Experimental evidence for the Subject Rule

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## 1.	Introduction

Theories of formal discourse representation (e.g. Ariel 1990, Grosz et al 1995) have proposed that assignment of reference to a pronominal element in ambiguous contexts, follows a rule-guided ranking of the candidate NP's. The purpose of this paper is to experimentally evaluate this proposal regarding one such ranking rule, to which we will refer as the *subject rule*. Both Ariel's (1990) theory of accessibility and Centering Theory (Grosz et al 1995) state that an NP in a subject position is ranked higher, all things being equal, than an NP in the object (or any other syntactic) position. Using an experimental comprehension task, we show that indeed, in cases of uncertainty, NP's in subject position are selected more often as the reference of a pronominal element. Furthermore, the same task was conducted with 18 preschool children and 7 aphasic patients. The results show that also children and aphasics make use of the *subject rule* to select between competing antecedents. These findings contribute to the conclusion that the *subject rule* plays a significant role in discourse reference assignment and that it is a fundamental rule which appears early in acquisition and remains intact in cases of language breakdown.

## 2.	Theoretical background

Unlike full NP elements and proper names, pronominal elements (*he, she,* etc.) are by definition void of semantic content. In order to be interpreted, a relation of dependency must be established between these elements and full NP's that appeared earlier in the discourse. This is demonstrated in (1) below:

(1)   Mary lives in New-York city.
        She works in a law firm.

The pronoun *she* in (1) is interpreted as referring to *Mary*, in this case, since *Mary* is the only NP candidate for reference in the discourse segment. When more then one NP, that matches the pronoun in gender and number, appears in the discourse preceding the pronoun, the interpretation of the sentence is ambiguous. This is demonstrated in (2) below:

(2)   Mary shares an apartment with Barbara.
        She works in a law firm.

In (2), the pronoun *she* can in principle refer to either *Mary* or *Barbara.* This ambiguity is demonstrated in (3a,b) through additional information that disambiguates the choice of reference to each of the options:

(3)a.   Mary shares an apartment with Barbara.
        She works in a law firm and returns home late every evening.
        Barbara is currently unemployed and is home most of the time.

   b.   Mary shares an apartment with Barbara.
        She works in a law firm and returns home late every evening.
        So basically Mary has the place for herself most of the time.

The examples in (3) above show that indeed at the point of the second sentence in which the pronoun appears, the interpretation is open and both NP candidates are valid for supplying a reference. These examples also demonstrate that the context (in these cases the third sentence) can strongly affect the choice of reference and disambiguate the interpretation. When looking at the whole discourse segment, in both 3a and 3b there is only one possible reference for the pronoun, in 3a – Mary, and in 3b – Barbara.

Our topic of investigation in this paper concerns cases such as (2) above where ambiguity exists. Most speakers, although acknowledging the ambiguity in (2) have a preference for interpreting *Mary* as the reference of the pronoun. In the recent decades several theories have been proposed to explain and formalize this preference that speakers seem to have towards one of competing NP antecedent candidates. Such theories (e.g. Chafe 1976, Givon 1983, Levinson 1987, Ariel 1990, Gundel et al. 1993, Grosz et al 1995, Walker et al. 1998), attempt to predict which of several possible antecedents will be preferred in a certain context. Several of these theories assume for this purpose a ranking procedure, based on which the possible NP antecedents are put in a hierarchical order of preference. One rule that was suggested to be a part of the ranking procedure is the *subject rule*, put forth explicitly by Ariel (1990) and within the centering framework by Walker et al. (1998) and adopted implicitly in many studies. This rule explains the preference that speakers admit to in (2) above, by the fact that the preferred antecedent (*Mary*) is in subject position and thus ranked higher than its competitor (*Barbara*), which is in object position.

Evidence for the validness of the *subject rule* comes from speaker's judgements of discourse coherence and from corpus studies which show that in both spoken and written language a pronoun, which is preceded by two gender/number matching NP's, is more likely to refer to the NP in subject position. An additional type of evidence for the validity of the subject rule is given in Grosz et al (1995) who shows that even in cases where speakers show little or no preference for the NP in subject position, such preference can be uncovered through judgements of utterances that follow the relevant pronoun. This is demonstrated below in an example taken from Grosz et al (1995).

