used to be a laborious procedure involving a lot of testing booklets and forms to be carried along. The analysis was often even more time consuming and the interpretation of the data difficult. With the tablet application we develop, these troubles can be overcome. This results in a user-friendly but nonetheless sophisticated test that controls for various variables and takes these into account in the analysis of the results. This way, a diagnosis of the underlying disorder is made possible for therapists lacking a deep linguistic background. Therefore more aphasic individuals can be properly diagnosed - a prerequisite for effective treatment.

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Past tense in children with focal brain lesions

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Introduction

Recent studies on children with focal brain lesions (FL) have compared their performance to that of typically developing (TD) children and examined potentials for rehabilitation (Balantyne et al. 2008; Marchman et al. 2004).
The present study aims at examining the production of past tense for existing and novel verbs by Greek FL children in comparison TD children matched on chronological age (CA). By so doing, we address the question of recoverability in linguistic abilities of children with FL.
Past tense in Greek is a morphologically complex form, as *tense* interacts with *aspect* (perfective & imprefective). Consequently, Greek distinguishes between a perfective and an imperfective past tense (Holton et al., 1997). The imperfective past is formed with the present tense stem (e.g. *graf*-o, I write; *egraf*-a, I was writing) and thus it is morphologically simpler than the perfective one. The perfective past tense can be either sigmatic (regular), which involves a segmentable affix (-s-), or non sigmatic (irregular).
Our still on-going study aims at investigating whether there are differences in the performance of children with FL compared to that of TD children with respect to the production of

(i) perfective vs. imperfective forms for existing and novel verbs

(ii) sigmatic vs. non-sigmatic past tense forms for existing and novel verbs

Methods

Participants

So far four children with FL have been tested. They all suffered a post-natal stroke resulting in a FL as shown by MRI.
In more details:

Participant FL1: girl, aged 8;5, with a history of neurofibromatosis. At the age of 5 she suffered ischemic stroke with symptoms of right hemiparesis due to a middle cerebral artery infraction. The stroke resulted in a left FL (lobes involved: temporal,

parietal). She is currently motor impaired; no history of seizures.

Participant FL2: boy, aged 8;5. At the age of 17 months, he experienced a left ischemic stroke due to a watershed infarction. The stroke resulted in a left FL (lobes involved: parietal). He currently suffers from right hemiplegia; no history of seizures.

Participant FL3: boy, aged 13;2, diagnosed with a congenital heart disease. At the age of 3, he experienced a left ischemic stroke while he was undergoing heart operation. He had an infraction of the middle cerebral artery which resulted in a left FL (lobes involved: temporal, paretial). Currently he does not show any motor impairment; no history of seizures.

Participant FL4: boy, aged 6. Immediately after birth, he was diagnosed with aortic stenosis and suffered an infraction of the middle cerebral artery resulted in right FL (lobes involved: temporal, paretial). Currently he has left hemiparesis and shows motor impairment; no history of seizures.

The performance of those individuals on past tense is compared to that of TD children and 10 adults, as it is reported by Stavrakaki & Clahsen (2009) who used exactly the same task. Specifically, the 8-year-old children with FL have been matched on CA with 12 TD children aged 8-9 (CH-VIII) and the 6-year-old boy with 16 TD aged 6-7 (CH-VI). The 13-year-old boy's performance was compared to that of adults as adult level of performance is shown on this task after a certain CA.

Materials and procedure

We used the Perfective Past Tense Test (PPTT) designed to elicit perfective past tense forms (Stavrakaki & Clahsen, 2009). The test materials included:

- Existing sigmatic and non-sigmatic verbs (N=20)
- Novel sigmatic and non-sigmatic rhymes (N=20)
- Novel non-rhymes (N=10)

The experimental procedure was as follows:
The participant was presented with pairs of two pictures (60 picture pairs, 50 for the experimental items and ten fillers). The first picture presented an ongoing action (e.g. a boy writing a letter), while the second picture showed the corresponding completed action, e.g. a written letter. The experimenter pointed to the first picture saying for example, 'Here the boy is writing a letter', and then to the second picture saying 'and what did the boy do here?'. Importantly, this set-up requires a *perfective* past tense form to describe the second picture (e.g. *the boy wrote the letter*).

Results

The children's responses were classified as (i) sigmatic, (ii) non-sigmatic and (iii) other. *Other* responses included imperfective past tense forms (exclusively for participants with FL and mostly for TD population). See Tables 1 - 3.

Existing verbs

All children with FL showed ceiling performance on *sigmatic* forms except for the 6-year-old child with FS while the three younger children showed delay in the acquisition of *non-sigmatic* forms.
FL participants showed more reliance on *other* forms (=imperfective past tense forms) compared to TD children (aged 6 and 8) and adults.

Table 1: Mean percentages of the production of correct and incorrect (sigmatic/non-sigmatic or other) forms of existing verbs in the sigmatic and the non-sigmatic condition

	SIGMATIC CONDITION			NON-SIGMATIC CONDITION		
	Correct	*Non-sig*	*Other*	*Correct*	*Sigmatic*	*Other*
FL 1	100	0	0	60	0	40
FL 2	88.88	0	11.11	66.66	0	33.3
FL 3	100	0	0	80	0	20
FL 4	60	0	40	37.5	12.5	50
ADULTS	100	0	0	97	0	3
CH-VIII (8-9-y.o.)	99.17	0.83	0	90	7.50	2.50
CH-VI (6-7-y.o.)	93.12	1.25	5.62	73.75	18.13	8.12
CH-III (3-4-y.o.)	69.99	0.71	29.3	35.53	11.43	53.04

Novel rhymes

Individual variation but trends for reliance on *other* (=imperfective past tense forms) for all FL children.

Table 2: Mean percentages of the production of sigmatic, non-sigmatic or other forms for novel verbs rhyming with existing sigmatic or non-sigmatic verbs

	SIGMATIC CONDITION			NON-SIGMATIC CONDITION		
	Correct	*Non-sig*	*Other*	*Correct*	*Sigmatic*	*Other*
FL 1	20	20	60	0	14.28	85.71
FL 2	55.55	11.11	33.33	22.22	22.22	55.55
FL 3	100	0	0	0	90	10
FL 4	50	12.5	37.5	33.33	33.33	33.33
ADULTS	92	1	7	20	73	7
CH-VIII (8-9-y.o.)	87.50	4.17	8.33	11.02	70.65	18.33
CH-VI (6-7-y.o.)	80.32	3.39	16.29	4.62	80.28	15.10
CH-III (3-4-y.o.)	43.97	0	56.03	2.78	52.63	44.59

Novel non-rhymes

Remarkably high number of *other* (=imperfective past tense forms) by the 8 and the 6 year old children with FL in contrast to TD children who produced sigmatic (regular) verb forms. This performance resembles that of younger TD children (aged 3) who produced a large number of imperfective past tense forms in this condition.

Table 3: Mean percentages of the production of sigmatic, non-sigmatic or other forms for non-rhyming verbs

	Sigmatic	*Non-sig*	*Other*
FL 1	0	12.50	87.50
FL 2	70	0	30
FL 3	100	0	0
FL 4	25	0	75
ADULTS	91	5	4
CH-VIII (8-9-y.o.)	80.83	10	9.17
CH-VI (6-7-y.o.)	77.10	5.27	17.63
CH-III (3-4-y.o.)	39.48	9.24	51.28

Discussion

The 13 year-old child with FL showed performance within typical range in most of the cases. FL and TD participants performed better on existing sigmatics than non-sigmatics. The findings also revealed a strong tendency for reliance on *imperfective past tense forms* and thus show that the FL children avoided the morphological complexity of the perfective past tense by employing a simpler verb form. That was evident especially in the novel non-rhymes condition. Remarkably, strong reliance on imperfective forms was also attested in very young TD children (CH-III). We suggest that the three younger FL participants follow the typical path for perfective past tense acquisition with some delay. We point out that reliance on imperfective past tense was also attested in adult Greek aphasia indicating preference for morphological simplicity in these patients (Stavrakaki & Kouvava, 2003). With respect to the present findings, we interpret reliance on imperfective forms as indication of grammatical immaturity and, consequently, delay in the acquisition of the perfective past tense form by FL children.

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Dichotic listening in professional simultaneous interpreters

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Introduction

Simultaneous interpretation is a highly demanding cognitive process. It requires not only a high level of proficiency in two languages, but also necessitates complex linguistic perception and expression: simultaneously decoding the incoming speech in the source language and expressing it in the target language. As such, it has been associated with increased verbal memory (Cristoffels et al., 2006), verbal fluency (Moser-Mercer, 2000), and semantic processing and working memory capacities relative to those based on mere proficiency in a second language (i.e., teachers of a foreign language) (Stavrakaki et al., 2012).

Considering the association of bilingualism with unique cognitive mechanisms, we wondered whether professional experience in simultaneous interpretation might be associated with altered cerebral pathways for the processing of linguistic information. In particular we expected that it would be related to strong interhemispheric processing, rather than the typical left hemisphere (right ear) dominance for language. Indeed, while the left hemisphere is dominant for language in most right-handed monolinguals, there is some evidence suggesting different cerebral organization for language in bilingual and polyglot individuals (Fabbro et al., 1991). Additionally, an investigation of Chinese-English bilingual adults showed interhemispheric processing on a dichotic word listening task, unlike the right ear advantage (REA) found in their comparison group of monolingual speakers of English (Ke, 1992). Finally, Fabbro and colleagues (1990) investigated hemispheric specialization for language in female students training in interpretation and in monolingual controls. They employed an automatic speech production task to investigate two paradigmatic modes of interpreting, namely the word-for-word technique and the meaning-based technique in L1 (first language/mother tongue), L2 (second language) and L3 (third language). The results showed no significant cerebral lateralization for the mother tongue (Ll) in both groups, but weak left hemispheric lateralization for L2 in the interpreting students. The investigators considered a number of factors, which might account for their findings, including the gender of their participants. Clearly, more research on this topic is warranted.

In the present study, we re-addressed the question of hemispheric specialization for language in professional simultaneous interpreters (SI), including a group of

experienced SI and another group of professionals with demonstrated proficiency in a second language to control for bilingualism. Specifically, we compared the SI to experienced teachers of a foreign language (FL), and to a group of non-bilingual individuals (NB), using a dichotic listening paradigm. Considering not only the structural brain areas typically involved in linguistic processing (i.e., left hemisphere), but also the functional mechanisms (related to bilaterally represented attentional resource activity; Reinvang et al., 1994), and our own findings of increased attentional and working memory capacity in SI (Stavrakaki et al., 2012), we hypothesized that the SI will show less lateralized language processing than both other groups, reflecting the additional skills mastered beyond mere proficiency in a second language.

Method

Participants & Procedure

We administered a dichotic syllable listening task to SI (n=15; male:female=1:14), FL (n=15; male:female=1:14) and NB individuals (n=35; male:female=3:32). (The latter group presumably had some knowledge of a second language, as it is required in school curricula and university programs, but had no professional experience in language teaching or interpreting). All three groups were matched on age [F(2,64)=1.61, p=.208] and level of education [F (2,64)=1.52, p=.227]; the SI and FL groups were matched on number of years of professional experience [t(28)=.85, p=.404]. The task included consonant-vowel syllables *(ba, ga, da, pa, ka, ta)*, wherein two stimuli were presented simultaneously, one in each ear. Examinees were instructed to report the first syllable they heard for each pair.

Results

The variable of interest was right ear advantage (REA), calculated as follows: REA=(right ear syllables-left ear syllables)/(right ear syllables+left ear syllables). A positive score reflects more correct answers from the right ear than the left, while a negative score indicates that the individual reported more correct answers from the left ear than the right. We found no group effect for REA [F(2,62)=.163, p=0.850, η^2=.005]; the SI group REA [mean=.08 (SD=.40)] was slightly smaller than that of the FL [mean=.13 (SD=.21) and the NB [mean=.14 (SD=.33)] groups, but this difference did not meet the criterion of statistical significance.

Discussion

In contrast to our predictions, we found no significant difference in language processing laterality in our group of SI, relative to that of FL and NB control adults. In fact, in all three groups, we found a low REA. This is consistent with previous findings from our lab of a weak REA (=.03) when given instructions to state all syllables heard vs. a stronger REA when the same individuals were

instructed to report the syllables heard only from the right ear (=.71) (unpublished data). Additional data from our group reported similarly low REAs among elderly women on a word-based dichotic listening task (ranging from .03-.16, depending on literacy and level of education) (Kosmidis et al., 2004).

The present findings appear to contradict the conclusions reported by Ke (1992). In that study, however, no REA was calculated per se. In that study, the investigator compared the bilingual and monolingual groups on the difference in the number of stimuli reported for each ear. When we, too, compared our groups on each ear we found no interaction of these factors. Thus, methodological factors may account for inconsistencies in the relevant literature.

Several other factors may explain our findings as well. One possibility is that the task is not sufficiently sensitive to detect subtle differences in REA. Another may be related to the gender ratio, as all groups consisted predominantly of women. Finally, it is also possible that differences in cognitive skills related to language may not necessarily reflect differences in cerebral pathways with respect to language processing laterality. Both the methodological and the cerebral pathway hypotheses warrant further exploration.

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STEM-, SPRAAK- EN TAALPATHOLOGIE

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Naming actions in non-fluent aphasia: an fMRI study of compensatory reorganization of brain activity[1]

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Introduction

The key characteristics of motor (Broca) aphasia are verb finding difficulties and effortful speech production in general (among other symptoms). These characteristics may be related to different loci of linguistic deficit: lexical retrieval and motor execution. The aim of the study was to identify the normative brain activation associated with verbs generation in healthy subjects and patterns of its reorganization depending on the locus of linguistic deficits in patients with motor aphasia.

Method

The study involved 18 healthy individuals (mean age 44) and 4 patients with aphasia due to a lesion in the left hemisphere (mean age 49). All patients were diagnosed with efferent motor aphasia, according to Luria's neuropsychological classification, of mild to moderate severity. Disorders of expressive speech were observed in all patients. Lesions varied and included the inferior frontal gyrus only in P2 (pars opercularis). All participants were native speakers of Russian and were premorbidly right-handed.

Participants were presented with pictures of actions and abstract images. Verbs were balanced on frequency, imageability, length and argument structure. As a control condition, abstract images (digitally distorted real images) with the same level of objective visual complexity were presented. Participants were asked to say out loud what the hero was doing on the picture or to pronounce the pseudoverb "kavaet" in response to abstract images.

Each of the two fMRI experimental sessions consisted of 18 blocks (12 with real actions, 6 with abstract images). A block consisted of three pictures presented for 5.5 sec each, with 0.5 sec interstimulus interval. Blood oxygen level dependent

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imaging (BOLD) was performed on a 1.5T Siemens Avanto scanner using gradient-echo planar sequence (TE= 50 ms, TR= 3000 ms, FOV = 25 x 25 cm, 64 x 64 matrix, voxel dimension 3 x 3 x 3 mm). A high-resolution anatomical image (T1-weighted, MPRAGE; 0.98 x 0.98 x 1 mm; TE/TR 3/1900 ms) was also acquired. FMRI data analysis was performed in SPM8.
Action naming was also tested out of the scanner in participants with aphasia the following day (a preliminary study confirmed that patients with aphasia show no learning effect in naming identical action pictures on two consecutive days). The same action pictures were presented with the same timing parameters, but in a different order. Responses were quantitatively and qualitatively analyzed.

Results

In healthy Russian speakers, action naming elicited extra brain activation in occipital regions bilaterally, left inferior temporal gyrus and, critically, the triangular part of inferior frontal gyrus - relative to the baseline condition (uttering a pseudo-verb in response to an abstract picture). Individuals with aphasia showed brain activations in bilateral occipital regions, as well as in inferior frontal gyrus, similarly to normal individuals.
Extra activation found in patients, but not in healthy individuals, was dependent on their quantitative scores and type of errors during the naming testing out of the scanner. P1 and P2 named correctly 68% and 65% of actions, correspondingly. Majority of the incorrect answers were non-dominant, but synonymous nominations ('lifting' - 'pulling'). Thus, P1 and P2's ability to name actions might be considered relatively spared. In contrast, P3 and P4 were only 32% and 26% correct, and the errors were mostly non-responses and semantic paraphasias ('searching' - 'palpating'). The same patients' grouping was revealed in fMRI results. P1 and P2 activated right cerebellum regions for action naming more than in the baseline condition. For the same contrast, P3 and P4 showed wide-spread frontal left hemisphere activation (supplementary motor area, precentral gyrus), as well as additional right hemisphere activation (supplementary motor area, precentral gyrus, inferior and middle temporal gyrus in P3; middle frontal gyrus in P4).

