CHAPTER 10

The Left Periphery and Agrammatism

Wh-extractions in Danish

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1. INTRODUCTION

Broca's aphasia is characterized by non-fluent, effortful speech and problems in the formation of grammatical strings due to improper use or non-use of function words such as auxiliaries, complementizers, prepositions, and verbal inflection. Most relevant for the present study, Broca's aphasia is also characterized by agrammatism, a severe CP-related deficit manifested as problems with for example relative clauses and questions. The syndrome is traditionally considered an expressive deficit, as the breakdown in production is most manifest. Indeed, Broca's aphasia was initially thought to be associated with impairment in speech production exclusively, and this modality was consequently assumed to reside in Broca's area in the left frontal lobe of the brain.

Syntax is relatively intact in agrammatic comprehension. Studies have demonstrated that agrammatic patients have preserved knowledge about the parts of the lexicon that interact with syntax, such as subcategorization, argument structure, and theta-role assignment; furthermore, they have little or no problems interpreting case and binding relations (for an overview, see Grodzinsky 2000:4). Comprehension problems arise with certain movement-derived structures, such as passives, *wh*-questions, and

clefts. However, since Caramazza and Zurif (1976) and Caplan and Futter (1986), it has been documented repeatedly that it makes a difference whether sentences are semantically reversible or not. *The girl pushed the boy* is reversible because both DPs (*the girl* and *the boy*) could be AGENTS, whereas *The woman drove the car* is irreversible because with *the car* being inanimate, only *the woman* is a possible AGENT. Agrammatic aphasics have no problems with movement-derived irreversible strings, such as *The car was driven by the woman*, probably because they can use semantics and world knowledge to infer which is AGENT and which is THEME. In reversible sentences, such as *The boy was pushed by the woman*, on the other hand, they do have problems, as access to syntactic information is required to interpret who did what to whom.

The 'standard' pattern of agrammatic comprehension is illustrated in Table 10.1 and is characterized by relatively preserved comprehension of structures with base order or subject extraction and impaired comprehension of structures involving object extraction resulting in non-canonical word order.

Agrammatic performance following this pattern has been reported for a wide range of languages, including Dutch (Bastiaanse & Edwards 2004), English (Caplan & Futter 1986), French (Caplan et al. 1985), German (Burchert et al. 2003), Hebrew (Friedmann & Shapiro 2003), Italian (Luzzatti et al. 2001), Serbo-Croatian (Lukatela et al. 1995), and Spanish (Beretta et al. 1999). There is thus a massive amount of data supporting the hypothesis that Broca's aphasia involves a syntactic deficit. Grillo (2008) proposed an extension of the empirical coverage of Rizzi's (1990) Relativized Minimality in order to account for this subject/object asymmetry: The hypothesis is basically that in agrammatism morpho-syntactic feature bundles are underspecified. As such, the feature-bundles of moving elements are potentially non-distinct from the feature-specifications

Table 10.1. THE 'STANDARD' COMPREHENSION PATTERN IN AGRAMMATISM

		Type	Comprehension
(1a)	The boy follows the woman	Active	ABOVE CHANCE
(1b)	The boy [OP_i that t_i follows the woman]	Subj relative	ABOVE CHANCE
(1c)	It is the boy [OP_i that t_i follows the woman]	Subj cleft	ABOVE CHANCE
(1d)	[The woman]$_i$ is followed t_i by the boy	Passive	CHANCE
(1e)	The woman [OP_i that the boy follows t_i]	Obj relative	CHANCE
(1f)	It is the woman [OP_i that the boy follows t_i]	Obj cleft	CHANCE

of many more potential interveners than normal and hence induce more locality violations (see also Friedmann, Belletti, & Rizzi 2009). However, a number of studies (cf. Hickok & Avrutin 1996; Thompson et al. 1999; Saddy 1995) have shown that syntactic movement of certain types of constituents does not inevitably result in a subject/object asymmetry or in chance-level performance. The following examples have all been found to yield near-normal performance:

(2a)	Who$_i$ t_i hit the woman?	(Subject *who*-question)
(2b)	Who$_i$ did the boy hit t_i?	(Object *who*-question)
(2c)	[Every woman]$_i$ was hit t_i by a boy.	(Passive with universal quantifier)

Grodzinsky (1995) noted that the *wh*-element in (2b) and the passivized quantified expression in (2c), which escape the standard pattern described already, have a property in common, namely, their lack of D(iscourse)-linking (Pesetsky 1987). To account for the pattern in Table 10.1 and the exceptions in (2 a-c), Grodzinsky (1995, 2000) proposed his highly influential *Trace Deletion Hypothesis* in (3):

(3) *Trace Deletion Hypothesis (TDH)* (adapted from Grodzinsky 1995:46)*:*
- (i) In agrammatic representation, traces in θ-positions are deleted (or are invisible to θ-role assignment).
- (ii) Referential Strategy:
  Assign a *referential* DP a role by its linear position iff it has no θ-role (DP_1=AGENT).