(4)   a. Susan gave Betsy a pet Hamster

        b. She reminded her that such hamsters were quite shy

At this point, Grosz et al report that many people did not show a clear preference towards the subject antecedent (*Suzan*) as would be expected from the *subject rule*. However when a third utterance was added it drastically affected people judgments and revealed that a hidden preference for the subject-antecedent was present from the moment the pronoun was presented. This is demonstrated below:

(5)   a.   Susan gave Betsy a pet Hamster

          b.   She reminded her that such hamsters were quite shy

          c.   She asked Betsy whether she liked the gift

          c.'   She told Suzan that she really liked the gift

The authors report that people's judgments changed into disfavoring and sometimes rejecting sentence (5c'). If at the point of the second utterance there was no preference towards *Suzan* as antecedent, we should have expected no difference between 5c and 5c'. The fact that such preference is attested can be taken as evidence that in fact from the beginning *Suzan* was ranked higher then *Betsy* as a possible antecedent, based on the *subject rule.*

Many authors have noticed that the subject rule can be 'overridden' by other principles and by pragmatic factors. That is, the theories of discourse mentioned above do not predict that a preference for the subject antecedent always exists. We have already seen in (3b) above that certain context can create an almost obligatory reference to the non-subject antecedent. More examples are given below:

(6)   a.   Mary gave Barbara a present

          b.   She thanked her

In (6), pragmatic considerations (e.g. people thank people that give them presents) divert the preference towards the non-subject antecedent. Example (7) below, is an even stronger case of pragmatic 'overriding':

(7)   a.   John pushed Bill off a cliff

          b.   He died instantly

Other cases in which the *subject rule* does not hold are when another discourse-related rule dictates the choice of antecedent. Two examples, which will be relevant to the experimental study reported in this paper, are presented below:

(8)   Parallelism:
      a.   First John pushed Bill
      b.   And then Mary pushed him

The discourse rule of *parallelism* (Akmaijan and Jackendoff 1972) dictates that in certain cases, which are characterized by continuance in time and action, the NP in a syntactic position parallel to that of the pronoun will be favored as the antecedent of that pronoun. When the pronoun is in subject position there is no conflict with the *subject rule* but when the pronoun is in object position, as in (8), the two rules conflict and the *Parallelism rule* seems to come with the upper hand, as most people interpret the pronoun as referring to Bill. In (9) below, the *parallelism rule* itself seems to be 'overridden' by another rule of *contrastive stress*.

(9)   Contrastive stress:
      a.   First John pushed Bill
      b.   And then Mary pushed HIM

Applying a contrastive stress intonation to the pronoun in (9b) creates a shift in the choice of reference that is dictated by the parallelism rule. In (9) therefore, the pronoun is judged as referring to *John*. Although in (9) the preferred antecedent is in subject position, this is not due to the *subject rule*. This is demonstrated in (10) where the contrastive stress on the pronoun shifts the reference in the other direction - from the subject *john* (which is dictated by parallelism) to object *Bill*.

(10)   Contrastive stress – pronoun in subject position:
      a.   First John pushed Bill
      b.   And then HE pushed Mary

We have seen therefore several cases in which the *subject rule* fails to predict the correct antecedent. These cases are sometimes treated as cases in which the subject rule is overridden by other factors and principles. Another way to look at these examples, however, is to say that the subject rule is a default rule that kicks in only when no other

rule can select among the competing antecedent candidates. In this way there is no need to assume that rules can be overridden and no conflicts arise. Note that this view of the subject rule is different than the one proposed in e.g. accessibility theory or centering theory, where the subject rule is one among several rules that guide the ranking of NP's. Viewing the subject rule as a default rule that applies only to cases of uncertainty, affects the manner in which evidence for the rule's validity should be obtained. In natural occurring speech or in written text, which are used in corpus studies, the relation between the pronoun and the antecedent reflect the intentions of the speaker/writer rather than the interpretation of the reader and therefore the prominence of subject antecedents in these studies does not necessary support the *subject rule* as a default rule. Furthermore examples taken from such corpuses can never be totally disconnected from pragmatic influence, which has a potential effect on the interpretation as we have seen above. Support from judgements of discourse coherence do reflect the rules that people apply for interpretation of pronouns but they, too, cannot be totally 'clean' of pragmatic influence. Additionally, these examples are usually not quantified and only a limited number of examples are presented to a limited number of people.