Discussion

The activation pattern found in healthy individuals supports critical involvement of inferior frontal gyrus in verb production. Additional activation in response to action pictures relative to abstract pictures in bilateral occipital regions and left inferior temporal gyrus, which are parts of the ventral visual stream, reflects the more advanced level of complexity of pictures with realistic actions and tools.
The observed two different patterns of brain activation in patients with non-fluent aphasia suggests that P1 and P2, on one hand, and P3 and P4, on the other hand, have two different locus of linguistic impairment and use distinct

brain mechanisms to overcome their deficits. Verb retrieval per se was relatively spared in P1 and P2, as follows from their naming scores. It was motor execution of the word that caused difficulties in them. The effort to overcome those difficulties resulted in specific activation in the right cerebellum, which is known to be a regulator of speech temporal sequencing. In contrast, P3 and P4 had intrinsic linguistic difficulties with verb finding and used wide-spread bilateral frontotemporal network to overcome them.

Thus, in addition to the identification of brain substrate involved in normative verb production, the present study showed how different loci of linguistic deficits within the same aphasia syndrome are represented in distinct cerebrocerebellar networks.

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An fMRI study of morphosyntactic processing in Chinese

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Introduction

Languages vary widely in the complexity of their morphosyntactic system. Chinese, representing one end of the spectrum, is well-known for its impoverished inflectional morphology. From the perspective of cross-linguistic study, the relative simplicity of the Chinese system raises the question of whether the degree of complexity or richness of a grammatical component would affect its representation in the brain, analogous to previous reports of null findings for representation of lexical (or derivational) morphology in English (e.g. Davis, Meunier, & Marslen-Wilson, 2004; Devlin, Jamieson, Matthews, & Gonnerman, 2004; but see Vannest, Polk, & Lewis, 2005), but positive findings in Hebrew (e.g. Bick, Goelman, & Frost, 2008), German (e.g. Meinzer, Lahiri, Flaisch, Hannemann, & Eulitz, 2009), and Italian (e.g. Berlingeri et al., 2008; Marangolo et al., 2006). In addition, contrary to most European languages in which the verbal paradigm is more complex than the nominal counterpart, the contrast between the nominal classifier and verbal aspect marker inventories in Chinese presents the opposite pattern. This difference renders Chinese a highly interesting case for assessing the view that neural correlates of morphosyntactic processes, particularly in LIFG, specific to a grammatical class is driven by computational demands. If correct, one would expect to find brain areas in the left prefrontal cortex more strongly activated for nominal than verbal grammatical morphemes in Chinese, and none for the reverse comparison. On the other hand, if neural representation of grammatical morpheme processing does not simply reflect processing demand but in fact is form class specific, it is possible to find separate neural correlates for nominal classifiers and verbal aspect markers.

Methods

Participants

Forty-seven right-handed native Mandarin speakers with no history of psychiatric or neurological disorders were recruited from Beijing Normal University to participate in the current study, with 27 (16 females, Mean age = 20.8, *SD* = 2.14) in a grammaticality judgment experiment, and 20 (10 females, Mean age = 21.3, *SD* =

3.00) in a sentence completion experiment.

Tasks and procedures

In the sentence completion task, participants were asked to supply either a classifier or an aspect marker to complete a sentence. In the grammaticality judgment task, grammatical violation arose from inappropriate pairing between a noun and a classifier (CL), or from the incongruity between an aspect marker (ASP) and the lexical aspect (or semantic structure) of a verb. As in Yu et al. (2011, 2012), abstract and concrete nouns and verbs were used as stimuli for representativeness.

An event-related design was adopted. Functional MRI scans were collected on a 3.0 Tesla Siemens scanner using a 12-channel transmit/receive gradient head coil (Beijing Normal University, China). A T2*-weighted gradient-echo planar imaging (EPI) sequence was applied to acquire the blood oxygen level-dependent (BOLD) signals (flip angle 90°, TE = 30ms, TR = 2000ms, in-plane resolution = 3.125*3.125, slice thickness = 4mm, slice gap = 0.8mm). Data preprocessing and analysis were performed using SPM5 (http://www.fil.ion.ucl.ac.uk/spm/software/spm5/).

Conjunction analyses were conducted across concreteness conditions in the sentence completion experiment to identify brain areas that were more activated for nominal classifiers than verbal aspect markers as well as those that were more active for aspect markers than classifiers regardless of concreteness ($p_{uncorrected}$ < 0.001 at voxel level, cluster extent threshold ≥ 60 voxels for each contrast corresponding to Monte-Carlo corrected clusterwise alpha level of 0.049). These regions then served as regions-of-interest (ROI) to detect differential activation in grammaticality judgment to the classifier vs. aspect marker conditions using two-way ANOVAs. Task-independent regions specifically activated for a grammatical class were considered for their associated cognitive processes.

Results

Conjunction analyses of CL vs. ASP contrasts between the two concreteness levels in the sentence completion task revealed that the left posterior middle temporal gyrus (LpMTG) was activated more strongly for the ASP than CL sentences, whereas regions showing greater activation for the CL conditions of both concreteness levels included bilateral calcarine and lingual gyri, BA44 (k =56, corresponding to cluster-level $p = 0.06$), bilateral orbital inferior frontal gyri and insula cortices (BA47, right BA47 (rBA47)), as well as left supplementary motor area and superior medial frontal gyrus (LSMA&SMedFG).

Results of the ROI analyses using two-way ANOVAs (grammatical morpheme x grammaticality) of the grammaticality judgment task found (i) significant main effects of grammatical morpheme and grammaticality in LpMTG with greater activation for ASP and ungrammatical sentences (p < 0.01), (ii) significant effect of grammatical morpheme in bilateral posterior cortices with higher activation for CL sentences but the effect was confounded with sentence length, (iii) significant grammaticality effects in bilateral BA47 and LSMA&SMedFG, with ungrammatical

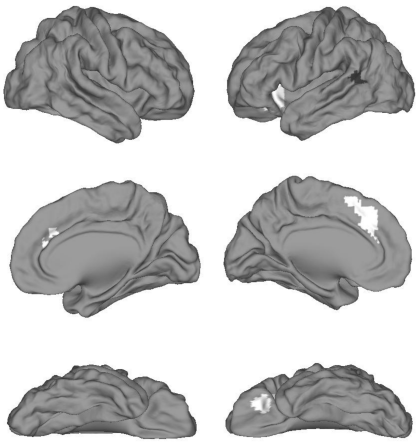

Figure 1: Task-independent regions of grammatical morpheme processing in Chinese (nominal classifier regions in white, verbal aspect marker regions in black).

sentences inducing stronger responses ($p < 0.05$), and (iv) significant interaction effects between grammatical morpheme and grammaticality in these areas, among which higher activation for CL sentences than ASP sentences in grammatical trials was observed in BA47 ($t(21) = 2.42$, $p < 0.05$) and LSMA&SMedFG ($t(21) = 2.50$, $p < 0.05$). (See Figure 1 for detail).

Discussion

Through contrasting the processing of classifiers and aspect markers representing, respectively, nominal and verbal grammatical morpheme operations in receptive and expressive tasks, we have identified task-independent distinct brain regions differentially responsive to one type of stimuli over the other, and vice versa. We attributed the activation in the left prefrontal cortex to greater selection demand during processing of classifiers than aspect markers, which may reflect domain general computational loads, consistent with views from studies of Indo-European languages (Grindrod et al., 2008; Righi et al., 2009; Sahin et al., 2006; Siri et al., 2008; Thompson-Schill et al., 1997), and the LpMTG to more demanding verb semantic processing stemming from judging congruency between aspect markers and semantic structure of verbs. The overall findings have significantly demonstrated the existence of neural correlates of grammatical morpheme processing associated with nouns and verbs in an analytic and classifier language.

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The effect of static versus dynamic depictions of actions in verb and sentence production in aphasia

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Introduction

From clinical practice we know that there is a lack of materials for the treatment of problems with verbs in naming and sentence production. In therapy, we often use pictures or photographs depicting actions, although the meaning of certain verbs clearly involves movement. We therefore questioned, if aphasic speakers might benefit more from speech therapy in working with dynamic materials (video clips) rather than static materials (pictures) while training action naming and/or sentence production. During the therapy sessions with static materials speech therapists often use gestures to cue the patient in naming verbs, which is rather artificial.

Research to the role of the depiction in verb retrieval is scarce and still contradictory. On the one hand, Berndt, Mitchum, Haendiges and Sands (1997) found that five aphasic speakers were equally impaired in naming pictures of actions and video clips of actions. On the other hand, Druks and Shallice (2000) reported a patient who had superior verb naming of actions that were acted out by the experimenter compared to those same actions portrayed in pictures. They argued that the patient had been helped by the strengthened semantic context and information given by a more dynamic presentation. D'Honicthun and Pillon (2008) described a patient with frontotemporal dementia who showed a difference between action and object naming under picture naming conditions. Verbs were retrieved significantly worse than nouns. However, when the patient was presented with the same verbs and nouns in a dynamic condition, specific difficulties with action naming virtually disappeared.

In the current study, we explore the hypothesis that aphasic speakers are more accurate in retrieving verbs in isolation and in sentence context in a dynamic condition rather than in a static condition.

Methods

Participants

Eleven aphasic speakers were included in this study (9 males, 2 females). The mean age of the group was 55.6 years (range: 39-79). All participants were native speakers of Dutch and suffered from a left-hemispheric stroke. Both fluent and non-fluent aphasic speakers were tested. All participants were diagnosed with the Aachen Aphasia Test (Graetz, De Bleser & Willmes, 1992). Participants were selected based on the presence of syntactic disorders and difficulties in verb retrieval. Considering sentence production, in spontaneous speech their syntactic structures had to be either agrammatic or paragrammatic (<4 on the syntactic scale).

Materials

A naming task and a sentence production task were administered. Both the naming task and the sentence production task contained 20 items. Half of the verbs used were high-frequency verbs, the other half were low-frequency verbs (Celex, 2001). The verbs were also matched for transitivity, instrumentality and name-relation to a noun. There were two versions of each task with identical items; a static version and a dynamic version. Both versions were presented on a computer screen. The dynamic tasks included 20 video clips each with a duration of 4 seconds. The video clips were soundless and the actions were filmed in a natural context.

The static tasks included 20 photographs each. The photographs were stills cut from the video clip used in the dynamic condition. The photographs depicted the peak moment of the action. The photograph stayed on screen for 4 seconds.

Procedures

There were two sessions per participant, with a lag of approximately a week, randomly starting with the dynamic or the static condition. Within each session the participant started with the naming task followed by the sentence production task. The order of the items in all tasks was identical. Each task started with two practice items. The tasks were performed on the computer which was controlled by the researcher. The researcher showed the participant a photograph or video clip, which automatically disappeared from the computer screen after 4 seconds. A black screen was presented until a response was given. The participant was asked to respond as soon as possible. The number of correct responses for both action naming and sentence production was counted. Slight phonological errors were not counted as incorrect. In the sentence condition, it was only counted whether the correct verb was produced, not whether the correct form was mentioned.

Two sided paired sample t-tests ($p<0.05$) were used to compare the dynamic and static condition.

Results

The scores are depicted in Figure 1. The results show that the participants were able to produce significantly more correct reactions in action naming in the dynamic condition as compared to the static condition (t(10)=3,105, p=0.011).

At the sentence level there was no significant difference in accuracy considering the two conditions (t(10)=0.590, p=0.568).

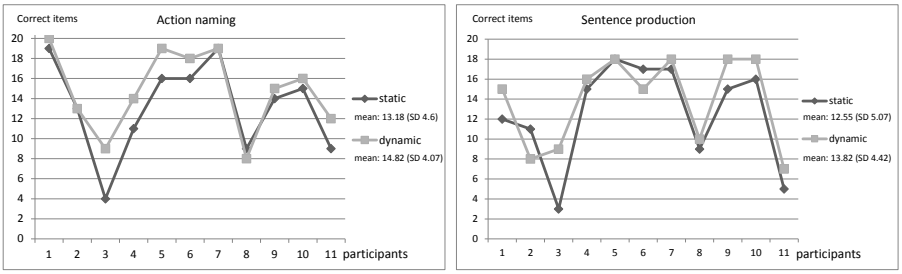

Figure 1: Individual scores for verb retrieval in isolation and in sentence context for both conditions.

Discussion

The outcomes of this study show that in verb retrieval aphasic speakers profit from a dynamic display of an action in comparison to a static depiction. However, this is only seen in action naming and not in sentence construction. The absence of an effect of depiction in sentence context, might be due to the fact that participants suffer from a syntactic disorder and that due to this disorder the effect was undone. Related to this, we have to mention that our aphasic group was rather heterogeneous. Although participants all had problems with verbs, some produced agrammatic speech and others paragrammatic speech. We expect a confounding effect of syntactic problems on verb retrieval in sentence context especially in aphasic speakers with agrammatic speech and therefore aim to test more aphasic speakers considering the type of aphasia.

From this study it can be concluded that depicting action verbs in a dynamic context, helps aphasic speakers in verb retrieval. In treating aphasic speakers with verb retrieval problems, we therefore recommend to make use of video fragments of actions.

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Early and late semantic processing of action verbs: evidence from fluent and stuttering speakers

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Introduction

Although action verb processing has been repeatedly shown to elicit motor cortex activation, no consensus is yet achieved on the function, timing and necessity of this activation (e.g. Hauk & Pulvermüller, 2004; Tomasino et al., 2008, Hickok, 2010). If motor related areas contribute to word understanding, action verb processing deficits should occur in patients with diseases affecting the motor system. Stuttering is known to evoke abnormal activations in cortical and subcortical motor related brain sites during speech production, speech perception and silent reading. To our knowledge, action verb processing has never been explored in stuttering. Furthermore, most studies using patient populations contrast action verbs with non-action *nouns*. Since verbs are inherently more difficult than nouns, an action verb processing deficit might rather be related to grammatical aspects. Therefore, the present study aimed to evaluate action vs non-action verb processing in both fluent and stuttering speakers. As a research tool, electro-encephalography (EEG) was used because of its excellent temporal resolution which permits a delineation of the time course of word processing.

Methods

Subjects

30 adult, fluent speakers (FS) (male/female ratio:22/8) and 30 adults who stutter (AWS), matched for age, gender and education, were recruited. All participants were right-handed. Speech samples were collected to ascertain each participant was indeed a fluent or a stuttering speaker.

Stimuli

50 action and 50 non-action verbs were selected. The action verbs referred to voluntary hand and/or arm movements (e.g. to throw), the non-action verbs were abstract verbs unrelated to actions or body parts (e.g. to believe). They were randomly presented in their infinitive form as single words. Participants were instructed to read each of the words mentally and to avoid overt articulation.

Data acquisition and analysis

EEG data were collected from 24 Ag/AgCl electrodes that were placed on the scalp according to the international 10/20 system. Off-line EEG data were analysed using BrainVision Analyzer (Brain Products) and averaged to create event-related potentials (ERPs). Source reconstruction was applied on the individual ERPs from 60 to 500 ms after word onset to evaluate the temporal flow of activation. 60 ms was chosen as starting point because visual information needs on average 60 ms to travel from the retina to higher cortical areas. This 440 ms during time window was divided in 11 successive time windows of 40 ms. The reconstructed activity was statistically analyzed with ANOVA.

Results

In FS, action verbs elicited stronger brain responses than non-action verbs at several time points. From 60-100 ms, a higher activation in bilateral superior parietal and right inferior frontal cortex was observed. From 100-140 ms, a larger right dorsolateral prefrontal cortex (DLPFC) involvement was seen. A higher bilateral temporal and sensorimotor activation was found from 260 to 420 ms and from 300 to 380 ms respectively.

In AWS, bilateral sensorimotor cortex differentiation arose extremely early (60-100 ms) and re-occurred in the right hemisphere from 300-340 ms. Remarkably, this differentiation showed an opposite pattern: non-action verbs elicited more activation than action verbs. No differentiation in inferior frontal nor in parietal areas was observed.

Discussion

Fluent speakers

Differences between action and non-action verbs occur both in an early and a late time window. Because action and non-action verbs were matched for visual and orthographical features, evoked differences can only be attributed to differences in lexical access and semantic processing.

Between 60 and 100 ms, a larger brain response to action verbs is observed in bilateral superior parietal and right inferior frontal cortex, which both contain mirror neurons. These neurons contribute to action verb understanding by mentally simulating the act the verb refers to, which makes its meaning accessible for language. At this stage lexical access is suggested to occur.

In the consecutive window (100-140 ms), a larger involvement of DLPFC is observed. We hypothesize that the mental simulation of the mirror neurons implicitly triggered mental images and/or motor planning for which DLPFC is responsible.
Differences in both temporal and sensorimotor areas are seen in a later time window, between 260 and 380 ms. Temporal areas are involved in amodal semantic analysis, sensorimotor involvement is related to the action content of the stimuli. Recent theories suggest that since initial semantic retrieval has already emerged earlier, post-conceptual processes occur in this stage.

Stuttering speakers

The twofold semantic processing is confirmed by the results of the stuttering speakers. Sensorimotor differences are found in an early (60-100 ms) and a late (300-340 ms) time window. However, a reversed pattern is observed with non-action verbs eliciting more activation than action verbs. As expected, motor cortex abnormalities cause alterations in action verb processing confirming its importance for action semantics.
Motor alterations in stuttering are attributed to a reduced white matter integrity of the left superior fasciculus longitudinalis (SLF). This white matter bundle is part of the dorsal stream responsible for sublexical reading. However, this pathway is hypothesized to have a role in action semantics because it would be responsible for sensorimotor activation. Since no structural anomalies are reported in AWS in the ventral stream, the present results confirm this hypothesis.