Note that the Referential Strategy applies to *referential arguments* (of the *which*-NP type) but not to non-referential *wh*-words (*who*) and not to adjuncts (*why*, *where*). In (2b), for example, the in situ subject in Spec-TP is assigned the θ-role AGENT; the fronted object is not assigned a θ-role via a chain because the trace is deleted, and because it is non-referential, it is not assigned a θ-role by the Referential Strategy either. Its role is inferred from intact lexical semantics and world knowledge.

Van der Meulen (2004) examined the comprehension deficits in French agrammatic patients. French is particularly interesting because it has optional *wh*-movement, and as such it is possible to test whether movement-derived structures are more impaired than otherwise parallel non–movement-derived structures:

(4a)	Le	roi	couronne	qui?	(Object in situ)
	The	king	crowns	who	
	'Who does the king crown?'				

(4b) Qui$_i$ est-ce que le roi couronne t_i? (Object moved)
Who Q the king crowns
'Who does the king crown?'

(4c) Qui$_i$ t_i couronne le roi? (Subject moved, null C°)
Who crowns the king
'Who crowns the king?'

(4d) Qui$_i$ est-ce qui t_i couronne le roi? (Subject moved, overt C°)
Who Q crowns the king
'Who crowns the king?'

Van der Meulen (2004) found that both subject and object questions were difficult for French-speaking Broca patients. In addition, she made three observations regarding this patient group. First of all, they understand *wh*-in-situ object questions (4a) significantly better than questions with overt *wh*-movement (4b). Secondly, subject *wh*-questions with either a null C° (4c) or an overt C° (*est-ce qui*) (4d) were understood equally well, indicating that length of movement as such is not the cause of the difference in performance on object questions in (4a) and (4b). Note that 'length' is a processing term referring to working memory, not to phrase structure; *est-ce qui* is longer than null, but structurally speaking the distance is the same. Finally, patients performed worse on subject questions than on object questions, which is remarkable considering that previous research usually found the opposite pattern. This is not accounted for by the TDH since movement of non-referential *wh*-elements, for example, *qui* in the subject question in (4c), also affects comprehension. In fact, a number of other studies have also reported no subject/object asymmetry (e.g., Fyndanis et al. 2010; Salis & Edwards 2008).

According to the Tree Pruning Hypothesis (TPH) (Friedmann 2001; Grodzinsky & Friedmann 1997), there is a correlation between structural position in the syntactic tree and level of impairment in agrammatic speech production, such that higher nodes, in particular CP, are more impaired than lower nodes (see also Hagiwara 1995). Friedmann (2008) argues in favor of extending the domain of the TPH to include language comprehension as well. An impaired CP layer results in reduced performance on, for example, *wh*-questions, topicalization, and clausal embedding, in particular those involving object extraction. In more severe cases, TP is also impaired, resulting in problems with tense inflection and with passives. It appears that CP is particularly 'vulnerable' in agrammatism (Platzack 2001) and that all operations dependent on C° are impaired; the comprehension problems may as such not

be due to the traces of movement but rather to the target of movement (see Christensen 2008).

2. EXPERIMENTS

Danish is an interesting object for the inquiry into the nature of the agrammatic comprehension deficit, considering previous findings indicating a deficit in movement to the left periphery. Given that Danish is a V2-language, it is standardly assumed that all main clauses involve movement to Spec-CP and C° (Vikner 1995); as such, all main clauses would also be predicted to be impaired under the TPH. Under the TDH (see (3)), on the other hand, agrammatic comprehension in Danish is predicted to manifest active/passive and subject/object asymmetries and a contrast between referential and non-referential *wh*-elements.

In order to test these hypotheses on data from Danish, three experiments were designed: Experiment 1 tested agrammatic comprehension of simple actives and passives and subject and object clefts. Experiment 2 tested (short) subject vs. object *wh*-movement in simple main clauses. Experiment 3 investigated short and long *wh*-movement and clefts with an additional overt *wh*-movement (combining the clefts investigated in experiment 1 and the *wh*-questions of experiment 2).

All three experiments were based on the same set of verbs, as shown in Table 10.2.

Each condition (e.g., active and passive in experiment 1) consisted of 19 semantically reversible sentences based on the set of verbs in Table 10.2.

Table 10.2. VERB TYPES AND TOKENS USED IN THE THREE EXPERIMENTS

Verb type	Tokens
Ditransitive[V DP DP] (*n* = 2)	*give* (give), *vise* (show)
Transitive[V DP] (*n* = 7)	*vaske* (wash), *fotografere* (photograph), *kysse* (kiss), *bære* (carry), *ae* (stroke), *slå* (hit), *omfavne* (embrace)
Transitive prepositional [V PP] (*n* = 10)	*følge efter* (follow after), *vinke til* (wave to), *se på* (look at), *smile til* (smile at), *pege på* (point at), *prikke til* (poke), *røre ved* (touch), *sparke efter* (kick at), *trække i* (pull at), *skubbe til* (push at)

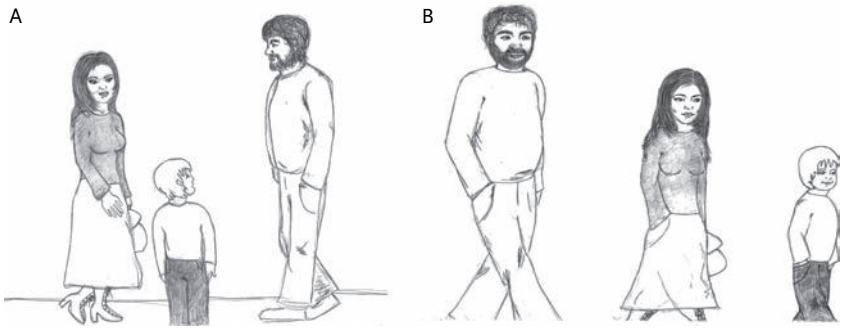

Figure 10.1: (A) The drawing for the sentences with the expression *se på* ('look at'). (B) The drawing for *følge* efter ('follow after').