In this paper we choose a different approach to support the validity of the subject rule. Instead of looking at cases that seem to be resolved by the *subject rule* alone (e.g. (2) above) we study the errors that people make in cases that are dominated by other rules (e.g. (8)-(10) above). If the subject rule is indeed a default rule, than we can expect it to affect the type of errors that people make. Specifically we look at people's responses to structures governed by the parallelism and the contrastive stress rules presented in (8)-(10) above, in which the pronoun can appear both in subject and object positions, entailing a different interpretation in each case. The view of the subject rule as a default rule makes the prediction that the errors people make in these structures, should take an asymmetrical form – people are expected to more often select the subject antecedent instead of the object antecedent than vise versa. The reasoning is that when people fail to apply the parallelism or contrastive stress rules, they have no guidance with respect to selecting the reference. In these cases they will apply the subject rule and select the antecedent in subject position. The result is that more errors are expected to be made in cases where the parallelism/contrastive stress rule point to an antecedent in the object position.

In the next section we present an experimental study that puts this prediction to a test.

3. The experiment

The purpose of the experiment is to supply evidence in support of the view that the *subject rule* operates as a default rule. As argued above, this view can be best supported if the sentences presented to the participants are governed by a different rule which predicts a clear choice of antecedent and then expecting that when participants fail to apply this rule, they will make use of the default *subject rule* instead.

For that purpose the two discourse rules of *parallelism* and *contrastive stress* were chosen. The advantage of these rules is that they both include variants that point to either subject and object antecedent. This is demonstrated below:

(11)   a.   *Parallelism – subject pronoun*
        First John hit Bill and then he hit Mary   (he=John)
        b.   *Parallelism – object pronoun*
        First John hit Bill and then Mary hit him   (him=Bill)

(12)   a.   *Stress – subject pronoun*
        First John hit Bill and then HE hit Mary   (HE=Bill)
        b.   *Stress – object pronoun*
        First John hit Bill and then Mary hit HIM   (HIM=John)

Using these four constructions in an experimental design enables us to evaluate the process of antecedent selection while controlling the context and other factors that affect this process, a feature that was missing in previous studies.

The experiment was conducted in Dutch, with three populations of participants: adult speakers, preschool children and agrammatic aphasics. The assumption is that if the *subject rule* is indeed a fundamental default rule, its effect might be visible also in these populations.

Our purpose here is not to evaluate participants' performance of these constructions but only to look at the errors they make. That is, cases in which they fail to select the

antecedent expected in (11a-b) and (12a-b) respectively. The subject rule predicts that such errors will occur more often in (11b) and (12a) since in these structures the correct antecedent is the object and obeying the subject rule leads to an error.

Subjects:

14 adults, 18 children and 7 aphasic patients participated in the study[1]. All were native Dutch speakers.

Materials and design:

A picture selection task was used to evaluate the participants' interpretation of the constructions under discussion. The participants were orally presented with a sentence representing one of the four conditions in (11a-b) and (12a-b) accompanied with a set of three pictures. One picture showed a scenario in which the subject NP is the antecedent, a second picture showed a scenario in which the object NP is the antecedent and a third showed a different action taking place – functioning as a filler.

The non-brain-damaged adults were presented with 6 items for each condition, the children with 12 per condition and the aphasics with 15 items per condition. For each sentence a correct response was recorded when the participant pointed to the picture that represented the correct antecedent as indicated in (11) and (12)[2].

Results:

Table 1 presents the total number of errors that were made by each group for each condition.

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[1] In order to avoid a possible influence of memory limitations (e.g. when children/aphasics are unable to hold the first NP – which is always the subject – long enough in their working memory) we selected for the current analysis only participants that showed good (above 50%) correct performance on the parallelism constraint. 10 children (out of 28) were excluded for that reason. All adults and aphasic patients showed good performance on parallelism)

[2] The items were part of a bigger task in which more conditions (pronouns in simple transitive or exceptional case marking constructions) were examined. The conditions presented here were mixed with these other conditions.

Table 1   number of errors per condition

Rule:	Parallelism		contrastive stress	
Antecedent:	subject	object	subject	object
adults	3	8	23	12
children	82	92	111	95
aphasics	22	44	60	45

In table 2, the errors are divided into two groups based on the expected (correct) antecedent.