Conclusion

The present study confirms recent theories that posit a dual semantic processing system. After a very early contribution of the mirror neuron system, later post-recognition analyses occur in temporal and sensorimotor areas. In addition, results from the AWS demonstrate the important contribution of the dorsal stream.

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Arabic-speaking aphasics: Analysis of naming errors

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Introduction

Naming deficits are common symptoms in all types of aphasia; the degree of deficit, however, may differ depending on the word class. Several studies have shown that action- naming is more impaired than object-naming among individuals with different types of aphasia [1, 2, 3]. Various linguistic and psycholinguistic studies have been conducted to explain the greater action-naming deficits; however, little evidence has been adduced from studies into naming errors, which vary broadly. A picture-naming study on English- speaking aphasics [3] showed that object pictures elicited more semantic errors than action pictures; whereas action pictures elicited more visual misinterpretation errors, circumlocutions and omissions. The authors argued that the greatest indicator of complexities involved in picture-naming is visual misinterpretation errors, they also claimed that these errors might affect action-naming more than object-naming because the relationship between action pictures and their verbal labels are less direct, as they demand additional inference-making, and because action pictures are conceptually and visually more complex than object pictures. The present study aimed to provide further empirical evidence on the differences between error types elicited by object versus action pictures. It predicted that action pictures will elicit more visual errors than object pictures, whereas object pictures will elicit a greater number of semantic errors compared to action pictures.

Moreover, studies have associated the variety of error types to the clinical diagnosis of aphasia. Some argued that semantic errors are commonly manifested in Wernicke's aphasics, but rarely in Broca's aphasics [4], and others posited that semantic errors are not associated with a particular type of aphasia [5]. Additionally, a study revealed that semantic errors are common among all types of post-stroke aphasia [6]. However, no study was found that related different error types to fluency in aphasia. Therefore, the current study further aimed to investigate the distribution of naming error types in relation to two groups of aphasics (fluent and non-fluent) among Arabic-speaking aphasics.

Methods

Fourteen Arabic-speaking adults clinically diagnosed with aphasia (seven fluent and seven non-fluent) participated in the study. Their aphasia resulted from acquired unilateral left- hemisphere-brain-damage at least three months post-onset; and had no concomitant speech or cognitive impairment that interfered

with their performance.

Fifty object and 50 action pictures from the Object and Action Naming Battery [7] were presented to each participant separately. Participants named all pictures using a single word and responses were deemed correct if they named the picture using the target word.

Naming errors were then classified according to a pre-specified error classification system [3, 6]. The errors were classified into eight types: (i) omission: total absence of a verbal response, (ii) semantic-coordinate: response from the same semantic category (iii) semantic-superordinate: too general response (iv) semantic-associative: response thematically related to the target with a semantic association (v) phonological: response with phonological distortion (vi) visual error: response closely similar to the visual appearance of the picture with no semantic relation or response that names parts of the picture other than the target (vii) circumlocution: accurate definition of the target (viii) un- related: response with no clear relation to the target.

Results

A two-way repeated-measures mixed ANOVA was carried out on the percentage of total naming errors; the effect of picture type on naming performance was significant ($F(1,12)=44.12$, $p<0.0001$, partial $\eta^2=0.786$), with action pictures eliciting more errors (52.57%) than object pictures (32.43%). The effect of aphasia group was also significant ($F(1.12)=142.64$, $p<0.0001$, partial $\eta^2=0.922$), with non-fluent aphasics producing more errors (70.43%) than fluent aphasics (14.57%). However, the interaction effect between picture type and aphasia group was not significant.

To measure the differences between visual and semantic errors (including coordinate, superordinate and associative) elicited by object versus action pictures, a two-way repeated-measures ANOVA was performed; the effect of error type was significant ($F(1,13)=11.96$, $p=0.004$, partial $\eta^2=0.479$). The effect of picture type and the interaction effect were not significant. Due to a significant effect of error type, further post hoc analyses were carried out. Results were, as predicted; visual errors were elicited by action pictures (9.57%) significantly more than by object pictures (1.79%) ($t(13)=3.108$, $p=0.008$). However, contrary to the prediction, action pictures elicited more semantic errors (6.43%) than object pictures (5.43%), but the difference was not significant.

The distribution of error types differs between fluent versus non-fluent aphasics, as illustrated in Table 1. The most prominent error type among non-fluent aphasics was omission comprising 79.7% of the total errors, compared to only 7.2% among fluent aphasics; the difference was significant ($t(12)=6.11$, $p<0.0001$). Among fluent aphasics, visual errors were the most prominent type, compromising 33% of the total errors, compared to 9.7% of the total errors among non-fluent aphasics, but the difference was not significant. Semantic errors were not associated with one

aphasia group, as the difference between fluent and non-fluent aphasics was not significant.

Table 1: Number (%) of errors made in object and action pictures naming among fluent and non-fluent aphasics organized according to error type.

Error type	**Aphasia group**		**Picture type**	
	Fluent	**Non-fluent**	**Objects**	**Actions**
Omission	7 (7.2)	394 (79.9)	167 (75.2)	234 (63.6)
Semantic-coordinate	15 (15.5)	23 (4.7)	23 (10.4)	15 (4.1)
Semantic-superordinate	13 (13.4)	1 (0.2)	2 (0.9)	12 (3.3)
Semantic-associative	16 (16.5)	10 (2.0)	8 (3.6)	18 (4.9)
Phonological	3 (3.1)	8 (1.6)	9 (4.1)	2 (0.5)
Visual errors	32 (33)	48 (9.7)	11 (5)	69 (18.7)
Circumlocution	9 (9.3)	2 (1.4)	1 (0.5)	10 (2.7)
Un-related	2 (2.1)	7 (1.4)	1 (0.5)	8 (2.2)

Discussion

This study revealed that object pictures did not elicit any error type significantly more than action pictures, whereas action pictures elicited more visual errors compared to object pictures. These results are compatible with the suggestion that action pictures are susceptible to greater complex error types than object pictures [3].

The findings also showed that the distribution of error types in picture naming varies among individuals with fluent versus non-fluent aphasia. Fluent aphasics produced different types of errors with no single prominent type, whereas among non-fluent aphasics, omission was the only prominent type, and the production of other errors was very minimal. This has an important clinical implication, as it advocates the use of different naming approaches including hierarchy and cueing when treating individuals with fluent aphasia versus those with non-fluent aphasia. This study also showed that action pictures elicited a greater number of semantic, phonological, visual, circumlocution and unrelated errors than object pictures, which could be in line with the postulation that language processing differs between object-naming and action-naming [3], and this might suggest that action-naming gives rise to greater processing demands cross-linguistically, including a highly inflected language for both nominal and verbal systems such as Arabic.

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A fragile category: Turkish evidential source markers in agrammatism and bilingualism

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Introduction

Evidentiality is the grammatical marking of reference to the information source, that is, how and from where an event was known. In reference to past events, the following evidential usages are marked in Turkish: *direct perception*–**DI** *(seen past),reportative*textbf–ImIş *(heard past),* and *inference*–**mIş** *(inferred past)*. Studies in agrammatic aphasia have shown that reference to the past is vulnerable (i.e., Bastiaanse, 2013; Bastiaanse et al., 2011; Yarbay-Duman & Bastiaanse, 2009; Gavarró & Martínez-Ferreiro, 2007). Some recent studies have demonstrated that past time reference violations are processed at higher cost than their present counterparts (Bos et al., 2013; Dragoy et al., 2012). Taken together these data, they suggest that past time reference is a particular case not only in agrammatic aphasia but also in normal language processing. An interesting notion of Turkish past time reference is the encoding of reference to the information source. One has to choose between one of the evidential usages described above while referring to past events. Arslan et al., (in progress) studied seven individuals with agrammatic aphasia (mean age 43, four females) and age-and-gender matched non-brain-damaged control subjects. They were asked to observe 30 events with three modes of presentation, given either by observing events as whole, their final states, or someone else's report about them. In the production task, the participants were asked to complete the given sentences with an appropriate evidential marker for each event. In a subsequent information source recall task, they were asked to listen to the items from the production task and choose the correct mode of information acquisition. Results showed that agrammatic speakers had more difficulties in producing sentences in *seen past* than *inferred past* and *heard past*. Moreover, they had selective deficiency in recalling the correct source. The performance in production and source recall was controversial; the easiest

condition in production was the most difficult one in source recall. One interesting outcome from the source recall task was that the agrammatic speakers pointed to visual perception as the source when the original source was either inference or report. In other words, they claimed to have seen events that they did not see (Arslan et al., in progress).

In the current study, we dealt with how evidentials are processed by Turkish-Dutch bilinguals and Turkish monolinguals. It is proposed that evidentials form a very sensitive category that is affected not only in aphasic but also in bilingual individuals. To reveal how bilingualism may affect evidentiality, we conducted an auditory sentence processing study. We expect that bilinguals are less sensitive to violations to reference to information source comparably to monolinguals.

Methods

26 monolingual Turkish speakers (mean age 29, fourteen females) without proficient level of any second language and 21 early bilinguals of Turkish-Dutch (mean age 19, four females) participated in the study. The material consisted of 120 experimental sentences, comprised of 60 sentences with seen past (a), and 60 sentences with heard past (b).

(a) Yerken gördüm, az once adam yemegi ye**di**. Hemde nasil ...
Eat-while see-seen past just before man food-acc eat-**seen past** also how eat-INF surprise-Past1sg
***'Previously* I saw the man eating, he *ate* the food. I was surprised how he ate.'**

(b) Yerken görmusler, az once adam yemegi ye**mis**. hemde tabaklari...
Eat-while see-seen past-3rdPl just before man food-acc eat-**heard past** also plates-acc wash-Neg-PST
***'Previously* they saw the man eating, he *ate* the food. He didn't even wash the dishes.'**

Half of the sentences in each condition included an inappropriate source marking resulting in a violation. *Seen Past* presupposes the observer is "I", and similarly, *Heard Past* tends to go with third person more often; if not, the sentences sound unusual or unnatural. The experimental sentences were mixed with fillers (with relative clause violations) and presented auditorily. Participants were instructed to press the space bar as soon as they noticed a violation. Therefore, accuracy and reaction time could be recorded.

Results

Anovas were done with the factors of group (bilingual vs. monolingual) and condition (seen past vs. heard past; violation vs. non-violation). The interactions between group and condition were significant for reaction times: $F(3,966)=5.211$ $p=.001$; and for accuracy of hits: $F(3, 2812)=119.118$ $p=.000$. We observed an overall latency in responses of bilinguals and they were less accurate in noticing violations compared to monolinguals. In *seen* and *heard past,* bilinguals correctly judged only 32% of the violations in each condition. The reaction times of these 32% hits were little over 3000ms for *seen past* and 2700ms for *heard past.* However, monolinguals were quite robust in detecting violations (*seen past:* 90%; *heard past:* 87%) and they were faster than bilinguals (see *Figure 1*). Monolinguals

showed a difference in judging violations: seen past (1600ms vs. 1810ms). The slower processing of heard past sentences was confirmed by a t-test: $t(683)$=-2,355; p=.019. Such a difference was not significant in bilinguals.

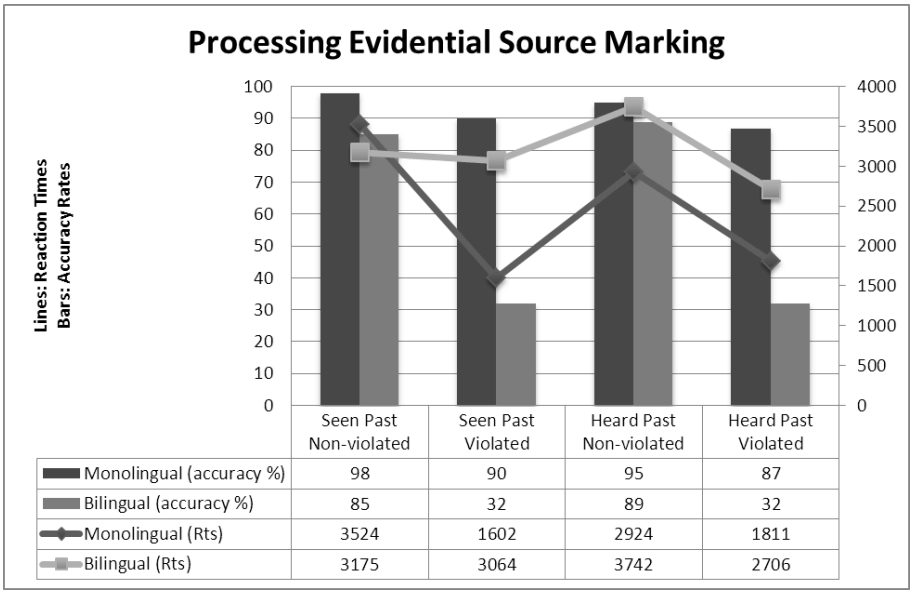

Figure 1: Reaction Times (ms) and Accuracy of Hits (%) in response to source marking violations by Monolingual and Bilingual speakers

Discussion

The studies we have presented here have several implications for the theory how evidentials are affected in agrammatism and bilingualism. Firstly, in agrammatic aphasia, the production of *seen past* was severely impaired while *heard* and *inferred pasts* were well-retained. Evidential markers were shown to be affected in bilingualism as well: bilingual speakers were quite inaccurate and reacted slower than monolinguals. We, therefore, argue that evidential markers are quite sensitive and vulnerable not only in agrammatic aphasia, but also in bilingualism.

The obligatory marking of evidentials in Turkish seems to be affecting the language processing in the monolingual speakers of Turkish. Particularly, the monolingual speakers show slower processing in *heard past.* Comparably, the bilingual speakers who are under dominance of a non-evidential language do not show such an evidential effect.

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The effects of (in)direct speech on aphasic discourse comprehension

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Introduction

In conversation, direct reported speech (e.g., '*John said: "I'm hungry!"*') is assumed to constitute a *demonstration* of a reported utterance, whereas its indirect reported speech counterpart (e.g., '*John said that he was hungry*') provides a *description* of what was said (Clark & Gerrig, 1990). The distinction between direct and indirect speech exists in many languages and has been a major focus in linguistic studies. Direct speech constructions are perceived as more vivid and perceptually engaging than their indirect speech counterparts (Wierzbicka, 1974; Macaulay, 1987). In this study, we examine the effects of direct speech on aphasic discourse comprehension in Dutch. The additional communicative "layers" (e.g., intonation, facial expression, and gesture) that go along with direct speech may facilitate language comprehensibility. In addition, its grammatical characteristics may contribute to the comprehensibility of speech. Direct speech is distinguished from indirect speech in that the pronouns, spatial and temporal references, and verb tenses are appropriate to the reported context rather than the current one (Holt, 1996). In addition, in Dutch, indirect speech requires a subordinate construction, whereas direct speech does not. Since individuals with aphasia are known to have difficulties with subordinate constructions (Menn & Obler, 1990; Bastiaanse & Jonkers, 1998; Bastiaanse, Hugen, Kos & Van Zonneveld, 2002), Dutch direct speech constructions may be easier to comprehend than indirect speech constructions.

Methods

Participants

The aphasic subgroup consisted of 24 Dutch individuals (19 male) with mild to moderate aphasia. Criteria for selection of the individuals with aphasia were (1) medical diagnosis of brain damage, (2) no audiologically or medically documented hearing impairment, (3) diagnosis of aphasia by a speech pathologist using standardized tests, and (4) time post-onset ≥3 months. The individuals with aphasia ranged in age from 41 to 82 years (M=57.4, SD=13.5).
The Non Brain Damaged (NBD) subgroup consisted of 16 individuals (7 male)

who were matched for age, gender, and educational level to the aphasic subgroup. Criteria for selection of the NBD subjects were (1) no documented history of brain damage, and (2) no audiologically or medically documented hearing impairment. NBD subjects ranged in age from 35 to 76 years (M=53.4, SD=12.0).

Materials and procedures

Each subject was tested in a single session of approximately 50 minutes for the aphasic and 25 minutes for the NBD subjects. The aphasic participants were administered the Token Test to get an indication of the aphasia severity.

DIRECT SPEECH COMPREHENSION TEST

Both the aphasic and the NBD subjects performed the iPad-based Direct Speech Comprehension (DISCO) Test. The test, which was developed specifically for this study, consists of 1 practice and 6 target videos, during which short stories are told. The target stories can be subdivided into 3 story lines each with two stories, one using direct speech and the other using indirect speech. All participants were presented with both conditions of a story line (i.e., direct speech and indirect speech), without hearing the same story twice. This design allowed us to draw comparisons both within and between groups.

The stories had an average length of 217 words (SD=22.8), 19 utterances (SD=1.9), and an average Flesch Reading Ease Score of 80 (SD=2.1), indicating that they were (very) easy to understand. To rule out the effect of order, 12 different presentation lists were created.