Each verb was associated with one particular illustration printed on a sheet of A4 paper, such as the drawings in Figure 10.1 for the expressions *se på* ('look at') and *følge efter* ('follow,' literally 'follow after'). All illustrations portrayed scenarios involving the same three event participants: A man, a woman, and a boy.

In all three experiments, the patients listened to sentences and were required either to make a truth-value judgment about the match between sentence and drawing (experiment 1) or to point to a person in the drawing representing the answer to a *wh*-question (experiments 2 and 3).

2.1. Patients

The study involved four female, Danish-speaking aphasics who had all undergone language-related examinations and check-ups over an extended period of time (from several months to years). They were diagnosed as Broca's aphasics using the Danish version of the Western Aphasia Battery (WAB) (Pedersen & Vinter 2001). The etiology in all four patients included a lesion in the left frontal lobe. Participation was voluntary.

Prior to testing the agrammatic patients, the experiments were tested on a control group consisting of four neurologically intact, monolingual Danish-speaking women matched to the extent possible to the agrammatic patients on age and education. The control group performed at ceiling on all tasks (overall score 100%, 1216 correct responses/1216 trials).

Ethical approval for the experiment was acquired from the Central Denmark Region Committees on Biomedical Research Ethics.

2.2. Experiment 1

Experiment 1 was based on two research questions: (i) Do Danish-speaking Broca's aphasics perform worse on passives than actives? (ii) Is there a subject/object asymmetry in the comprehension performance on clefts? Results from previous studies on agrammatism in other languages suggest the answer to both is yes. The experiment was based on four conditions: simple active and passive sentences (5a)–(5b) and subject and object clefts (6a)–(6b):

(5a)	Kvinden kysser drengen. Woman-the kisses boy-the 'The woman is kissing the boy'	(Active)
(5b)	Drengen$_i$ bliver kysset t_i af kvinden. Boy-the is kissed by woman-the 'The boy is being kissed by the woman'	(Passive)
(6a)	Det er kvinden$_i$ [OP$_i$ der t_i kysser drengen]. It is woman-the that kisses boy-the 'It is the woman that is kissing the boy'	(Subject cleft)
(6b)	Det er drengen$_i$ [OP$_i$ kvinden kysser t_i]. It is boy-the woman-the kisses 'It is the boy that the woman is kissing'	(Object cleft)

The task in the experiment was a truth-value judgment task. For each picture, a sentence was read aloud and patients were asked to judge whether it was true or false for the scenario in the drawing. A nod indicated agreement ("true") on the part of the patient, whereas shaking of the head was used to signal disapproval ("false"). This procedure was employed instead of requiring a yes/no answer, because Broca's aphasics occasionally confuse

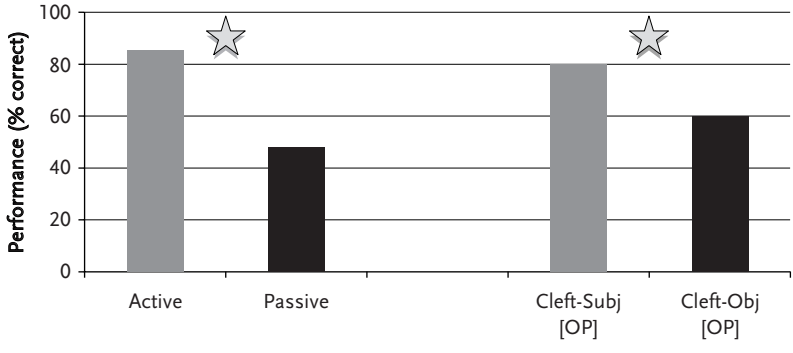

Figure 10.2: Average performance (% correct) across subjects in experiment 1. (A star indicates a statistically significant difference in performance.)

Table 10.3. PATIENT PERFORMANCE STATISTICS.