Table 2   number of errors divided by the expected antecedent

	Expected antecedent		
	object	subject	Total errors
adults	31	15	46
children	203	177	380
aphasics	104	67	171

Figure 1 below shows the relevant proportion of each error in each group

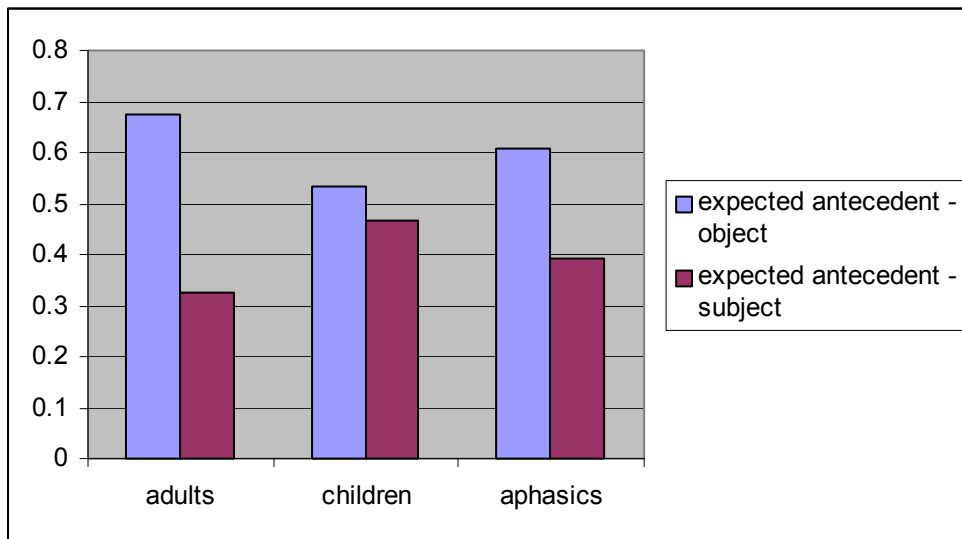Figure 1 proportion of errors by expected antecedent

Figure 1 reveals that more errors were made when the expected antecedent was an object. A statistical analysis of these differences shows that this different is significant for all three population groups[3](for the non-brain-damaged adults: t(13)=2.23, p=0.02,

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[3] For adults and children a t-test was used to calculate significance. For the aphasics whose low number requires a non-parametric test, a chi-square test was used. The p values are calculated based on one-tailed probability, as previous studies and the current hypothesis make a clear one-sided prediction.

for the children: t(17)=1.98, p=0.03 and for the aphasic patients: chi-square=13.5, p=0.0003).

An analysis of the individual results shows that 13 of the 14 adults, 12 of the 18 children and 5 of the 7 aphasic patients conform to the predicted response pattern of selecting more often the subject antecedent and thus making more errors when the expected response was an object antecedent.

Discussion

The results of all three populations confirm our prediction that when errors are made in selecting an antecedent for a pronoun, the subject antecedent will be more often selected based on the default *subject rule*. These results join therefore the existing data from corpus analysis and from speakers' judgements of discourse coherence in supporting the validity of the *subject rule*. The current results further support the view that this rule should not be seen as one among several rules of ranking antecedents but rather as a more fundamental rule which operates as a default when no further guidance is available for selecting the antecedent. The fact that also pre-school children and aphasic patients make use of this default rule supports the claim that it is more fundamental then other rules of discourse reference (as parallelism and contrastive stress themselves) which are known to create difficulties for these populations.

Our account of the current results is therefore as follows: the children and also the aphasic patients have some knowledge of the parallelism and contrastive stress rules, as indicated by the fact that they do not treat all conditions equally. If they are completely insensitive to contrastive stress, for example, one would expect them to treat conditions (12a) and (12b) as the (unstressed) parallelism conditions (11a) and (11b). This would lead to a (close to) 100% incorrect score, and this is clearly, not what we find. Nevertheless the children and aphasic patients (as well as the non-brain-damaged adults) sometimes fail to apply these rules and thus find themselves in a state of uncertainty with respect to antecedent selection. This is precisely the state that examples given to coherence judgements try to simulate, only that in this case it is controlled with respect to any influence of context. In this situation of uncertainty all participants, non-brain-damaged adults, children and aphasic patients, apply the default *subject rule* and select the antecedent in the subject position, resulting in more errors in the conditions

that require an object antecedent. Children and aphasic speakers thus make use of a normal 'strategy' to interpret ambiguous pronouns, whereas the cause of this ambiguity lies in their relatively 'abnormal' problems with other rules of discourse reference (i.e. parallelism and contrastive stress).

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