After each of the stories the participants heard 8 questions, which they could answer with "yes" or "no" touching a response button that appeared on the screen. This method ruled out possible confounds from language production difficulties.

The DISCO scores reflect the proportion of correctly answered questions per condition type (0-1.0).

Results

For all participants the proportion of correctly answered items per story was calculated, resulting in 6 scores per participant. The aphasic subgroup (n=24) had an average score of 0.80 (SD=0.10), and the NBD subgroup's (n=16) mean score was 0.90 (SD=0.06). In order to examine the effects of group (aphasic, NBD) and condition type (direct, indirect), we conducted an ANOVA using a repeated measures design. There was a significant main effect of listener type: the NBD group performed better than the aphasic group, $F(1, 38) = 12.18$, $p = .001$. In addition, there was a significant main effect of condition, $F(1, 38) = 4.22$, $p < .05$. A paired t-test split for groups showed that in the case of the aphasic subgroup there was a significant effect of condition type: they scored better on the direct speech condition (M=0.83, SD=0.13) than on the indirect speech condition (M=0.77, SD=0.11), $t(23) = 2.27$, $p = .03$. No such effect was found for the NBD subgroup, $t(15) = .74$, $p = .47$. A negative correlation between the Token Test

and DISCO scores was found (r = -.67, n = 24, p = .00), indicating that preserved comprehension is associated with high DISCO scores.

Discussion

Previous studies have suggested that direct speech constructions may facilitate language comprehensibility since they are perceived as more vivid than their indirect speech counterparts. In this study, the effects of direct speech constructions on aphasic discourse comprehension were examined. The experimental design allowed us to make direct comparisons between the comprehensibility of stories told using direct speech and those with indirect speech. For the aphasic subgroup we found an effect of condition type: the stories that were told using direct speech proved easier to comprehend than the stories with indirect speech. A possible explanation for this finding is the occurrence of additional "layers" of communication that often accompany direct speech constructions, such as intonation and facial expression. Another possible account is the difference in grammatical complexity: in Dutch, unlike direct speech, indirect speech requires subordinate constructions, which are known to be difficult for particularly agrammatic aphasic individuals. A repetition of this study in English will provide us with insight into the role of the grammatical characteristics of the two construction types.

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Spreading the word 'aphasia'. New international comparisons of the public awareness of aphasia in Argentina, Canada, Croatia, Greece, Norway and Slovenia

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Introduction

The public awareness of aphasia is vital for extending services, research support, social inclusion (Elman et al., 2000) and, importantly, for targeted awareness raising. Studies to date (Code et al., 2001; Simmons-Mackie et al., 2002) have showed that knowledge of aphasia varies across a range of variables, but is low compared to comparable conditions like Parkinson's disease.

Methods

Convenience samples were surveyed in face-to-face interviews in shopping centres, parks, libraries, stations, etc. in cities in Argentina (N=800), Canada (832), Croatia (400), Greece (N=800), Norway (N=251) and Slovenia (N=400) using the same (suitably translated) questionnaire used in previous studies (Code et al, 2001; Simmons-Mackie et al., 2002) requesting information on age, gender, occupation, whether respondents had *heard of aphasia* and *where they had heard*. Those who selected from features that were (e.g., 'speech problems', 'language problems', 'communication problems') and were not (e.g., 'impaired intelligence', 'mental' problems) features of aphasia and also noted that aphasia follows 'brain damage' were classified as having some *basic knowledge* of aphasia, and were questioned further to determine *how* and *where* they had learnt about aphasia.

Results

Mean age of the entire sample was 43.16 (SD 17.68). Between 57.4% (Norway) and 20% (Argentina) had *heard of aphasia* (37.1% overall) but those with *basic knowl*edge ranged from 13.9% (Norway) to 1% (Argentina). The combined mean percentage of those with a *basic knowledge* of what aphasia is, was 9.2%. Those who had *heard of aphasia* were significantly younger (p<.0001) and females had higher levels of awareness (Chi Sq=9.65; df=2; p=.008). Of those with *basic knowledge,* only Greeks were significantly older (t=4.868; df=798; p<.0001).

Those who had knowledge of aphasia gained their knowledge from occupational exposure to aphasia, because a relative or friend had aphasia and through the media (TV, radio, newspapers, magazines, etc.).

Discussion

We surveyed public places because we wanted to tap the knowledge of those who come into contact with aphasic people in shops, banks, restaurants, etc. (Code, 2003). Levels of awareness were predictably low, but there was significant variability between most countries. Figures contrast in some respects with Simmons-Mackie et al who found between 9.25% and 18% of their English-speaking samples had *heard of aphasia* (13.6% overall), while those with *basic knowledge* ranged from 1.54% to 11.53 (combined 5.42%). The earlier study too found age and gender interacted significantly with knowledge.

Interactions between socio-economic variations and cross-cultural comparisons will be examined and the significance of the results for campaigns to raise the public awareness of aphasia will be discussed and compared with earlier results. We stress that caution must be applied in generalizing these findings to entire national and international populations and examine ways in which different countries, and regions or cities within countries, can utilise locally surveyed levels of understanding of aphasia to plan ways to improve levels of understanding of aphasia to improve community access and involvement for aphasic people. We also describe our development of a new dedicated Aphasia Awareness Website which is due to be launched by the National Aphasia Association (*www.aphasia.org*) in February, 2013 and is designed to provide data on international levels of awareness for professionals engaged with aphasia, the general public, aphasic people and their families and, importantly, for the media.

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Construction and validation of a speech-systematic aphasia screening (SAPS) and its appendent therapy regimen

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Introduction

Cognitive-linguistic therapies have been recommended as a Practice Standard for the remediation of language and communication deficits, with the approach favorably being accompanied by participation-based approaches and potentially being assisted by supervised computer-based training (Cicerone et al., 2000). Thus, a standardized aphasia test that, in one go, covers the multitude of speech-systematic impairments and directs subsequent therapy would be of high value. Moreover, the involvement of participation-based procedures and computer-based training would be desirable.

Thus, we constructed a speech-systematic aphasia screening (SAPS) which comprises the psycholinguistic language components of phonetics/phonology, lexicon/semantics, and morphology/syntax at increasing degrees of demands and in both receptive and expressive modalities, in order to direct and evaluate a therapy regimen based on resulting performance profiles (see Fig. 1). Moreover, we created a computer-based home training that builds on the screening tasks and that is performed in combination with SAPS-based therapy.

In the present study, we aimed to (i) validate an already optimized SAPS version as well as the home training procedure, (ii) determine therapy effects, and (iii) consider correlations between patient performance in SAPS and in a communicative-pragmatic test.

Methods

We included 16 patients with a mean age of 50;5 years (range 25;5 - 67;11; ten male, six female) of the Aachen Aphasia Ward. 13 patients were in the chronic (>12 months post-onset) and three patients in the post-acute (1-12 months) phase of recovery. All four standard syndromes were present, with ten patients having a non-fluent and six a fluent aphasia.

Language Component: **Degree of Demands:**	**Sub-lexical**	**Lexical**	**Morpho-syntactic**
Easy (Level 1)	*Receptive*: Discrimination of syllables *Expressive:* Repetition of syllables	*Receptive*: Lexical discrimination (word-to-picture matching) *Expressive*: Picture naming (high frequency words)	*Receptive*: Agent identification (agent first) *Expressive*: Picture description (object-verb phrases)
Moderate (Level 2)	*Receptive*: Identification of pseudowords (phonologically simple) *Expressive*: Repetition of pseudowords (phonologically simple)	*Receptive*: Synonymy judgement *Expressive*: Picture naming (medium frequency words)	*Receptive*: Agent identification (agent second) *Expressive*: Picture description (simple declarative sentences)
Difficult (Level 3)	*Receptive*: Identification of pseudowords (phonologically complex) *Expressive*: Repetition of pseudowords (phonologically complex)	*Receptive*: Semantic feature judgement *Expressive*: Picture naming (low frequency words)	*Receptive*: Agent identification (reversible sentences, agent second) *Expressive*: Picture description (complex sentences)
Goal of treatment*	*Improvement of phonological/ phonetic abilities*	*Improvement of lexical/ semantic abilities*	*Improvement of morphologic/ syntactic abilities*

Figure 1: Speech-systematic aphasia screening (SAPS): Overview
∗Two goals of a certain level and modality are chosen based on the patient performance profile (i.e. selection among 18 specific goals). Each receptive task entails 24, each expressive task 16 items, half of which are trained in each goal (i.e., trained and untrained item sets).

The computer-based home-training consisted of multi-modal stimulations of half of the items of a SAPS task (i.e., 12 items in receptive tasks and 8 ones in expressive tasks); the other half served as untrained control items. For each patient, two impairment-specific therapy goals were chosen according to the individual SAPS profile, and the according task and therapy items were part of the therapy sessions and again trained in home-training sessions, with each session lasting 1 hour per day. The therapy regimen lasted for a maximum of 16 treatment days. Patients were administered the SAPS and the Amsterdam-Nijmegen Everyday Language Test (ANELT) (Blomert et al., 1997) before and after the therapy regimen.

Results

As a result, the properties of our test construction largely could be confirmed: The screening tasks of each language component and modality were well graded in difficulty (univariate analysis of variance, factor: degree of demands, all $p \leq .003$), and all but two tasks yielded high estimates of reliability (Cronbachs Alpha > 0.9). The computer-based training also proved its value regarding construction and feasibility. The therapy regimen was effective for nearly all modality-specific

language components and tasks as featured in SAPS (exact Wilcoxon-test, one-tailed, $p < .05$). Given published data on critical differences (Kawalla, 2011), the understandability (A-) score of the ANELT improved significantly in three patients. Moreover, ANELT performance correlated with expressive lexical and morpho-syntactic SAPS tasks (Spearman correlations, range: $rS = .698$ - $.904$, one-tailed, all $p < .01$).

Discussion

To conclude, the newly developed screening allows the assessment of an individual performance profile and the derivation of psycholinguistically defined therapy goals. Thus, the screening can serve as an instrument to measure therapy outcomes both in clinical settings and in randomized controlled trials (RCTs) for patients with aphasia. Moreover, SAPS-based therapy and the associated computer-based home training have shown to be effective, and expressive SAPS performance in part correlates with communicative-pragmatic performance.

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Language acquisition, learning and dissolution

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Introduction

It was Roman Jakobson (1941/68) who probably first presented a comprehensive theory related to the acquisition of phonological oppositions in a systematic way. Many Jakobson's ideas were challenged by later research but his main ideas are still valid. Jakobson focused his attention on child language development and language dissolution in aphasia. He indicated that these two processes are based on the same rules.

The discovery that language develops in a special, general order and the fact that language breaks down according to special rules let us develop many ideas in terms of how to work with babies who acquire language and with aphasic patients in order to help them to use language again. During the years of studies new ideas appeared. One of them is that language problem in aphasia can be connected with the access to the components of language but not only with the components themselves (Linebarger, Schwartz and Saffron 1983).

Although language is a highly complex system, most children learn their mother tongue in a natural way. Biological, psychological, and social factors seem to be the most important in this area. For the author it is important to check if the factors work in the same way for those who suffer from aphasia. The most important seems to be the issue of phonological opposition, mainly because as Jakobson stated, it is not the phoneme itself but their oppositions that bear the meaning (Jakobson 1968, 68).

The first experiment investigated the acquisition of English oppositions by Polish young learners. The main idea states that acquisition of oppositions in L_2 is similar to L_1 but not the same.

Methods

The participants of the experiment attended primary school. Their phonological system of first language was shaped and they distinguished Polish oppositions perfectly.

To check the hypothesis Blache's test (1975) was used. The oppositions that were estimated by the author as not important were not included in the test.

The participants were presented with a set of minimal pairs that had been read by a native speaker and recorded. The next step was to play them to the participants who listened to them through the headphones. The participants decided which words they heard and repeated them. The opposition pairs that were repeated by the children were recorded and then it was decided which of them were correct

and which were not. It is important to stress that, in this experiment, the most important was the acquisition of phonological oppositions but not the correct pronunciation of the segments.

Results

The analysis of the experiment

During the experiment it turned out that the order of acquisition of phonological oppositions in L_2 is not exactly the same as in L_1. It can suggest that the sound discrimination process that was developed during the acquisition of the first language sometimes facilitates the development of oppositions of L_2. In many situations the children did not go through the exact order of the acquisition of the oppositions suggested by Jakobson. The oppositions that do not exist in Polish like /θ/ and /ð/ were distinguished by the children, although the pronunciation was not perfect. It was also noticed that the front sounds presuppose the existence of the back ones. There is also explanation why Polish speakers devoiced voiced stops in word-final position in English.

Discussion

The author connects her ideas of language restitution in aphasia with the research she conducted in terms of the acquisition of English phonology by Polish young learners, mainly phonological oppositions. She wants to check if the results are similar, the same or different in the field of phonological oppositions in L_2 of the patients who recover from aphasia and compare them with L_1 phonological oppositions. In this project she presents three main questions:

- **if language recovery goes parallel in L_1 and L_2 or**
- **L_2 is recovered before L_1 or**
- **L_1 is recovered before L_2.**

This attitude seems to be important because nowadays more and more people communicate in more than two foreign languages and it is essential to know how to work with these patients. That is why author raises more additional questions that she is going to answer. Some of the most important are:

- is the recovery from aphasia in terms of phonological acquisition the same in different languages that were used by one person who is at least bilingual?
- is the recovery in L_2 the same or similar to L_1?

The child is not able to control vocal organs until he/she is about six months old (Kaplan and Kaplan 1971). The sounds that appear are rather accidental in character. There some more questions arise:

- is the situation similar to that in aphasia?
- are the sounds that appear at the beginning in the process of language recovery only accidental in character or are they ordered in a special way?

When we learn language after the period of puberty our right hemisphere is more engaged in the process of learning. However, L_2 is influenced by L_1 in both ways: positively and negatively since transfer works in this way. Because during the process of L_2 learning the right hemisphere is more involved it may suggest that after stroke, when the left hemisphere is affected, it is possible that L_2 can work. It should be stressed, however, that the brain functions as a whole and we can only talk about domination of the hemisphere. In this context it would be helpful in language recovery to check phonological oppositions in L_2 of bilingual patients:

- how they work when a patient acquired L_2,
- how they work when he/she learnt L_2,
- are in L_2 preserved those oppositions that are distinctive also in L_1 or the oppositions that have distinctive features only in L_2.

It is beyond this paper to present these issues in more details. However, the author is willing to talk with all interested in these problems.

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Processing pseudo-words in mild cognitive impairment: On-line and off-line evidence from Slovenian

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Introduction

The term Mild Cognitive Impairment (MCI) refers to a condition between normal aging and dementia which is often seen as prodromal for dementia (Chertkow, 2002). When MCI individuals demonstrate impairments in other-than-memory domains, including language, they are more likely to develop dementia than are those with a pure memory impairment (Petersen, 2003). Thus, understanding the nature of language impairment and possibly identifying sensitive measures of linguistic impairment constitutes a vital tool in early detection of dementia. While there exists plentiful evidence of language deficits in MCI mainly from standardized assessment tools (for a review see Taler & Phillips, 2008), psycholinguistic studies of language processing are scarce. The few studies that have employed psycholinguistic methodology have revealed disturbances in performance mainly at the *lexical-semantic level* (Olichney et al, 2002; Puregger et al, 2003; Davie et al, 2004; Taler & Jarema, 2004; 2006; Duong et al, 2006) reflecting an impaired semantic network in this population. At the same time, structural aspects of language, namely phonological and morphological structure as well as syntax are thought to show no alterations. One important dimension of previous research is that, with few exceptions, most studies have employed off-line measurements, thus, only targeting "controlled" and not automatic processing.

In this context, the present study examines aspects of both controlled and automatic lexical processing in MCI patients by looking at their performance in differentiating pseudo-words which appear to have different patterns of violability. The goal of the study is to present data regarding the boundaries of lexical representations and their decay in this population, thus contributing to the establishment of the nature of linguistic deficits seen in MCI. Moreover, by employing both off-line and on-line chronometrized tasks we attempt to detect differences between MCI and healthy populations in more subtle aspects of pseudo-word processing.

Methods

Participants

So far six healthy volunteers (all females, aged 60-79) and eight individuals with MCI (6 females, 2 males, aged 55-82) participated in the study. Testing is still being carried out targeting a total of 15 participants for each group. Patients were recruited from the Neurology Clinic of the University Medical Centre in Ljubljana. All of them were diagnosed by a neurologist or a neuropsychologist at the Neurology Clinic. In addition, their performance was examined by means of MMSE and MoCA translated and adapted versions for Slovenian. All patients performed below the proposed cut-off scores, indicating the presence of cognitive disturbances.