	Performance (% correct)						Statistical Differences		
	LM	KH	AM	MT	Mean	St.D.	From 100%	From chance	Between constructions
EXPERIMENT 1									
Active	57.9	89.5	94.7	100.0	85.5	3.5	**	**	$t = 5.22$,
Passive	42.1	52.6	47.4	52.6	48.7	5.0	**	n.s.	$p = 0.000$ **
Cleft OP-Subj	52.6	84.2	94.7	89.5	80.3	4.0	**	**	$t = 2.71$,
Cleft OP-Obj	42.1	73.7	57.9	68.4	60.5	4.9	**`	n.s.	$p = 0.008$ *
EXPERIMENT 2									
Who-Subj [-PP]	94.7	89.5	94.7	84.2	90.8	2.9	**	**	$t = -0.29$,
Who-Obj [-PP]	89.5	100	84.2	94.7	92.1	2.7	*	**	$p = 0.774$ n.s.
Who-Subj [+PP]	78.9	89.5	84.2	89.5	85.5	3.5	**	**	$t = -0.48$,
Who-Obj [+PP]	89.5	100	73.7	89.5	88.2	3.3	**	**	$p = 0.634$ n.s.
EXPERIMENT 3									
Short *wh*-Subj	42.1	52.6	42.1	21.1	39.5	4.9	**	n.s.	$t = -2.47$,
Short *wh*-Obj	68.4	47.4	57.9	63.2	59.2	5.0	**	**	$p = 0.015$ *
Long *wh*-Subj	26.3	52.6	31.6	36.6	35.5	4.8	**	n.s.	$t = -2.48$,
Long *wh*-Obj	36.8	73.7	57.9	52.6	55.3	5.0	**	**	$p = 0.014$ *
Cleft *Who*-Subj	42.1	47.4	36.8	52.6	44.7	5.0	**	n.s. (*)	$t = -1.96$,
Cleft *Who*-Obj	52.6	52.6	68.4	68.4	60.5	4.9	**	**	$p = 0.052$ n.s. (*)
Cleft *Which*-NP-Subj	52.6	73.7	36.8	31.6	48.7	5.0	**	*	$t = -1.64$,
Cleft *Which*-NP-Obj	63.2	78.9	52.6	52.6	61.8	4.9	**	**	$p = 0.104$ n.s.

P and *t*76-values from two-tailed independent-samples t-tests; equal variance not assumed. ** = $p<0.001$, *= $p<0.05$, n.s. = not significant ($p>0.05$), (*) = marginal ($0.050<p<0.053$). Note that chance level is defined as 50% in experiment 1, and as 33.3% in experiments 2 and 3.

yes and no in speech (Tanner 2008:209). As response choice in this experiment was binary (true/false), chance performance, reflecting a guessing strategy, was defined as 50%.

As illustrated in Figure 10.2, the results revealed a highly significant difference between actives and passive; see Table 10.3 for statistical details and individual performance levels. Performance was above chance (defined as 50%) on actives but below normal/ceiling performance (100%), whereas performance did not differ significantly from chance on passives. The same pattern was found for the clefts, that is, above chance (but below ceiling) performance on subject clefts and chance performance on object-clefts and a highly significant difference between the two (cf. Figure 10.2 and Table 10.3). In short, there was a highly significant subject/object asymmetry when comparing actives and passives and subject and object clefts; performance was above chance on subject extraction but at chance on passives.

2.3. Experiment 2

The aim of experiment 2 was to answer three questions: (i) Do Danish-speaking Broca's aphasics also exhibit the absence of subject/object asymmetry found in the comprehension of *wh*-questions by English-speaking patients (Hickok & Avrutin 1996; Thompson et al. 1999)? (ii) Does modifying the *wh*-word with a prepositional modifier have a significant effect on agrammatic comprehension? (iii) Is Danish agrammatic performance significantly different from chance on simple main-clause *wh*-questions?

The experiment consisted of four conditions: Simple subject and object *who*-questions with and without a prepositional modifier (PP):

(7a)	Hvem$_i$ ser t_i på manden? Who looks at man-the? 'Who is looking at the man?'	(*Wh*-Subject [-PP])
(7b)	Hvem$_i$ ser manden på t_i? Who looks man-the at? 'Who is the man looking at?'	(*Wh*-Object [-PP])
(8a)	[Hvem på det her billede]$_i$ ser t_i på manden? Who on this here picture looks at man-the? 'Who in this picture is looking at the man?'	(*Wh*-Subject [+PP])
(8b)	[Hvem på det her billede]$_i$ ser manden på t_i? Who on this here picture looks man-the at? 'Who in this picture is the man looking at?'	(*Wh*-Object [+PP])

The task in this experiment was a picture-pointing task. The patients listened to a sentence and were required to point to the person in the drawing corresponding to the *wh*-element. As response in this experiment and in experiment 3 involved choosing between three people in a drawing (the man, the woman, or the boy, cf. Figure 10.1), chance performance, reflecting random guessing, was defined as 33.3%.

The results are illustrated in Figure 10.3.

There was no significant performance difference between the presence of a PP modifier, (7a)–(7b), and absence of such a PP, (8a)–(8b), [+/–PP] (t_{152} = 1.29, p = 0.198). Performance on both subject and object *wh*-extraction was significantly above chance (but below 100%), but there was no significant difference between the two types of extraction within the individual [–PP] and [+PP] conditions (see Table 10.3); however, it is interesting to note that across conditions (7a) + (8a) vs. (7b) + (8b), there was a marginal effect (t_{152} = –0.55, p = 0.051), with object extraction being slightly better than subject extraction; see Figure 10.3.