Materials and procedure

Materials comprised 3 groups of words violating certain constraints of word formation in Slovenian (B-D), one group of unattested (due to blocking) possible words without violations (E), one group of real words (F) and one group of non-words (A). All were formed with a masculine-gender nominal ('-er') suffix. Materials were based on a normative study for Slovenian (Marjanovic et al, 2013)

A. **Non-Words** based on non-existing stems and existing suffixes (**lastje,* **dovina,* 'conper-er') (n=30)

B. PseudoWs violating **grammatical category** constraints of the base (**črkilec* 'letter-er') (n=30)

C. PseudoWs violating **thematic constraints** of the base (**počivalec* 'rest-er') (n=22)

D. PseudoWs violating **aspectual constraints** of the base (**preplavalec* (from *preplavati* 'to swim-perfective')) (n=30)

E. **Possible unattested Ws** without violations (**kuhalec* (possible but blocked by *kuhar* 'cook')) (n=30)

F. **Real Words** (*plavalec* ('swimmer') (n=30)

All stems of pseudo-words were matched on average for frequency and the actual pseudo-words were also matched for length and number of syllables.

Study 1 - Off-line acceptability judgment task: For each item, participants had to say "yes" or "no", answering the question "In your opinion, is this word part of Slovenian vocabulary?". If their answer was "yes", they were also asked to provide the meaning of this word.

Study 2 - On-line lexical decision task: The experiment was run on an IBM computer using E-prime professional. Stimuli were presented at the center of a

computer screen in black font on a white background and were randomized for each participant. Each item was preceded by a row of hashmarks that remained on the screen for 200 ms, and a pause of 150 ms.

Results

Off-line task: Percentages of correct responses ("Yes" for words, "No" for all pseudo-words) were calculated for each group of words for patients and controls. Patients' data were similar to controls' with the exception of pseudo-words with aspectual violations (group D) where there is a tendency for MCI patients to accept them as words of Slovenian more often than the controls (p=0.11). Percentages are displayed in Table 1.

Table 1: Off-line and on-line results for both groups of participants

	Off-line acceptability task: Mean percentages of correct responses					
	Non-words	Categorical	Thematic	Aspectual	Possible	Real Words
MCI	94	95	87	78	62	97
Control	97	97	87	66	61	97

	On-line lexical decision task: Mean RTs in ms of correct responses					
	Non-words	Categorial	Thematic	Aspectual	Possible	Real Words
MCI	1891	1926	1955	2327	2255	1205
Control	1298	1501	1674	2242	1802	1101

	On-line lexical decision task: Accuracy (percentages of correct responses)					
	Non-words	Categorial	Thematic	Aspectual	Possible	Real Words
MCI	93	90	68	50	54	99
Control	97	95	77	58	61	98

On-line task: Mean RTs in ms and accuracy results are displayed in Table 1. In terms of RTs, a 2(group) x 6(word type) mixed model ANOVA has revealed a main effect of word type while post-hoc tests revealed a significant difference between MCI & control when it comes to non-words (p=0.02) and to possible (p=0.05), while the difference between RTs for other types of pseudo-words are substantial but did not reach significance. An interesting observation derives from the comparison between the accuracy data obtained from the two tasks for MCI patients. Namely, MCI patients accepted significantly more pseudo-words with aspectual violations (p=0.01), thematic violations, (p=0.04) and possible (p<0.001) in the on-line task than in the off-line, revealing an important task effect.

Discussion

Study 1 showed that patients seem to have maintained the ability to detect violations, which further suggests the preservation of word formation rules. However, although their performance was strikingly similar to that of healthy controls, the higher percentages in pseudo-words with aspectual violations (group D) might suggest that the boundaries of their lexical representations are becoming loose and their lexicon more flexible. Study 2 confirmed in a more robust way the differences between the two populations revealing that when automatic processing is required, MCI patients fail to behave as healthy participants do. In other words, patients perform within normal range when there is no time pressure, but do worse under time pressure revealing a reduced speed of processing, which is in accordance with their deficit. This task effect is suggestive of the potential that on-line studies provide for the detection of risk groups for dementia.

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The role of the dorsal pathway in primary progressive aphasia

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Introduction

The study of fronto-temporal brain pathways is commonly associated to different Primary Progressive Aphasia (PPA) subtypes (Gorno-Tempini 2011; Mesulam et al 2012). The present works aims at exploring how a dissociation of two different dorsal pathways provides a unique and useful way to dissociate two different patterns within the heterogeneous group of agrammatic/nonfluent Primary Progressive Aphasia (G-PPA). To do so, the connection between language areas in the frontal and temporal lobe are taken into account, and linguistic and speech processes implemented by distinct neural pathways are considered.

Current neurocognitive models of language processing (Friederici 2002; Hickok and Poeppel 2007) provide a framework for a functional neuroanatomy of syntactic and lexical processes. More specifically, neurolinguistic reseach has shown that Broca's region consists of three different areas (Friederici et al. 2003) which are connected with the temporal lobe by a dorsal and a ventral route (Anwander et al. 2007; Catani et al. 2005; Glasser and Rilling 2008; Saur et al. 2008). This work claims that the three different variants of PPA are associated to linguistic operations rooted in distinct fronto-temporal networks in the left hemisphere. More concretely, our main focus is the PPA population and their linguistic and neuroanatomical distinct profiles.

The present research focuses on the particular case of non-fluent/agrammatic PPA individuals. Interestingly enough, patients need to show at least two of the following criteria in order to be included in this subtype: (1) motor speech deficits; (2) agrammatism in language production; (3) spared single-word comprehension and impaired comprehension of only the most complex syntactic structures. Therefore, motor speech deficits and agrammatic production are not necessarily both found in order to classify patients into this variant.

Methods

The present contribution focus on two different types of agrammatic/nonfluent PPA deficits, more specifically, AOS and agrammatism, which we claim to relate to a pattern of damage associated to two different dorsal pathways. To do so, we carried out a literature review, including pathology driven alterations as well as data from DTI studies on PPA population, establishing a novel correlation between specific types of language and speech deficits found in G-PPA individuals and the neural pathways underlying their different occurrence.

Results

Recent studies using DTI method have shown that patients with PPA differ from normal controls with respect to brain pathways structure (Agosta et al., 2011; Galantucci et al. 2011). Comparing the three PPA variants, different connectivity patterns for each PPA variant have been found (Galantucci et al. 2011). In non-fluent/agrammatic PPA individuals, the ventral tract is found to be spared while the dorsal tract is damaged (Galantucci et al. 2011; Wilson et al. 2010). These findings have been claimed to show that the syntactic processing depends mainly on dorsal tracts, since there seems to be a correlation between damage to in the superior longitudinal fasciculus and deficits in syntactic comprehension and production.

In a recent study, Josephs et al. (2012) have studied the occurrence of apraxia of speech (AOS), characterized by impaired planning or programming of the movements for speech in degerative diseases. In these diseases, AOP and aphasia often co-occur, in which cases, patients are usually diagnosed as having PPA. Our contribution follows the lines of Josephs et al. (2012), suggesting that a separation of AOS from aphasia is plausible. The clinical presentation they refer to is based on a progressive neurological disorder dominated by AOS in which there is no evidence of agrammatism in their spoken language or in their narrative writing performance. They refer to these individuals as having primary progressive AOS, or primary progressive apraxia of speech (PPAOS).

Interestingly enough, subjects with PPAOS had focal pattern of grey matter atrophy affecting the lateral premotor and supplementary motor area. These findings point towards the premotor cortex as the possible neuroanatomical correlate of PPAOS (Josephs et al., 2012). The association between premotor cortex and PPAOS syndrome is plausible due to the fact that the premotor area is said to be involved in motor programming. These findings suggest that a dissociation of the two dorsal pathways would be useful for a better understanding of both syndromes and anatomical correlates of G-PPA.

Discussion

The present work claims that, once AOS and agrammatic deficits are dissociated, a window to their neural correlates is open. More concretely, we propose that while damage to the Dorsal Pathway I running from the posterior superior temporal gyrus to the premotor cortex may be associated to AOS syndrome, damage to the Dorsal Pathway II connecting the posterior superior temporal gyrus to pars opercularis (BA44) may give rise to agrammatic deficits. In sum, we claim that the heterogeneos G-PPA variant can be further subdivided into two different clinico-pathological variants once a dissociation of the two dorsal pathways is considered.

The present research focuses on the structural connectivities underlying the neural network of language processing and language breakdown. A dissociation of language deficits (e.g. PPA) vs. speech disorders (e.g. AOS) and a dissociation of the two dorsal patways provides a unique and useful way to approach linguistic

deficits in PPA individuals. This work also contributes to a further understanding of the Language Faculty implemented in the human brain and sheds some light to the study of the language processing from which language acquisition and language breakdown fields are based on.

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Fronto-temporal pathways and paraphasias

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Introduction

With the spread of neuroimaging techniques, the existence of pure cortical lesions has been proved, at best, as anecdotic (Lieberman 2002, Dronkers et al. 2004). The participation of subcortical structures and, more specifically, neural pathways turns out to be crucial for the clarification of the complex profiles that the analysis of acquired deficits tends to provide. Although aphasic syndromes are thought to be explained away by the classic model of the language network, the dual stream model of Hickok and Poeppel (2004) combined with tractography results and data from direct brain stimulation provides arguments in favour of the existence of a main dorsal subcortical pathway underlying the syntactic system, and a main ventral subcortical pathway underlying the semantic system within the left hemisphere (Catani et al. 2005; Saur et al. 2008; Glasser & Rilling, 2008, Friederici 2011).

The present contribution aims at exploring the viability of an extended version of the dual stream model (Hickock & Poeppel 2007) to account for specific symptoms of acquired and degenerative forms of aphasia. To do so, we explore the occurrence of paraphasias traditionally associated to Wernicke's aphasia and cortical lesions affecting the temporal lobe (Dell et al. 1997, Fridriksson et al. 2012). While semantic paraphasias, i.e. the production of words that are semantically linked to the target word (e.g., chair-table), are traditionally associated to a failure at the lexical-semantic level, disruptions in the access to the phonological output lexicon may underlie the appearance of phonemic paraphasias, i.e. non-words that are phonologically related to the target word (Kay & Ellis, 1987; Biran & Friedmann, 2005). The present work aims at proving that the proper account of language processing and language breakdown does not only benefit from but crucially depends on white matter tracts connecting frontal and temporal language areas.

Methods

We focus on two different types of paraphasias, more specifically phonological and semantic paraphasias, which we claim to relate to deficits associated to the dorsal and ventral circuitry respectively. To do so, we carried out a literature review, including pathology driven alterations as well as data from direct brain stimulation, establishing a correlation between specific types of paraphasias and the neural pathways underlying their occurrence.

Results

The two sources of data analyzed, more specifically abnormalities caused by electric stimulation and the results from the analysis of cases of primary progressive aphasia (PPA) shed similar results. According to Suzuki (2012), electrical stimulation of the arcuate fasciculus induced phonological paraphasias, whereas the stimulation of the inferior occipitofrontal fasciculus induced semantic paraphasias. Similar results are reported by Mandonnet et al. (2007) and Duffau et al. (2009).

Phonological paraphasias are also found as a consequence of logopenic primary progressive aphasia and non-fluent primary progressive aphasia (Gorno-Tempini et al. 2011; Mesulam et al. 2012; Joseph et al. 2012). Crucially for the present proposal, semantic paraphasias are never attested in these deficits. Contrary to this picture, the presence of semantic paraphasias is common in cases of semantic dementia (Ogar et al. 2011; Reilly, 2008). Crucially, both non-fluent and logopenic PPA variants have been related with damage to the superior longitudinal fasciculus including its arcuate component (Wilson et al. 2011; Galantucci et al. 2011), while the semantic PPA variant has been related to damage to the ventral pathway, more concretely, to the extreme capsule fiber and the uncinate fasciulus (Agosta et al. 2010; Galantucci et al. 2011).

Discussion

Studies on degenerative pathologies and language acquisition have shown that both lesions and developmental stages of subcortical pathways can predict linguistic behavior (Whitwell et al. 2010, Agosta et al. 2011, Galantucci et al. 2011, Friederici et al. 2011; Brauer et al. 2011). According to recent language models in the brain, dorsal pathways are associated to sound-to-motor mapping and higher-level language processes, ventral pathways are related to sound-to-meaning mapping and lexical semantics (Hickok & Poeppel 2004, Friederici et al. 2006, Friederici 2011).

The present research focuses on the structural connectivity underlying the neural network of word retrieval, showing how word retrieval proceeds in different stages that may fail independently. The dissociation of brain damage patterns in phonemic and semantic paraphasias, once the neural networks connecting frontal and temporal language regions are taken into account, provides a unique and useful way to approach language processing.

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Conversational turn length and fluency measurement in aphasia

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Introduction

A common assumption regarding fluency is that the difference between a fluent and non-fluent speaker can be easily stated (Poeck, 1989; Gordon, 1998). However, there is no objective and valid measure to determinate the level of a person with aphasia on the fluency continuum. Traditionally, people with aphasia have been classified as fluent or non-fluent following the cognitive criteria (Uribe, Arana & Lorenzana, 1969; Goodglass & Kaplan, 1986; Kertesz, 1994; Price et al., 2003).
The present study has attempted to clarify differences between fluent and non-fluent patterns of speech using analysis data from natural conversation settings.

Methods

Data collection

In order to guarantee validity of linguistic data, they should be collected in their natural conversational frame, as demanded from clinical practice (Penn, 1985; Ahlsén, 1995; Joanette & Ansaldo, 1999; Perkins, 2005; Gallardo-Paúls, 2009). Conversations by 30 bilingual people with aphasia (Spanish- Catalan) talking with their key conversational partners (Withworth, Perkins & Lesser, 1997) were analyzed and compared with interactions between 'non damaged' bilingual (Spanish- Catalan) speakers in order to identify which variable can be relevant for the fluent/ non-fluent diagnosis.

Data analysis

All analyzed conversations were fragments of 20 minutes chosen at random from conversation of one hour length. Fluency measurement has to be developed which can be adapted to the different types of discourse and their components; at the same time, the formula used has to indicate where the patient in the continuum of fluency is. The formula evolved was: speaker total words / speaker total speech turns.

Results

Analyzed the 60 conversation fragments, the average number of words was 1,795 and the average number of turns was 134,33; so the average number of words per turn was 12,89. The Standard deviation (SD) was 5,59. As it has to be considered

that fluency is not a dichotomous property of the discourse, but a continuum, it implies that the rating between -1SD and +1SD can be considered the norm. Only the ratings more or less than 2SD can be considered as pathological. For this reason, we have fixed the -1SD (7,3) as the value to differentiate fluent aphasic speakers from non-fluent.

Discussion

Results of the quantitative analysis allow us to consider that *7,3 words-per-turn* value is the measure to delimit fluent and non-fluent speakers. Our proposed value adds real conversation data to what we know from less-conversational data context. It supports other proposals we can find in BDAE-3, where Goodglass, Kaplan and Barresi (2000) talk about *7-word* utterances as the difference to consider a speaker normal or fluent. Analysis presented in Hernández-Sacristán & Rosell (2009) agree as well with the measure presented in this work.

These results emphasize the importance of the quantitative analysis of fluency in speech in its natural environment. The established value of 7,3 words-per-turn allows a specific evaluation about the fluency level of an aphasic speaker in their natural linguistic production. Taking into account this natural evaluation the diagnosis will be closer to the real state of the patient and the rehabilitation will produce better results. As well, the measure of 7,3 words-per-turn not only can determinate the difference between fluent and non-fluent speaker, but allows the diagnosis of severe fluency deficits as logorrhea or mutism.

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Language mixing in discourse in bilinguals with aphasia

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There is substantial literature reporting differences in connected language production in aphasia depending on the elicitation tasks, including differences in narrative length and sentence complexity (Goral, 2012; Olness 2006). Little is known about the relationship between language mixing in bilingual aphasia and the type of task used to elicit the narrative.

In India, language mixing is not uncommon in bilingual and multilingual individuals. That is, during communication framed in any one language, bilingual or multilingual speakers mix in various units from a second language, such as words or morphemes, for effective communication (Bhat & Chengappa, 2003; Sebastian, Dalvi & Obler, 2012). For bilingual and multilingual individuals with aphasia, there are studies reporting use of at least two languages when patients are asked to speak in only one language (Aglioti & Fabbro, 1993; Fabbro, Skrap, & Aglioti, 2000), but the extent to which bilinguals with aphasia mix their languages inappropriately is still under debate. Therefore, in the current study we asked the following questions:

1. Does the amount of language mixing in bilingual individuals with non-fluent aphasia differ in two different types of discourse: personal narratives and picture sequence description?

2. Are bilingual individuals with non-fluent aphasia capable of modifying their language usage based on the monolingual or bilingual status of the listener?

Participants

Five bilingual or trilingual (Kannada-English-Hindi) male participants with non-fluent aphasia were tested. All the participants were of mild to moderate severity of aphasia with good comprehension in all their languages. The participants had an average age of 46 years (29-62 years) and average education of 14.2 years (12-16 years). The language history and degree of bilingualism was determined using a questionnaire on language proficiency. Participants were asked to rate themselves on a 5-point rating scale (0: virtually nothing and 4: excellent) on their understanding, speaking, reading and writing abilities before and after the stroke in

Kannada and English (for the four bilinguals) and, in Kannada, English, and Hindi (for one trilingual). Participants whose average score was 3 or more for their first (L1) and second language (L2), and 2 or less for their third language (L3) both pre- and post-stroke on the language questionnaire were selected for the present study. Participant selection, test administration and language transcription were done by the first author, a trilingual (Kannada-English-Hindi) certified Speech Language Pathologist.