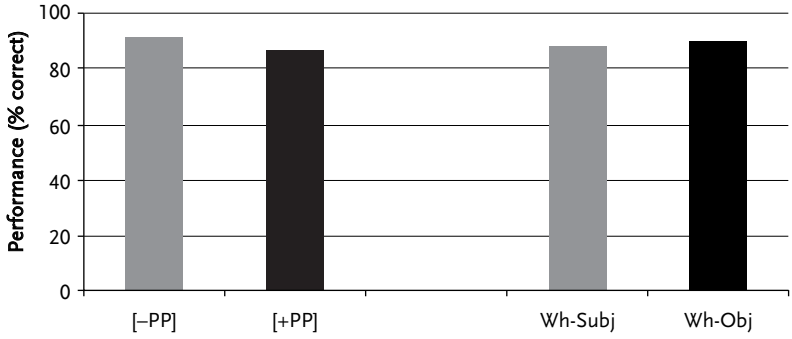

Figure 10.3: Average performance (% correct) across subjects in experiment 2.

In summary, patient performance did not display a significant subject/object asymmetry on *wh*-movement in simple main clauses (though there was a marginal effect). This result replicates the result in Hickok and Avrutin (1996) and Thompson et al. (1999). Furthermore, adjoining a PP to the *wh*-word had no significant effect, suggesting that the length of the *wh*-phrase per se is not a significant factor. The results on all conditions in this experiment were significantly above chance-level (but significantly below normal).

2.4. Experiment 3

As in experiment 2, experiment 3 consisted of a picture-pointing task. There were three research questions: (i) Does performance on sentences with an embedded clause show the same subject/object asymmetry as the clefts in experiment 1, or is there no difference between subject and object extraction, as was the case in experiment 2? (ii) Is there a difference between structures with referential (D-linked) *which*-NP and questions with non-referential (non-D-linked) *who* (Hickok & Avrutin 1996)? Finally, (iii) is there a difference between short and long *wh*-extraction?

There were eight conditions in experiment 3, all consisting of complex sentences with embedded clauses headed by the verbs in Table 10.2: short *wh*-extraction (9 a,b); long *wh*-extraction (10 a,b); *who*-clefts (11 a,b); and *which*-NP-clefts (12 a,b):

(9a) Vis mig [hvem$_i$ der t_i vinker til kvinden]. (Short Subj-extraction)
Show me who that wave to woman-the
'Show me who is waving to the woman'

(9b) Vis mig [hvem$_i$ kvinden vinker til t_i]. (Short Obj-extraction)
Show me who woman-the waves to
'Show me who the woman is waving to'

(10a) Hvem$_i$ mener du [t_i der t_i vinker til kvinden]? (Long Subj-extraction)
Who think you that waves to woman-the
'Who do you think is waving to the woman?'

(10b) Hvem$_i$ mener du [t_i kvinden vinker til t_i]? (Long Obj-extraction)
Who think you woman-the waves to
'Who do you think that the woman is waving to?'

(11a) Hvem$_i$ er det t_i [OP$_i$ der t_i vinker til kvinden]? (*Who*-Subj-cleft)
Who is it that waves to woman-the
'Who is it that is waving to the woman?'

(11b) Hvem$_i$ er det t_i [OP$_i$ kvinden vinker til t_i]? (*Who*-Obj-cleft)
Who is it woman-the waves to
'Who is it that the woman is waving to?'

(12a) [Hvilken person]$_i$ er det t_i [OP$_i$ der t_i vinker til kvinden]?
Which person is it that waves to woman-the
'Which person is it that is waving to the woman?' (*Which*-NP-Subj-cleft)

(12b) [Hvilken person]$_i$ er det t_i [OP$_i$ kvinden vinker til t_i]?
Which person is it woman-the waves to
'Which person is it that the woman is waving to?' (*Which*-NP-Obj-cleft)

In experiment 3, performance was above chance in all conditions except short and long subject extraction where performance was at chance level. As illustrated in Figure 10.4, there was a significant subject/object asymmetry in short as well as long *wh*-extraction. Performance on subject extraction was significantly poorer than on object extraction (Table 10.3). There was no difference between short ((9a)–(9b)) and long extraction ((10a)–(10b)) ($t_{152} = 0.69$, $p = 0.492$).

In both the *who*-clefts and the *which*-NP-clefts, there was no significant difference between subject extraction and object extraction (though there was a marginal effect for *who*-clefts). Because there was no significant difference between *who*-clefts and *which*-NP-clefts ($t_{152} = -0.46$, $p = 0.647$), the two are collapsed in Figure 10.4.

In summary, agrammatic comprehension of complex sentences showed an unexpected subject/object asymmetry. The difference between subject and object extraction was significant in two of four conditions, namely, short and long extraction, but not in the *who*-clefts and *which*-NP-clefts. Hence, short (embedded) *wh*-movement exhibited the inverse pattern of experiment 1, both patterns different from the one found for short main-clause *wh*-movement in experiment 2. Furthermore, there was no significant subject/object asymmetry in the clefts, and *who*-clefts did

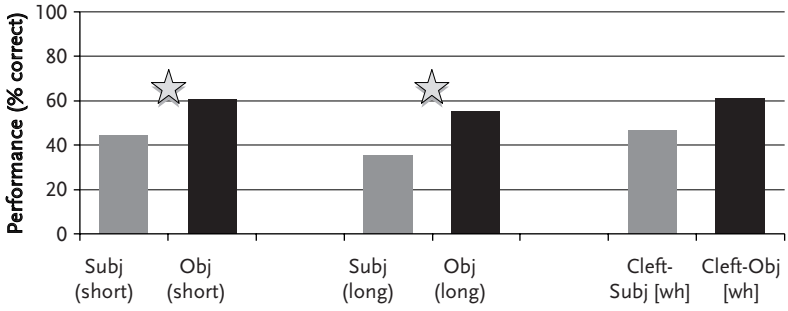

Figure 10.4: Average performance (% correct) across subjects in experiment 3. (A star indicates a significant difference in performance.)

not differ significantly from *which*-NP-clefts, similar to the pattern for main-clause *wh*-movement in experiment 2. That is, there was no difference between movement of D-linked and non–D-linked *wh*-elements. Finally, there was no significant difference in performance between short and long *wh*-extraction.

3. DISCUSSION

Our analysis of the overall pattern (performance on simple main clauses below normal but above chance and significantly better than on sentences with clausal embedding) is based on the syntax of Danish being V2 and the particular vulnerability of CP in aphasia (cf., e.g., Friedmann & Grodzinsky 1997; Friedmann 2001, 2002, 2008; Platzack 2001; Hagiwara 1995). In V2 languages, all main clauses involve movement to CP, including head movement to C°. That means that any constituent preceding the finite verb in a main clause is in Spec-CP. If the presence of a CP causes comprehension problems, it follows that one CP is bad, but two is worse.

However, the CP layer in main clauses would seem to be less impaired than the one in embedded clauses. Performance on subject-initial main clauses (the active sentences in experiment 1 and *wh*-questions in experiment 2), where the subject is in Spec-CP, is above chance and better than performance on object-initial main clauses. In embedded clauses, this asymmetry is reversed, and subject extraction yields chance performance while object extraction is above chance. In other words, the presence of a CP in itself does not predict the level of performance; what matters, it seems, is whether or not it is embedded (we will return to this shortly).

The reduced performance on main clauses (i.e., that performance is below ceiling) may in fact not be due to a linguistic impairment per se (e.g.,

related to main-clause C°); it is also possible that it has to do with limited general cognitive resources, such as attention and working memory, resulting from brain damage (cf. e.g. Avrutin 2000).

The performance pattern on the active/passive contrast shows an asymmetry with actives above chance level and passives at chance level, which is predicted by the TDH (e.g., Grodzinsky 2000). Furthermore, the symmetric performance on simple main-clause *wh*-questions in experiment 2 also fits the TDH; since *hvem* 'who' is non–D-linked (non-referential), it is exempt from the Referential Strategy (see (3)), and its θ-role is inferred from lexical and world knowledge and from the fact that the other argument DP is assigned a θ-role syntactically. This predicts above chance level results on both subject and object extraction. However, there is no effect of D-linking (referentiality) in the clefts in experiment 3; that is, there is no significant difference between fronting a *who* argument and a *which*-NP argument. This suggests that D-linking is not relevant to the level of performance in experiment 2. (As D-linking is not related to the properties of C°, this does not follow from a difference between main clause and embedded CP). Since the Referential Strategy is not applicable to *wh*-movement in this study, neither is the rest of the TDH.

The hypothesis we propose here is that type of movement is relevant to performance levels. That is, it is crucially important whether the structure involves A-movement or Ā-movement. For experiment 1, it is obvious that the active/passive contrast involves A-movement, but not for the clefts; for now we shall assume it. Experiment 2 and 3 involve Ā-movement in the form of *wh*-movement. The distinction between the two types of movement is linguistically motivated (cf., e.g., Rizzi 1990, 2001). However, the A vs. Ā distinction is also observed in recovery from aphasia. Thompson and Shapiro (2007) found constrained generalization in training patients with agrammatism. Training on raising constructions displayed generalization to untrained structures with passivization, that is, from more complex A-movement to less complex A-movement. Likewise, training on more complex Ā-movement, such as *wh*-movement in relative clauses, displayed generalization to untrained less complex Ā-movement, such as *wh*-movement in main clause questions. Crucially, though, there was little or no generalization between A- and Ā-movement.

In the present study, A-movement is more impaired than Ā-movement, cf. the fact that passivization leads to chance performance, whereas this is not necessarily the case with *wh*-movement; as we shall argue, other factors influence performance on *wh*-movement. (Note that the idea that

A-movement can be more impaired than Ā-movement runs contra to the general spirit of Friedmann's TPH; the position targeted by *wh*-movement, Spec-CP, is higher in the tree than the position targeted in passivization, Spec-TP, and the TPH predicts higher nodes to be more impaired than lower nodes.)

The TDH is relevant only for A-movement (experiment 1), not for Ā-movement (experiments 2 and 3). That is, traces are deleted, and the Referential Strategy (DP_1=AGENT) applies. Traces of *wh*-elements, on the other hand, are not deleted. Furthermore, overt *wh*-elements are salient and available as operators, in line with Rizzi's (1996:70) proposal that only moved *wh*-phrases are *wh*-operators, whereas *wh*-phrases in situ are not. This means that overt *wh*-operators signal the presence of a *wh*-chain and 'prime' (activate) the traces and, in the case of clefts, the empty operator OP in Spec-CP.