Procedure

All the participants also filled out a questionnaire on language mixing. In this questionnaire, after an explanation of what language mixing is they were asked questions such as, 'Do your family members mix languages while speaking to you?', 'What is the preferred direction of language mixing your family uses¿ etc. The participants received a battery of discourse tasks and a test of language impairment (WAB). The first four sub-tests of the WAB (Spontaneous Speech (information content and fluency), Auditory Comprehension, Repetition, and Naming) were administered in both Kannada and English. The discourse tasks included three descriptions of two six-picture sequences (Bilingual Aphasia Test-BAT picture sequence and Husband-Wife Fight), one eight-picture sequences (Cycle-Car Incident), and personal narratives (about the stroke, a vacation, and an event when they were happy).

The picture-sequence description and the personal narrative tasks were administered in three conditions: (A) Monolingual Kannada condition, (B) Monolingual English condition and (C) Bilingual/Trilingual Kannada-English-Hindi condition. In each condition, participants were shown a brief video clip of a person they were told would be the person their discourse responses were being recorded for. In the first condition the participants viewed a short video clip of a monolingual Kannada speaker. After the video clip a still photo of the listener remained and the examiner provided the following instructions: 'Make up your own story about what is happening in the picture, with a beginning, a middle, and an end, only using your first language, i.e., Kannada'. In the second condition the video clip was of a monolingual English speaker and the instructions were modified *mutatis mutandis*. In the last condition, the video clip was of a trilingual Kannada-English-Hindi speaker and the examiner instructed the participants that they could use any of their languages for this listener. The first time they mixed in a word from another language, participants were reminded once to use only L1 or only L2 in conditions A and B respectively.

Participant responses were orthographically transcribed from the recordings by the examiner. Each word in the transcript was coded as Kannada, English, or Hindi. The words were further coded as language-mixed or borrowed words (borrowed words being words like English 'car' that should be considered Kannada as they are part of the daily speech of non-brain-damaged individuals and may even be

Table 1: Averages of number of words in each language in Picture Sequence Description and Personal Narratives. LM: Language Mixed Words; K: Kannada; E: English; H: Hindi

	LM in Picture Sequences	**LM in Personal Narrative**
Condition A - Kannada Monolingual	K: 28.8 E: 7.8	K: 20.4 E: 7.2
Condition B - English Monolingual	K: 2.06 E: 48.8	K: 7.6 E: 34.13
Condition C - Kannada-English Bilingual	K: 25.13 E: 19.5 H: 0.46	K: 27.7 E: 13.7

inflected with Kannada affixes, e.g., 'caru' for nominative). The number of words from each language for each discourse type was tallied (Table 1).

Results

The Mann-Whitney U test was used for analysis due to the small N. Not only was there no significant difference in the number of language-mixed words between the two discourse tasks; the base-language word usage was also not significantly different between the two discourse tasks. As well, mixing was greatest in the non-monolingual condition, suggesting that individuals with aphasia are able to modify their mixing appropriately for the listener.

Conclusion

It appears that language mixing during narrative production in bilingual individuals with aphasia is similar regardless of the elicitation task. Additionally, individuals with aphasia are able to appropriately modify their language mixing behavior based on the listener, albeit not flawlessly.

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When object clitisation and climbing happen alone, and when they dance cheek to cheek: Selective impairment in Spanish agrammatism

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Introduction

Previous studies have shown that production of clitics in agrammatic Broca's aphasia is compromised, either by analyzing spontaneous speech (Nespoulous et al., 1988; Reznik et al.,1995; Stavrakaki and Kouvava, 2003; Chinellato, 2004; Rossi, 2007) or by testing clitic production in an experimental setting (Rossi, 2007; Gavarró, 2008, Nerantzini, 2008; Martínez-Ferreiro, 2010). Clitics in agrammatism have only been explored in Greek, Italian, French and Ibero-Romance (Spanish, Catalan and Galician). In Spanish, the study reported by Reznik et al. (1995) explicitly focused on the production of clitics in aphasic spontaneous speech, while Martínez-Ferreiro (2010) tested clitic production and comprehension in an experimental setting. This study focuses on the morpho-syntactic problems of Spanish agrammatic speakers with emphasis on the production of sentence word order. Because of the particular flexible word order with which Spanish can be grammatically produced, and due to the predictions that can be drawn from the 'Derived Order Problem Hypothesis' (DOP-H) (Bastiaanse & van Zonneveld, 2005), the present study focuses on two movement operations, clitic and object scrambling, in a way that has not been explored before. It is hypothesized that syntactic complexity, in a linguistic sense, is a critical factor in agrammatic production, and, therefore, it is predicted that sentences with object movement and clitic movement will be more difficult than sentences with basic word order (SVO), regardless of the position in the syntactic tree.

Methods

Participant	Age	Time Post-Onset (years)	Etiology	City
A1	34	8	Hematoma due to diffuse vasculitis	Barcelona
A2	59	3	CVA	Barcelona
A3	53	18	CVA	Barcelona
A4	68	5	CVA	Barcelona
A5	64	10	CVA	Barcelona

Stimuli

A set of 64 semantically reversible target sentences with transitive verbs and animate subjects and objects were used, the first 16 employed by Bastiaanse, Edwards and Rispens (2002) in the development of the Verb and Sentence Test (VAST), and another 48 sentences derived from them. The set included four target sentence types: (a) active declarative sentences with a transitive (finite) lexical verb, that is *assumed* to stay in its base-generated position in English and Spanish (the "full object in base position" condition; e.g., "The man carries the woman - El hombre carga a la mujer") (n=16); (b) active declarative sentences with a clitic pronoun, assumed to move from post-verbal to preverbal position (e.g., "The man *la* carries - El hombre *la* carga") (n=16); (c) active declarative sentences with a finite lexical verb in which the full object moves to preverbal position (e.g., "The man to the woman carries - El hombre a la mujer carga") (n=16); and (d) imperative sentences with a clitic pronoun in the postverbal position (e.g., "Man carries*la* - Hombre cárga*la*") (n=16). In all the sentences the subject and object differed in gender to avoid correct answers in the second (clitic) condition due to repetition, as in Spanish the use of third person singular clitics depends on the gender they refer to (*lo*-*la* refer to male or female respectively). For testing each sentence or item, black-and-white picture pairs developed by Bastiaanse et al. (2002) were used: the first picture in the pair depicts the prompt sentence and the other depicts its semantically reversed counterpart, so the two types of clitics (lo, la) were tested equally as half of the items have a male subject performing the action in the second part of the phrases. A set of 64 picture pairs (16 original pairs and 3 copies of each) was used to elicit the three sentence conditions mentioned above. Therefore, the 16 original picture pairs can elicit the 64 types of target sentences. The picture on the left always depicted the first sentence, and the picture on the right depicted the sentence which participants had to complete. The order of the items was pseudo-randomly assigned (each picture occurred only once in the first 16 items, once in the second 16 items, etc.) but the order was the same for each participant.

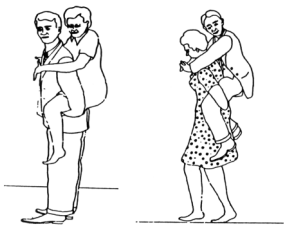

Figure 1: Taken from Bastiaanse et al. (2002), with permission.

Procedure

Using each pair, the 4 sentence conditions previously described were elicited using a sentence production priming task in the following way: the experimenter pointed to the first picture of the pair reading aloud the prompt sentence, after which the experimenter pointed to the second one, reading only the subject of the sentence aloud. The participant was expected to complete the sentence depicted in the second picture using the same sentence structure the examiner used before (e.g., the examiner said: "Here the man carries the woman, and here the woman..."), and according to the 3 sentence conditions, the participant responded: (a) "carries the man", (b) "*lo* (male Spanish clitic) carries", (c) "to the man carries"), or (d) "carries*lo*". The experiment was carried out in a quiet room. The participant sat in front of a computer screen and the experimenter sat next to him/her, and the experimental procedure was explained to the participant. There were three trial sentences (the last trial will be different from the first experimental sentence type). In case the task is not clear, any questions were allowed and additional trial sentences were added until the task was understood by the participant. All the responses were transcribed for analysis.

Results

Table 1: Correct sentence production per brain-damaged participant. Row percentages

Condition	n	A1	A2	A3	A4	A5
(a) -mov -clitic	32	100	96.875	100	84.375	93.75
(b) +mov +clitic	32	15.625	6.25	100	0	0
(c) +mov -clitic	32	0	0	0	0	0
(d) -mov +clitic	32	59.375	3.125	46.875	0	0

The first sentence condition was easier to produce than the other three ($p <$ 0.0001 Fisher's exact test at both overall and at the individual level, except among conditions (a) and (b) in the participant A3).

Discussion

The present data supports the hypothesis that it is difficult to move the object, whether it is a clitic or a full DP.
It is shown that movement and clitics can be affected selectively.

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Syntactic dependency resolution in Broca's aphasia

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Introduction

Research on sentence comprehension in aphasia has shown that individuals with agrammatic Broca's aphasia often exhibit a highly selective deficit in processing intra-sentential dependencies; comprehension of sentences that contain filler-gap dependencies (i.e. A'-Movement) is impaired, whereas comprehension of sentences that contain Binding relations are relatively spared. This dissociation has been attributed to the fact that there are important syntactic and processing differences between the two dependencies (Santi & Grodzinsky, 2007a, 2012). Syntactically, the antecedent of a reflexive (*John* in (1a) is in a theta position, whereas in A'-Movement, the displaced filler (*the man, that*, in (1b)) is not.

(1) a. Mary knows that John$_1$ loves himself$_1$ *Binding*
b. Mary knows the man$_1$ that$_1$ David pinched t$_1$ *Movement*

One could therefore hypothesize that the dissociation should be linked to predictability, i.e. whether the dependencies can be identified at an early stage of processing based on syntactic factors. In A'-Movement, the processor encounters the filler early on and provides a warning that the reader/hearer should store the DP in memory and go hunting for a gap (predictable dependency). In Binding no such cues are available; the dependency becomes evident only when processing reaches the reflexive, which is assigned its anaphoric reference in retrospect (unpredictable dependency). The two dependencies also make different demands on Working Memory (WM). A'-Movement puts greater demands on storage processes, but Binding on retrieval processes (Santi & Grodzinsky, 2012).

The hypothesis that predictability is the key factor distinguishing A'-Movement from Binding makes the further prediction that relations mediated by leftward LF movement should behave like Binding. This prediction is supported by the finding that agrammatic patients perform normally on ambiguous doubly quantified sentences (e.g. *A woman is photographing every child*) (Saddy, 1995; Varkanitsa et al., 2012), whose inverse scope reading involves (leftward) Quantifier Raising in the LF component (May, 1977).

The present study investigates whether this asymmetry in predictability effects between overt and covert leftward movement is also manifested in the processing

of sentences with contrastive foci (CF) by Greek-speaking patients with Broca's aphasia. As shown in (2), Greek provides an appropriate minimal pair, with the CF either moved or in situ.

(2)	a.	Ti GINEKA$_1$	filai	o adras	t_1	ohi to koritsi.	*Moved CF*
		The WOMAN$_{1\ ACC}$	is kissing	the man$_{NOM}$	t_1	not the girl.	
		'The WOMAN the man is kissing, not the girl.'					
	b.	O andras$_{NOM}$	filai	ti GINEKA$_{ACC}$	ohi to koritsi.		*In situ CF*
		The man	is kissing	the WOMAN	not the girl		
		'The man is kissing the WOMAN, not the girl.'					

Methods

Participants

Four chronic Greek-speaking patients with aphasia and four non-brain-damaged individuals participated in the study. Three patients are also agrammatic, that is, they exhibited impaired comprehension of movement-derived sentences (i.e. *wh*-questions and passives) during background testing, whereas comprehension of simple semantically reversible sentences was well preserved. Patients' WM was assessed with the digit span task and the Corsi block-tapping task (forward and backward). The agrammatic patients demonstrated WM deficits in both tasks, whereas the non-agrammatic patient performed within normal limits.

Procedure

Participants performed a picture-selection task, consisted of two experimental conditions and two filler conditions. The experimental conditions included sentences with moved object-CF and sentences with in situ object-CF. Sentences with subject-CF and simple transitives were used as fillers. Each condition included 20 semantically reversible sentences.

Results

Patients' performance on the picture selection task, presented in Table 1, revealed a dissociation between processing of sentences containing moved CF, as in (2a), and sentences containing in situ CF, as in (2b). The agrammatic patients (i.e. AG, AV, AA) performed significantly lower in the condition with displaced object-CF compared to the condition with in situ object-CF. This dissociation disappears in the case of the non-agrammatic patient (MD) who performed relatively well on both conditions. Controls performed at ceiling and, hence, their results won't be discussed here.

Discussion

These findings provide further evidence that predictability and the load it places on WM is a key factor in Broca's aphasia. An in situ CF must undergo LF movement

Table 1: Number of correct responses (/total) in the experimental conditions

	moved object-CF	in situ object-CF
AG	3/20	16/20
AV	8/20	14/20
AA	15/20	20/20
MD	19/20	20/20

to the left periphery of the clause so as to take scope over its background. As was the case with Quantifier Raising, this covert leftward movement appears spared in Broca's aphasics. Taken together, these results suggest that the problems with overt movement are WM-related.

This conclusion is further supported by the fact that all the agrammatic patients that participated in this study had lesions that include left IFG, whereas in the non-agrammatic patient left IFG was intact. Recent neuroimaging studies of non-brain-damaged individuals have shown that the presence of a syntactic dependency is not a sufficient condition for activating left Inferior Frontal Gyrus (IFG). Rather, a predictable displacement, as in movement-derived sentences, is required (Santi & Grodzinsky, 2007a, 2007b, 2012). This suggests that Broca's area hosts a 'syntactically constrained WM' (Santi & Grodzinsky, 2012: 830), that is the component of WM which is responsible for storage processes.

A currently unresolved issue is how the impaired performance on reversible passives in Broca's aphasia should be accounted for. Neuroimaging studies report activation in Broca's area, however the fact that patients' performance varies widely may suggest that the manner of Broca's area involvement is different from A'-Movement (Santi & Grodzinsky, 2012).

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The ability of verbal learning and memory in patients with non-fluent aphasia

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Introduction

Empirical studies show that aphasic patients have a decline on tests of memory (Barth et al., 2004; Vukovic, et al, 2008; Christensen & Wright, 2010). However, most studies were devoted to the working memory research with application tasks that require language skills. Therefore, it is difficult to say whether the poor performance on tests of verbal memory is result of linguistic or memory deficits. On the other hand, data from the literature show that little research has focused on the ability to learn, although learning is very important for the rehabilitation of aphasic patients. Bearing these facts in mind, the aims of the present study were:
1) examine the extent of short-term and long-term verbal memory in patients with non-fluent aphasia; 2) examine the ability to learn verbal material in those patients; 3) examine the presence of proactive and retroactive inhibition.

Methods

Participants and Material

The sample consisted of 20 patients with non-fluent aphasia, aged 45 to 76 years. The diagnosis of aphasia was done on the Boston Diagnostic Aphasia Examination (BDAE). The sample included ten respondents with Broca's aphasia (BA) and ten respondents with transcortical motor aphasia (TMA). All patients were right-handed, with a single left hemisphere CVA; they were at least six months post-onset, without other cognitive deficits, severe motor speech disorders or hearing impairment. In addition, all patients had ability to repeat single words and short phrases from the BDAE, as well as good auditory comprehension. Twenty healthy age-matched respondents (control group) were included in the test, as well.
The Rey Auditory Verbal Learning Test (Rey, 1964) was applied. The test consists of two word lists (A and B); each list contains 15 words.

Procedure

In the assessment of learning and memory Rey Auditory Verbal Learning Test (AVLT) was used, according to standard procedure (Lezak, 1995). First, the examiner reads a list (A) of 15 words five times, at the rate of one word per second and then requires the respondent to say all the words which she or he memorized after each trial. On completion of trial V, the examiner reads the second word list (B), instructing the respondents to say as many words from that list as they

memorized. During the repetition of the words from the list B, the examiner records intrusions from list A, and that helps assess proactive inhibition, i.e. the extent to which the previously learned material interferes with new learning. Following the B list trial, the examiner asks respondents to recall as many words from the list A as they can (trial VI). The score for each trial is the number of words correctly recalled. Based on the number of words, the respondent correctly repeated after first five readings of list A, the learning curve was created. At the same time, the score, after the first repetition of the words from the list A, represents the range of short-term verbal memory. The number of words, which the respondent repeated correctly after the sixth trial, represents a range of long-term verbal memory.

Results

The findings showed that both groups of aphasic respondents (patients with BA and those with TMA) have poor performance on the AVLT compared to the control group. At the same time, patients with BA had better achievement on the task of short-term and long-term memory compared to patients with TMA. Besides, differences in terms of the learning curve between BA and TMA were found. Patients with BA had a more productive learning curve than patients with TMA.

Discussion

Overall, the aphasic patients performed much worse than the control group. Aphasic respondents scored below average value, during each repetition, compared to the control group. Lower average values indicate that patients with non-fluent aphasia have limited capacity of short-term and long-term verbal memory. Further analysis indicates that aphasic patients differ from the control group in terms of the learning curve and learning strategies. While the control group established very productive learning curve without interference of the contents from the A and B lists, in patients with TMA the fatigue was observed. It is manifested by a plateau in learning, and/or lack of concentration, which in some cases leads to a bell-shaped curve of learning. In addition, patients with TMA had significantly more intrusion and paraphasia than the control group. The degree of retroactive inhibition is expressed in TMA. Hence, these patients have lower score on the A6 than on the A5 trial. This finding suggests that learning of the list B disrupted the reproduction of previously learned list A. Also, patients with TMA had lower score on B1 than on A1, which indicates the existence of proactive inhibition, as well as intrusions of list A during repetition of words from list B, which is not noticed in the control group and in patients with BA.

Regarding the aphasics, the obtained results showed significant difference in achievement between respondents with BA and those with TMA; patients with TMA had poorer performance on all trials compared to patients with BA. This finding shows that learning and verbal memory deficits are more pronounced in TMA than in BA. No specific learning strategies were observed in patients with TMA,

as is the case with the control group respondents who, as expected, remembered words from the beginning of the list better and had a uniform repetition of the same sequence. On the other hand, respondents with BA repeated words from the bottom of the list first. In addition, in patients with BA a high level of proactive inhibition was noted, which shows that previously learned material distracts the new learning. Although patients with BA, generally, have a productive learning curve, it was observed that in these patients plateaus in learning are formed, which suggests fatigue and limited attention span.

Bearing in mind differences in learning strategies between aphasic patients and the control group, on one hand, and differences between tested groups of aphasic respondents, on the other, a further study should be conducted in future to examine the factors that interfere with learning and memory in aphasia.

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Understanding discourse-linked processes in agrammatic and fluent aphasia: a threefold study in Russian

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Introduction

Agrammatic aphasic individuals encounter problems with grammatical encoding. However, not all syntactic processing is equally problematic, which becomes apparent in studies that involve the relationship between narrow syntax and discourse structure. Avrutin (2006) described that while agrammatic speakers have a relatively good performance on *who*-questions and reflexives, for which only narrow syntax is needed, their performance on personal pronouns and referential *which*-questions is often impaired. For the latter, discourse and access to information structures play an additional role. These discourse-linked elements have a specific referent, or set of referents, outside the clause.

Recently, the theory on disturbed discourse linking in agrammatic aphasia (Avrutin, 2006) has been combined with a theory on time reference. Agrammatic aphasic speakers find it more difficult to produce and comprehend verb forms that refer to the past than verb forms that refer to the non-past, captured by the Past DIscourse LInking Hypothesis (PADILIH; Bastiaanse et al., 2011). The PADILIH predicts that verb forms referring to the past, such as 'wrote', are impaired in agrammatic aphasia, because they are discourse linked: in order to interpret past time reference, an additional link has to be made to some other event time. Grammatical encoding, including discourse syntax, is impaired in agrammatic aphasia. Verb forms referring to the present, such as 'writes', are relatively spared, because they are locally bound: no additional discourse-link is needed because the event time the verb refers to is in the here-and-now of the moment of speaking.

Also for people with fluent aphasia, discourse-linked structures require additional processing. They can still refer to the past, however, they tend to resort in less complex structures with non-finite lexical verbs, such as 'has written'. Overall, agrammatic aphasic speakers are less stable in assigning the correct time reference than fluent aphasic speakers (Dragoy & Bastiaanse, 2013; Bos & Bastiaanse, subm.) Few studies reported on the performance in the pronominal domain in fluent aphasic speakers. These speakers have been reported to show general

problems with referential elements, both for reflexives and (discourse-linked) personal pronouns (Ruigendijk & Avrutin, 2003.) The performance of fluent aphasic participants on *who*- and *which*-questions is unclear until now.

Aims

The reported differences in locally bound and discourse-linked processing have been investigated in separate aphasic populations, and mixed results have been obtained. The current study investigated the three domains in parallel, aiming to provide answers to the following questions:

(1) Are agrammatic and fluent aphasic speakers both impaired in discourse-linked processes?

(2) Are discourse-linked processes equally impaired in the domains of time reference, Wh-questions and pronouns/reflexives?

Methods

Participants

Three groups were tested: 10 healthy, 10 agrammatic aphasic, and 10 fluent aphasic participants. Aphasic participants were diagnosed within Luria's classification with (agrammatic) efferent and/or dynamic aphasia, or (fluent) sensory aphasia.

Materials and analysis

Three sentence-picture matching tasks were administered: (1) the Test for Assessing Reference of Time (TART) for the Present-Imperfect and the Past-Perfect, (2) the Wh-Extraction Assessment Tool (WHEAT) for assessing reference of *which* - and *who*-questions in base order, and (3) the Reflexive-Pronoun Test (RePro) testing reflexive and pronominal reference to a man or a woman. Reflexive reference is expressed by verb inflection in Russian. Each test had 20 items per condition. A mixed model regression analysis was performed on the accuracy data of the three groups on the three tests.

Results

The agrammatic and fluent aphasic speakers were significantly less accurate than the healthy control participants, who made no errors ($z = 2.07$, $p < .05$ and $z = 2.17$, $p < .05$, respectively.) Overall accuracy of the agrammatic versus fluent aphasic participants did not differ ($z = 0.21$, $p > .05$), see the Figure.

The discourse-linking effect in the TART was larger than in the WHEAT ($z = 3.27$, $p < .001$), which was larger than in the RePro ($z = 2.62$, $p < .01$.) Furthermore, the effect of discourse-linkedness was smaller in agrammatic than in fluent aphasic speakers ($z = 2.83$, $p < .01$.) The two groups of aphasic individuals and the three tests have therefore been analysed separately.

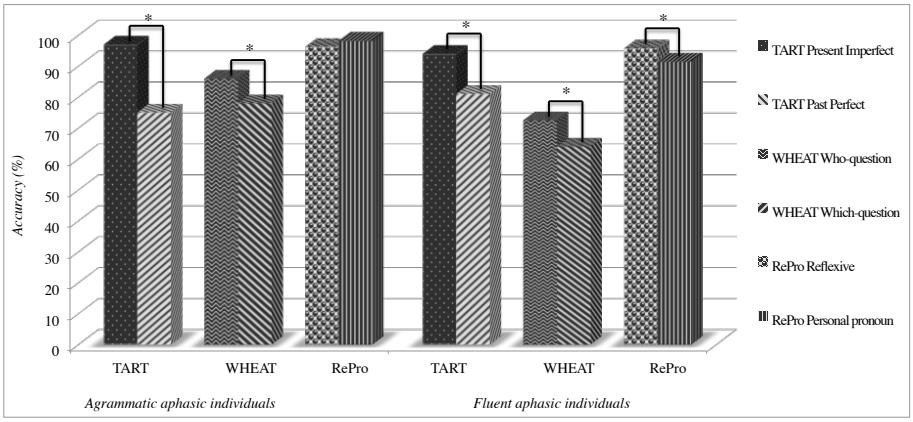

Figure 1: Accuracy of the agrammatic (left) and fluent (right) aphasic participants on the three tests.

On the TART, both aphasic groups were less accurate on the past than on the present ($z = 5.62$, $p < .001$ for agrammatic speakers and $z = 2.80$, $p < .01$ for fluent aphasic speakers). Similarly on the WHEAT, both participant groups scored lower on *which*-questions than on the *who*-questions ($z = 2.30$, $p < .05$ and $z = 2.08$, $p < .05$ respectively). On the RePro, only fluent aphasic individuals had a significantly lower accuracy on the discourse linked Pronoun condition than on the non-discourse linked Reflexive condition ($z = 2.74$, $p < .01$; for agrammatic speaking individuals: $z = 1.81$, $p > .05$.)

Discussion

Grammatical decoding disturbances in agrammatic aphasia affect discourse structure, and as a result, comprehension of discourse-linked elements was disturbed. Also in fluent aphasia, processing of discourse-linked elements was affected. For agrammatic speakers, this effect did not become apparent in the RePro test, where participants made only few errors, unlike the patients in the test of Ruigendijk and Avrutin (2003). A more complex task should be used to map out processing differences reflexives versus pronouns. The discourse-linking effect was largest in the WHEAT, which must be due to differences in sentence structure and task complexity.

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The process of diminutivization in patients with language impairments and children

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Introduction

Cross-linguistically, diminutive formation is the first morphological rule that children acquire. The exceptional status of diminutives makes them suitable for being acquired very early (Dressler, Savickiene, 2007). Diminutives are derivational and not inflectional, even if they are not prototypical representatives of derivational morphology, because they do not change the category of the base. For this reason, diminutive suffixes are not heads (Scalise, 1994), but still have some head properties because they can change both the inflectional class and the gender of the base (Dressler, Merlini, 1994). The representation of morphologically complex words in the mental lexicon and their neurocognitive processing have been debated topics in psycholinguistics, in cognitive neuroscience of language and in neurolinguistics. Despite the fact that the category of diminutives has a wide distribution across languages and has been largely investigated, except for Luzzatti, Mondini, Semenza (2001) nothing relevant has been reported on diminutives from a neuropsychological perspective. An aphasiological study, however can help in answering the following questions.
How are diminutives represented in the mental lexicon? Which processes are involved in their production? A comparison was thus made between selected cases of people with aphasia, healthy young and elderly adults, and preschool children. The relation between potentiality and illegality and the regression hypothesis were also investigated.

Methods

Procedure

Three tasks were administered: 1) a diminutive construction task, 2) a picture naming task and 3) a lexical decision task.

1. The diminutive construction task consisted of questions in this format: If I want another way to say *small chair* I would say *chair-DIM*. What would

be another way to say *small house*?'. This task included 54 masculine gender-bases and 50 feminine gender-bases from which different kinds of diminutives can be derived (simple, e.g. *gatt-ino*, 'cat-DIM'; compound, e.g. *radi-ol-ina*, 'radio-DIM-DIM'; interfixed, e.g. *pont- ic-ello*, 'bridge-INTERF-DIM', transparent, e.g. *strad-ina*, 'street-DIM', semi-trasparent/opaque, e.g. *cane* > *cagn-ol-ino*, 'dog-DIM-DIM' and lexicalized diminutives, f. *spazzola*, 'brush' > m. *spazzol-ino*, 'toothbrush').

2. In the picture naming task, two pictures appeared on a computer screen representing the same entity; the rightmost picture was smaller than the one on the left, however. Below the picture on the left the name of the entity portrayed in the picture was written. The participants' task was to name the second picture. This task included 43 masculine gender-bases and 38 feminine gender-bases from which different kinds of diminutives could be derived.

3. The lexical decision task required participants to classify items presented on the screen as words or non- words. This task included 216 diminutives (54 existent, high-frequency, e.g. *pecor-ella*, 'sheep-DIM'; 54 existent, low-frequency a, e.g. *pecor-etta*, 'sheep-DIM'; 54 potential, e.g. **pecor-uzza* and 54 illegal diminutives, e.g. **pecor-ic-etta*). Reaction times were recorded.

In all the tasks different diminutives categories were controlled for frequency.

Participants

Three Italian individuals with aphasia (TG, BR, RC) and eleven 4-5 years old children participated in the study. TG, BR and RC suffered an ischemic stroke. TG had a lesion to the left frontal lobe and had Broca's aphasia. BR and RC had a lesion to the left temporal parietal lobe. BR suffered from mild-minimal anomic aphasia, while RC suffered from a more severe anomic aphasia. Two control groups were involved; one included nineteen 24-30 years old subjects, while the other group included ten 55-67 years old subjects.

Results

In the diminutive construction task and in the picture naming task: (a) both the control and the experimental groups produced three kinds of errors: 1) the bases (e.g. *antenna*, 'antenna'), instead of *antenn-ina*, 'antenna-DIM', 2) bases different from the target bases (e.g. *cull-etta*, 'cradle-DIM', instead of *lett-ino*, 'bed-DIM') and 3) lexicalized diminutives (e.g. *spazzolino*, 'toothbrush', instead of *spazzol-ina*, 'brush-DIM'). (b) Only patients produced phonological errors. (c) Only children produced simple diminutives (e.g. *radio* > **rad-ina instead of radi-ol-ina*, 'radio-DIM-DIM') and augmentatives (e.g. *muro*, 'wall' > **mur- er-one* instead of *mur-etto*, 'wall-DIM'). (d) only patients and children produced inadequate responses as

analytic forms, e.g., *insetto*, 'insect' > *piccolo insetto*, 'small insect', instead of *insett-ino*, 'insect-DIM').
In the lexical decision task: (a) Control groups and RC were faster with high-frequency, than with illegal, than with potential, than with low-frequency diminutives. (2) Children only distinguished existing (faster) vs. non-existing and were not sensitive to the frequency and to the potentiality/ illegality of diminutive forms. (3) TG was not sensitive to the difference between potential and illegal diminutives but, unlike children, he was sensitive to the frequency effect. (4) BR was faster with high frequency than with low frequency, but was not sensitive to the difference between potential and illegal diminutives.

Discussion

Multiple neural circuits seem to be involved in the process of diminutivization since patients with different lesions seem differentially sensitive to different aspects of the process.
The error distribution in patients differed from the error distribution in children. This result is not fully consistent with a regression hypothesis.
Frequency plays a role only in adults – both in control subjects and in patients – whose lexicon is completely formed. On the contrary, it does not yet seem to play a role in children. The difference between potential and illegal diminutives does not play any role in the recognition of the items. Children as well as patients are not sensitive to illegal diminutives. For both groups potential and illegal – and not only potential – diminutives seem to remain as options and the patterns contained both in potential and in illegal diminutives are overgeneralized.

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Complex constructions across aphasic syndromes

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Introduction

The use of complex structures in aphasia has been traditionally linked to fluency. While grammatical deficits and spared lexicon are traditionally assumed in non-fluent aphasias (Grodzinsky, 2000), fluent aphasias tend to be characterized by prominent word retrieval difficulties and spared syntax (Edwards, 2005). The subordination deficit in non-fluent aphasias has received notable attention, especially in individuals with agrammatism. Failure to produce complex structures has been documented for several languages including English, German, Dutch, Swedish, Polish, Finnish, Japanese and Italian (Bates et al., 1988; Menn & Obler, 1990; Sasanuma, Kamio & Kubota, 1990; Thompson et al., 1994, 1996, 1997; Hagiwara, 1995). However, individuals with fluent aphasia have also been found to produce structures that are less complex than those produced by NBDs (Gleason et al., 1980; Butterworth & Howard, 1987; Niemi, 1990; Bastiaanse, Edwards & Kiss, 1996; Edwards & Bastiaanse, 1998; Edwards, 2005; Bastiaanse, 2011).

The aim of this study is to provide further evidence for the reduction of complexity in the speech of individuals with fluent aphasia and to determine if the strategies used to produce these structures vary in NBDs and subjects with aphasia. To do so, the production of embedded finite clauses in English speaking subjects with aphasia is analyzed. The claim has been made that embedded finite clauses in English allow for a simpler option, which does not contain *that* (Franks, 2005; Llinàs-Grau & Fernández-Sánchez, in press). Reduction of complexity may be associated with complementizer absence. On the basis of these results, implications for theoretical linguistic proposals are discussed.

Methods

Subjects & Corpus samples

An analysis of spontaneous speech that included the performance of 200 individuals brought together by the AphasiaBank project (MacWhinney et al., 2011) was carried out. Two groups were included in the study, an experimental group comprising 100 individuals diagnosed as aphasic according to the standards of the Western Aphasia Battery (WAB, Kertesz, 1982), and a control group including 100 non-brain damaged control subjects (NBDs).

The following corpora of subjects with aphasia were analyzed: Adler corpus, BU

corpus, CMU corpus, Elman corpus, Fridriksson corpus, Garrett corpus, Kansas corpus, Kempler corpus, Kurland corpus, and the first 21 files of the Scale corpus. Exclusion criteria only affected those subjects that were not found to be aphasic according to WAB (n = 8). The sample includes 60 males, 27 females, and 13 subjects for which no information is provided as for gender. The mean age across deficits is 65;7 ranging from 36;0 to 91;9 years old.

Three corpora of control data were analyzed: Capilouto corpus, Kempler corpus, and the first 25 files of the Wright corpus. The sample includes 48 males, 50 females and 2 subjects for whom no information is available (mean age: 69;7, range: 23;0 - 89;6 y.o.).

Scoring

The occurrences of three highly frequent verbs (*say, think* and *know*) that select finite complement clauses optionally introduced by *that* were counted. The corpus search provided constructions of different types that were carefully selected on the basis of their structure. Only constructions which followed the relevant pattern were chosen for analysis.