There was no significant difference between short extraction (within the embedded clause) and long extraction (out of the embedded clause) in experiment 3. That is, it does not matter whether *wh*-movement is within or out of the embedded clause, and, hence, length of movement is not important. However, the embedded clause in itself is difficult to process. It is thus important to distinguish between main clause and embedded clause. The embedded CP layer is impaired which causes performance to plunge (compare Figures 10.3 and 10.4). In main clauses, because Danish is V2, the finite verb moves to C°; in the current set of experiments, the finite verb is the main verb, that is, a lexical verb. A potential reason for why embedded CPs are much more impaired than main clause CPs could be that main clause C° contains a lexical verb, whereas in embedded clauses C° is either headed by an overt functional element (*der*) or is phonetically silent. Our hypothesis is that the lexical verb, being merged as the head (V°) of an unimpaired verbal projection where it is able to license the object, is also able to license the subject or the trace of the subject in Spec-TP when the verb is moved to the impaired C°. Merging the complementizer *der* as the head of impaired C° has no remedying effect on licensing.

A third important distinction is the one between subject and object as evidenced by the asymmetric performance levels in experiments 1 and 3. Interestingly, the pattern in Figure 10.4 bears a striking resemblance to the subject/object asymmetry characteristic of the **that*-trace paradigm (13 a,b) and certain extractions from *wh*-islands (14 a,b). (On licensing of Spec-TP under proper government, see Rizzi 1990:29–35, 2001:104–108.)

(13a) *[Who]$_i$ did she say [t_i that t_i knew him]? (Subject extraction)
(13b) [Who]$_i$ did she say [t_i that she knew t_i]? (Object extraction)

(14a) *[Who]$_i$ did they ask [where t_i met that man]? (Subject extraction)
(14b) (?)[Who]$_i$ did they ask [where she met t_i]? (Object extraction)

Although the subject extractions in (6a), (11a), and (12a) actually contain a complementizer, namely, *der*, we assume that this complementizer does not trigger *that*-trace effects because it only occurs in subject extractions, that is, only when a *that*-trace effect needs to be averted. In other words, following Vikner (1991:123–125), we assume an analysis of subject extractions with *der* completely parallel to Rizzi's (1990:51–60) analysis of French subject extractions with *qui* and West Flemish ones with *die*.

As we have argued, it is necessary to distinguish between A- (passivization) and Ā-movement (*wh*-movement); the former is subject to TDH, the latter is not. The traces of *wh*-movement are not deleted, but the licensing of the trace positions is important. The head of the embedded CP is impaired, and as such it has lost its ability to license Spec-TP as a trace position. This renders subject extraction highly problematic, since the subject trace in Spec-TP is unlicensed, compared with object extraction where the object trace in the base position of the object is licensed by V°.

As illustrated in Figure 10.5A, object extraction in an embedded clause results in reduced performance; the problem is not the *wh*-operator, which is not impaired, but the CP layer which is projected from the impaired C°. Subject extraction, on the other hand, as illustrated in Figure 10.5B, is more difficult, because in addition to the impaired CP, the trace in Spec-TP is not licensed, resulting in chance-level performance.

In recent minimalist syntax (e.g., Chomsky 2005), it is argued that T° 'inherits' its φ-features from C°. Our account is compatible with the assumption that the embedded C° is underspecified with respect to φ-features which prevents inheritance to T°. Our analysis is also compatible with a cartographic approach to the left periphery where CP is split

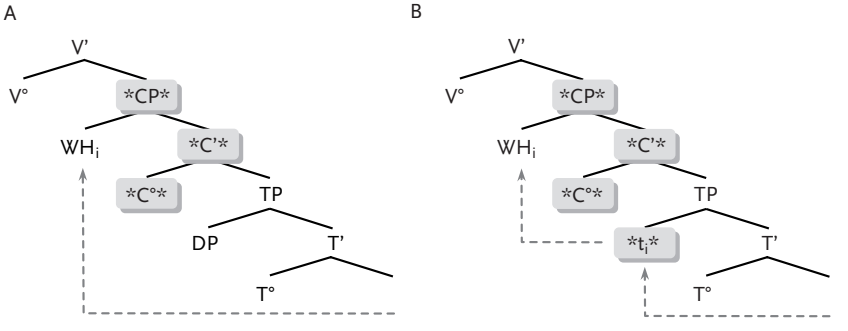

Figure 10.5: (A) Non-subject *wh*-movement to the specifier of an impaired CP. (B) Subject *wh*-movement to impaired CP. The asterisks indicate impaired nodes.

into ForceP-TopicP-FocusP-FinP (Rizzi 2001). Force° houses the complementizer, Topic° attracts the Topic to Spec-TopicP, Focus° triggers *wh*-movement to its specifier, and Fin° licenses Spec-TP. In order to account for the data presented here, it could be argued that Focus° is unimpaired, since *wh*-movement in itself is unproblematic, whereas Fin° is impaired and thus fails to license Spec-TP as a trace position; Force° is also impaired, resulting in reduced performance on embedded clauses.