Results

The overall results of the 100 subjects with aphasia include a total of 223 subordinate constructions. Out of them, 85.2% (n = 190) were produced without the complementizer. Significant differences were found between subordinate structures introduced by *that* and contexts of *that*-omission (Wilcoxon Signed Rank test: Z = -7.144, p = 0.000). As expected, significant differences were also found between fluent and non-fluent deficits (Mann Whitney U test: Z= -4.934, p =0.000). While the mean use of embedded finite clauses is 3.02 per fluent individual (SD = 3.87), it decreases to 0.26 in non-fluent subjects (SD = 0.51).

In addition to subjects with aphasia, the results of 100 NBD subjects were also analyzed. The overall results include a total number of 514 subordinate constructions (mean = 5.14, SD = 4.01). The complementizer was absent to a 78.4% (n = 403). Significant differences were found between subordinate structures introduced by that and contexts of that-omission (Z = -10.848, p = 0.000). Graph 1 summarizes the results across populations.

Discussion

Our results stand in favor of characterizations of fluent aphasia that acknowledge reduction of syntactic complexity in this group of subjects (Edwards, 2005; Bastiaanse, 2011; among others). Second, the pattern observed as regards *that*-presence vs. *that*-absence coincides, with the latter as the prevalent option, across NBDs and subjects with aphasia.

In line with Franks (2005) and Llinàs-Grau & Fernández-Sánchez (in press) the high percentage of *that*-absence in both the speech of subjects with aphasia and NBDs

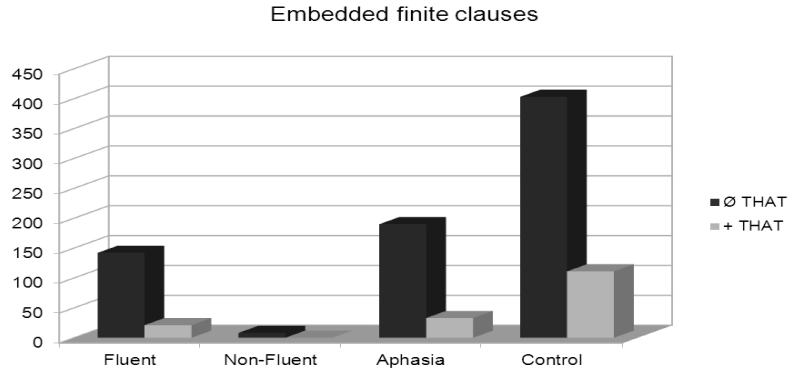

Figure 1: Embedded finite clauses across populations.

indicate that the embedded finite clauses selected by *say*/*know*/*think* may well be regarded as selecting a bare Tense Phrase (TP) in unmarked colloquial style.

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Exploring gender inflection: an insight from errors in aphasia

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Introduction

In Italian every noun must be morphologically inflected for Gender and Number. The latter is a feature whose inflection is - most of the times - clearly dependent on a communicative context: the speaker will choose the singular or the plural form to refer respectively to one or more entities. For what concerns Gender inflection, the relationship between form and meaning it is not so clear-cut. In the great majority of nouns, this feature does not bear any semantic information and surfaces as a mere formal value, but in some other it seems to be related to the sex of the referents.

Most grammatical theories (Matthews 1974, Thornton 2005, Zamparelli 2008) consider Gender as a feature always inherent to nominal lexemes, being dependent on a fixed property of each noun. Some other theories (Di Domenico 1997) admit that nouns may be inflected for Gender on the basis of the semantic and communicative context, as they are for Number.

A set of Italian nouns seems particularly fit for the purpose of exploring the possibility that Gender may inflect dependent on contextual properties: these nouns, all denoting animate referents, occur as couples like *cavallo-cavalla* (horse - mare) in which the masculine and the feminine forms, referring respectively to male/unmarked and female individuals, share the same root and differ only for the morpheme that marks their gender.

Testing people with aphasia may provide some insights on the question.

Methods

Materials

The experimental material consisted of: **(a)** 74 nouns whose gender might be contextually assigned (37 masculine, *cavallo* and 37 matched feminine, *cavalla*); in these nouns the opposition of Gender was overt at the morphophonological level: feminine nouns ended in -a, masculine ones in -o; **(b)** 26 nouns in which the opposition of sex is expressed by different lexical roots (13 masculine, *toro* - bull, and 13 matched feminine, *vacca*-cow); **(c)** 14 control nouns (7 masculine, 7

feminine) in which gender opposition does not bear the semantic opposition male-female (*collo*- neck, *colla*-glue).

The tasks administered were: **Repetition**; **Reading aloud**; **Gender Shift** (e.g.: S: cugino? R: cugina; S: vacca? R: toro); **Inflection Completion** (S: ho visto un maestr__? R: ho visto un maestr*o.*), **Article Completion** (S: ho visto __ maestra; R: ho visto *una* maestra).

Participants

PW is a 88 year-old right handed female. She suffered a CVA involving the left insula and was diagnosed as affected by Wernicke' s aphasia.

AB is a 61-year-old right-handed female. She suffered a CVA involving the territory of the left Middle Cerebral Artery. She was diagnosed as affected by Broca's aphasia.

Results

PW was tested only in "Gender Shift". She was more impaired on the nouns whose Gender is inherent: she made 4/74 (5,4%) errors in type (a) nouns vs 22/26 (84,6%) in type (b) nouns. The errors mainly consisted of switching gender of type (b) nouns by overextending the inflection rule expected for type (a) nouns, giving results such as *uomo* (man) >**uoma* instead of *donna* (woman) in 11/22 (50%) cases.

In the same task, AB showed a different pattern: she made 5/74 (6,75%) errors in type (a) nouns and 11/26 (42,3%) errors in type (b) nouns, mainly omissions: 7/11 (63.6%).

AB's overall performance was slightly worse in type (a) nouns: she made 60/370 (16.2%) errors; in type (b) nouns the errors were 13/130 (10%). The most interesting results emerged in her Completion tasks: in "Inflection Completion", errors were 37/74 (50%) for type (a) and 2/26 (7.7%) for type (b). In most cases (31/37), she produced the wrong gender morpheme, e.g. **una cavall**o***. In contrast, her performance in "Article Completion" was better: the errors were 6/74 (8.1%) for type (a) and none for type (b).

Discussion

The different performance of the two participants in "Gender Shift" points to an asymmetry between a Gender assignment of contextual kind and Gender as depending upon an inherent lexical feature (Atkinson 2012, Slehman & Ihsane 2013). The fact that PW overextended to type (b) nouns the morphophonological inflection rule of type (a) nouns suggests that such a rule is not only spared, but that it is also the default operation for animate nouns. Both the contextual and the lexical Gender are checked in an independent syntactic projection: for what concerns the former, the feature may assume different values depending on the semantic context; for what concerns the latter, it may only assume the value fixed on a lexical basis, depending on a constraint set by the lexical head.

The sharp discrepancy between AB's two Completion tasks is unlikely due to a generic difference in processing resources: it may rather stem from a contextual operation of gender assignment, independent of proper concord operations that take place in higher DP positions, which are spared in her performance.
With respect to linguistic theory, we suggest that Gender is assigned in an autonomous projection in syntax, [class]. More in detail, we hypothesize the existence of a syntactic layer AgrP (parallel of the verbal IP) whose position is intermediate between the lexical layer NP and the DP (Giusti 2009). In this layer the features that must show up at the morphophonological level are encoded: Gender (and maybe Number) are processed in AgrP projections before rising to the DP.
Both features may inflect according to the semantic and communicative context, but their formal values must be chosen among the set "allowed" by the lexical head for what concerns the word inflectional class; their variability depends on a parameter set by the lexical features as well.

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Comprehension of if-conditionals at the morphosyntax-semantics interface in Turkish Broca's aphasia

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Introduction

Broca's aphasia is diagnosed in individuals who have significant deficits in expressive and/or receptive language skills, due to brain injury (Goodglass, 1980). Hallmark features of the disorder include profound impairments in their morphosyntactic abilities, and specifically in their abilities to use correct tense / time-reference marking morphology (e.g. Stavrakaki & Kouvava, 2003; Yarbay Duman & Bastiaanse, 2009). However, specificity of language impairment is subject to debate. Recent studies suggest that non-linguistic deficits often co-occur with linguistic deficits in Broca's aphasia, implying that individuals with Broca's aphasia do not only have impaired language but also suffer from cognitive deficits, particularly in specific executive functions (e.g. inhibition: Peristeri, Tsimpli, & Tsapkini, 2011). From this point of view, the morphosyntax-semantics interface is a highly interesting area to look into because it allows detecting relationships between morphosyntactic abilities and cognitive abilities of individuals with Broca's aphasia. However, although there is extensive work on morphosyntactic impairments in Broca's aphasia (e.g. Bastiaanse & Thompson, 2003 for Dutch and English; Yarbay Duman et. al., 2011 for Turkish), hardly anything is known about the morphosyntax-semantics interface in this group.

For this investigation, we examined the ability of Turkish-speaking individuals with Broca's aphasia to comprehend counterfactuals and compared the results with those of a control group consisting of individuals with no speech and language impairment history. Counterfactuals are thoughts about 'what might have been', that is, imagining what might have happened, but did not. For example, when a person misses an important interview, he might think 'if I had taken the bus!'. In this scenario, the person generated a different event and an outcome than what has happened in reality, by *inhibiting* the current state of affairs. That is, the counterfactual is the scenario in which the person took the bus and made his interview as opposed to the factual where the person missed the interview. According to Beck, Riggs, & Gorniak (2009) three executive functions are required for counterfactual thinking: (1) inhibition – to ignore what has happened; (2) working memory – to hold two different representations simultaneously in mind;

(3) cognitive switching – shifting between those representations. Hence, using, but also understanding, counterfactuals involve complex cognitive processes. We also tested the comprehension of nonconditional clauses and factual conditionals, in which no such cognitive processes are involved, to manipulate morphosyntactic (the presence/absence of an if-conditional) and semantic (counterfactuality) variables separately.

Table 1: Summary of the clause types with respect to their relevant characteristics to the present study

	If - embedding	*Verb morphology*	*Factual*	*Specific EF*
NonConditional Gömleğ–i ütüle–*di* ve dolab–a as–tı The shirt-acc iron-past/3sg-conditional the closet-dat hang-aorist He ironed the shirt and hung it up in the closet Interpretation: the shirt was ironed and hung up in the closet	no	past tense	yes	no
Factual Gömleğ–i ütüle–*diy–se* dolab–a as–ar The shirt–acc iron–past/3sg –conditional the closet–dat hang–aorist If he has ironed the shirt, he will hang it up in the closet Interpretation: when the shirt is ironed, it is in the closet	yes	past tense + *-sa*	yes	no
Counterfactual Gömleğ–i ütüle–*sey-di* dolab–a asar–dı The shirt–acc iron–conditional–past/3sg the closet–dat hang–past/3 sg If he had ironed the shirt, he would have hung it up in the closet Interpretation: The shirt is certainly not ironed and not hung up in the closet	yes	*-sa* + past tense	no	yes

Individuals with Broca's aphasia have morphosyntactic deficits. Thus, it was expected that conditional clauses would be more difficult to comprehend than nonconditional clauses since the former are morphosyntactically more complex. Furthermore, in Turkish, counterfactual and factual conditionals are morphosyntactically equivalent, which allows observing whether counterfactuality itself adds to difficulties that individuals with Broca's aphasia experience in sentence comprehension. Considering the assumption that individuals with Broca's aphasia are impaired in executive functions such as inhibitory control, it was predicted that counterfactual conditionals would be more difficult to comprehend than factual conditionals. That is, it was expected that individuals with Broca's aphasia, unlike the control group, would have more difficulties with counterfactuals not only because of morphosyntactic complexity but also due to semantic complexity and the cognitive processes involved in counterfactuals.

Table 1 presents examples of test sentences and their relevant characteristics of the present study. Note that conditionals in Turkish are marked by a conditional suffix on the main verb *(-(y)sa)* 'if', which occurs to the right of the past tense marker – *dı* in factuals (temporally past) and to its left in counterfactuals. Note that Turkish, unlike English, has a specialized conditional morpheme used for both counterfactuals and factuals. Besides, Turkish does not make use of if – complementizer, modals, auxiliaries, and participle verbs in its formulation of these structures, which make them grammatically easier and semantically more transparent than in English.

Methods

Subjects

12 individuals with Broca's aphasia were tested (7 male / 5 female: MA: 54.2). The diagnoses were based on the standardized Afazi Dil Değerlendirme Testi (ADD)-The Test of Language Assessment in Aphasia (Maviş & Toğram, 2009) and the clinical judgments of a speech therapist. All the patients were at least 3 months post onset of left CVA (lesion data are available for each patient). Ten non-brain-damaged Turkish speakers participated (and performed at ceiling) on the test.

Materials

A spoken–sentence–to–picture–matching task was developed with three conditions (nonconditional, factual conditional, counterfactual conditional), with 15 items each in the test. A sentence was read aloud by the experimenter and the participants were asked to point to the picture that matched the spoken sentence (see Figure 1). In the factual condition, the subjects were always shown pictures in which the action of the main clause was realized (e.g. ironing was done), as a consequence of which the action of the other clause had to be realized as well e.g. the shirt is in the closet.

Results

Factual conditionals were significantly more difficult to comprehend than nonconditionals (t=2.311; df=1;p=.041) and counterfactual conditionals (t=2.692; df=11, p=.021). However, there was no difference between factual and counterfactual conditionals (t =1.351, df =11; p=.204). In this analysis, lexical errors were ignored (these were cases in which the patients interpreted the target sentence as a factual or a counterfactual correctly-but, by choosing a semantically related item e.g. shirt vs. dress) to see the effect of counterfactuality more clearly. This was the most conservative way to analyze the data since the subjects made twice as many lexical errors as in factuals than in counterfactuals. Exactly the opposite pattern was observed for Action Unfulfilled errors (these were the cases in which the patients interpreted a counterfactual as a factual or vice versa).
Although there was no significant group difference between factuals and counterfactuals at the group level, 4 patients (out of 12) were significantly impaired in counterfactuals compared to factuals (chi-square).

Discussion

There are two major findings. First, comprehending factual and counterfactual conditionals was more difficult than comprehending nonconditionals for Turkish individuals with Broca's aphasia. Second, although comprehending factuals and counterfactuals were equally difficult for them at the group level, some of the patients were selectively impaired in counterfactual thinking. Apparently, sentence

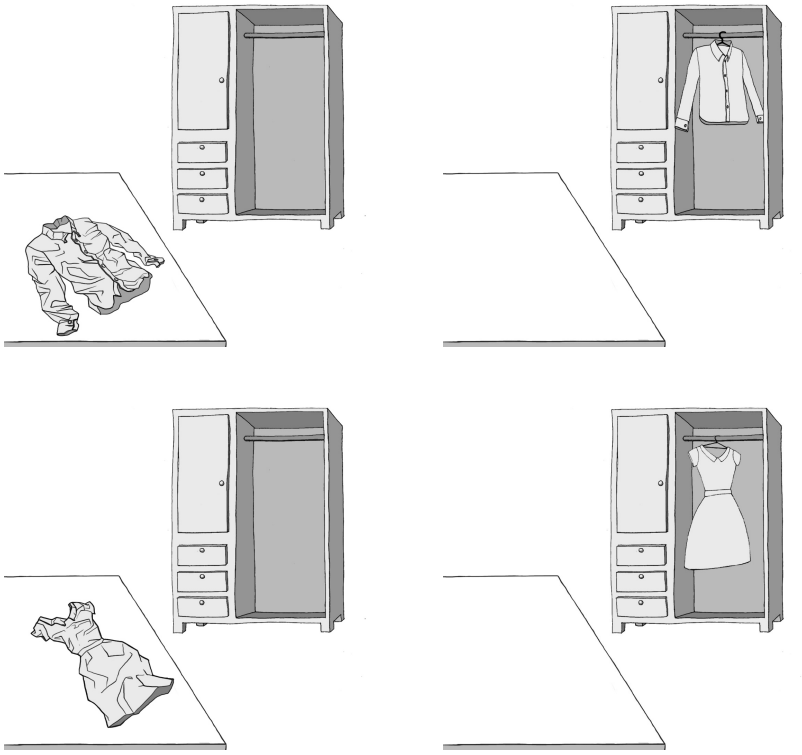

Figure 1: Counterfactual Test Stimuli: Gömleği ütüleseydi dolaba asardı 'If he had ironed the shirt, he would have hung it up in the closet'
(1) Target picture; (2) Action Unfulfilled distractor (picture in which the action mentioned was not fulfilled); (3) Lexical distractor (picture in which action was fulfilled, but the lexical item was incorrect); and (4) [Action Unfulfilled + Lexical] distractor (picture in which both the action was not fulfilled and the lexical item was incorrect).

comprehension in Broca's aphasia is influenced by morphosyntactic properties of sentence structure: conditionals that were morphosyntactically more complex than nonconditionals were more difficult to comprehend for them, supporting earlier data for Turkish (Yarbay Duman et. al., 2011). Furthermore, comprehending counterfactuals at the morphosyntax-semantics interface is particularly difficult for some individuals with Broca's aphasia. Thus, executive functions such as inhibition required for counterfactual thinking can also be a factor hampering their sentence comprehension ability.

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