Previously, it was assumed that the clefts in experiment 1 were treated as instances of A-movement. Normally, clefts are analyzed as involving movement of an empty operator OP to Spec-CP in the embedded clause, as illustrated in (11) and (12). The assumption here is that the agrammatic patients reanalyzed the object clefts as passive constructions. Since OP is non-overt, it does not signal the presence of a *wh*-chain, and 'prime' (activate) the traces. Furthermore, the complementizer *der* is impaired. Since clausal embedding is difficult, the string is treated as a simple main clause. The expletive *det*, the copula verb *er*, and the impaired complementizer *der* are simply not parsed, resulting in reduced clauses as illustrated in (16a) and (16b). The reduced subject cleft, (16a), looks like a normal simple transitive clause, whereas the reduced object cleft, (16b), is ungrammatical (the verb is not in V2):

(16a) ~~Det~~ ~~er~~ kvinden$_i$ ~~OP~~$_i$ ~~der~~ t_i kysser drengen (Agrammatic subject cleft)
~~It~~ ~~is~~ woman-the ~~that~~ kisses boy-the
'It is the woman that is kissing the boy'

(16b) ~~Det~~ ~~er~~ drengen$_i$ ~~OP~~$_i$ kvinden kysser t_i (Agrammatic object cleft)
~~It~~ ~~is~~ boy-the woman-the kisses
'It is the boy that the woman is kissing'

The remaining words in (16a) are thus taken to form a simple subject-initial transitive main clause, and θ-assignment is unproblematic (since the object is in situ). In the reduced object cleft in (16b), the residue forms a(n ungrammatical) main clause with two referential DPs preceding the verb; as both have undergone movement, their traces are deleted, and since both are referential, the Referential Strategy applies to both. Consequently, the first DP is assigned AGENT, and the second DP is assigned THEME by linear considerations. This assignment predicts performance to be below chance (in (16b), the correct θ-assignment is THEME-AGENT, the reverse order of the agrammatic assignment), which is not observed. However, the fact that the residue (the non-struck-out words in (16b)) is not grammatical may be the cause of the asymmetry; the idea is that more often than not, the ungrammaticality is detected, and the second DP is taken to be the subject and AGENT, and the first DP to be a fronted object THEME. The assumption

that, in some cases of agrammatism, expletive subjects, copula verbs, and empty operators are not parsed, is compatible with the fact that agrammatic speakers often leave out function words in production; it is also compatible with the general spirit of the TDH, since both OPs and traces are empty categories.

The *wh*-clefts in experiment 3 cannot be accounted for with the same analysis (i.e. that *wh*-clefts are reanalyzed as simple clauses). Performance on *wh*-clefts is significantly lower than on the *wh*-questions in experiment 2, suggesting that *wh*-clefts are in fact parsed as involving clausal embedding. Furthermore, since performance is symmetric, they are not treated as instances of long extraction. *Wh*-movement is in the matrix clause (as in experiment 2), not within or out of the embedded clause, which would have resulted in asymmetric performance, as with long and short extractions in experiment 3. As argued already, overt *wh*-elements signal the presence of a chain and activate the relevant traces and empty operators. However, performance on *wh*-clefts is symmetric, but it is predicted to be asymmetric due to the unlicensed trace in Spec-TP in subject clefts. If the OP stays in Spec-TP in subject clefts, the pattern is accounted for. This assumption, however, is not trivial, and we leave it to future research to solve this remaining problem.

4. CONCLUSIONS

The account of the performance pattern of the four agrammatic patients in this study is based on three crucial distinctions:

Distinction 1: A-movement vs. A-bar-movement (*wh*-movement). A-movement is impaired, hence, the classical asymmetry between active and passive. *Wh*-movement, on the other hand, is not impaired as such. *Wh*-movement in main clauses is symmetrical with respect to subject vs. object extraction, whereas *wh*-movement in embedded clauses is asymmetrical. D-linking (referentiality) is not a relevant factor, since there is no difference between the expressions *who* and *which*-NP in experiment 3. Hence, the above-chance performance on main clause *wh*-movement in experiment 2 is not due to *hvem* 'who' being non-referential (non–D-linked).

Distinction 2: Main clause CP vs. embedded clause CP. Even in simple main clauses, agrammatic performance is below ceiling. Because Danish is a V2 language, all main clauses involve head movement to C° and phrasal movement to Spec-CP (except possibly in *yes/no*-questions). If CP is impaired (underspecified with respect to ϕ-features), performance on all

clauses is predicted to be below normal/ceiling, which indeed is what is observed; performance is below ceiling but above chance. Embedding a CP further reduces performance significantly, although it generally remains above chance. In other words, two CPs are worse than one CP, and the main clause CP is less impaired than the embedded CP.

Distinction 3: Subject vs. object. For *wh*-movement, the licensing of trace positions is important. The embedded C°, being impaired, is unable to license Spec-TP as a trace position; hence, performance on subject *wh*-movement in embedded clauses is at chance level and significantly poorer than on object *wh*-movement (where the trace position is licensed by V°).

Together these distinctions provide an account of the asymmetry in A-movement (passivization) and symmetry in Ā-movement (*wh*-movement) in main clauses as well as the inverse pattern (subject extraction more impaired than object extraction) in embedded *wh*-movement resembling the **that*-trace pattern.

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