

# **Subject-verb agreement in English relative clauses: Using speech errors and psycholinguistic approaches to distinguish between syntactic representations**

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The analysis presented here makes use of agreement speech errors to address the question of which syntactic representations of relative clause structures are appropriate for the psycholinguistic production of the local dependency between subjects and verbs. If agreement is a strictly syntactic process, and such errors only occur as a result of interference between the copying of syntactic number from the subject to the verb, a Government and Binding representation is plausible. Such a theoretical representation suggests specific feature-copying relationships between head nominals, relative pronouns and traces. If, however, agreement in the cases of these errors is semantic, then a Head-driven Phrase Structure Grammar representation of relative clauses may be more appropriate for psycholinguistic accounts. Directions for future research are suggested.

## **1 Introduction**

Understanding how speakers process relative clauses has long been a goal of research in language processing. To accomplish this, it is necessary to make explicit the assumptions about the syntactic representations that speakers are drawing upon when they produce and comprehend these long-distance dependencies. Much research on relative clauses focuses exclusively on behavioural measures of how speakers process the head nominal and the gap within the relative clause; yet these two elements can be involved in other local dependencies, such as subject-verb agreement relations. This study suggests that by examining subject-verb agreement speech errors, we may be able to learn about the syntactic representations that speakers are drawing upon when producing utterances containing relative clauses.

A search of the Switchboard Corpus (Godfrey, Holliman & McDaniel 1992) yields a wide array of speech errors involving subject-verb agreement.

Some of those errors occur inside the relative clause, as in (1), and some occur outside the relative clause, as in (2).

- (1) a. And in this country, uh, **the solution** that, that people seem to think \_\_\_\_ **work are** unacceptable.  
 b. And you know, it, uh, it kind of knocks down **two** of the big risk categories for coronary artery disease which \_\_\_\_ **is**, uh, uh, low cardiovascular fitness, and also, uh, you know, the cholesterol.  
 c. Uh, I guess **the other thing was** that \_\_\_\_ **are** causing a lot of the crime now is the decrease in values.  
 d. They may be able to, to give **the resources** that \_\_\_\_ 's needed to, uh, to do a good job.  
 e. I'm not sure if we know what to do in terms of curing **some** who \_\_\_\_ **has** already gotten polio.
- (2) a. Well, and, uh, you know, **one thing** my wife and I've talked about \_\_\_\_, **i-, are**, uh, private schools.  
 b. Oh, **one thing** I thought about \_\_\_\_ the other day **were** batteries.  
 c. So really **the only bills** I have \_\_\_\_ **is** rent, utilities, insurance you know.

Assuming that producing subject-verb agreement involves drawing upon syntactic representations, I will address the question: what are the most appropriate representations for the process of language production?

Following a brief overview of psycholinguistic models of language production and psycholinguistic research on subject-verb agreement production, this study will examine the step-by-step process of producing a few of these speech errors assuming two syntactic representations of relative clauses: a classic Government and Binding (GB) representation and a Head-driven Phrase Structure (HPSG) representation. Problems that arise with each account will be illustrated, and future directions will be outlined.

## 2 Background

### 2.1 Psycholinguistic models of language production

Almost all psycholinguistic models of language production assume three basic stages for producing an utterance (Garrett 1975; Levelt 1989). The first stage is the message or conceptual stage, which in linguistic terms may be thought of as the stage during which semantic information is processed. The second stage is grammatical encoding, during which words and morphemes are accessed and fit into a syntactic structure for the utterance. During the third stage, morphophonological information is accessed and a phonetic plan is constructed.

While models vary with respect to modularity (that is, how encapsulated information is at each stage), they all assume that language production is incremental. The entire utterance does not have to be processed at each stage before information is passed on to the next stage. Incremental production becomes relevant in this study because it implies that a subject head noun may be grammatically encoded before, for example, a modifying relative clause is grammatically encoded; if agreement is a syntactic process, then the incremental update of information from the relative clause may have some effect on updating the number value of the modified subject head noun.

## 2.2 Psycholinguistic research on subject-verb agreement production

Much psycholinguistic research on subject-verb agreement concerns errors or mismatch between the subject and verb agreement features. This work is done under the premise that we can learn more about language production by investigating what types of information (i.e., semantic or syntactic) interfere with agreement, and under what structural conditions that interference occurs.

The most commonly study interference case of interference in subject-verb agreement is *attraction*, in which the verb agrees with a ‘local’ noun embedded in the subject noun phrase (e.g. *cabinets* in *The key to the cabinets ARE...*) (Bock & Miller 1991). Generally, such errors are said to occur when local nouns pass their features up the tree to the subject head noun, which then passes its number feature to the verb. Attractors do not directly influence verb agreement morphology, but interfere indirectly by affecting the number value of the subject noun. Importantly, local nouns that are hierarchically closer to the head noun have been shown to be more likely to cause attraction errors than nouns that are closer in linear distance to the verb (Vigliocco & Nicol, 1998; Franck, Vigliocco, & Nicol, 2002). For example, *presidents* in *The threat to the presidents of the company...* is more likely to result in an erroneous plural verb than *companies* in *The threat to the president of the companies*. Finally, only syntactic properties of local nouns cause attraction; semantic number does not (Bock et al. 2001).

However, it is not the case that semantic information does not matter at all. While semantic properties of local nouns do not seem to affect the subject-verb agreement relation, the semantic properties of the head noun (separate from its syntactic marking of number) do influence agreement patterns. For example, subjects with a distributive reading (e.g., *The label on the bottles...* where the head noun is syntactically singular but conceptually plural) have higher rates of plural agreement over and above singular nouns modified by prepositional phrases containing plural local nouns (e.g., *The baby on the blankets.*) Higher incidents of plural agreement are also seen with collective subjects (e.g., gang, family, faculty), which may be simultaneously conceptualized as single units composed of multiple individuals. (Bock et al, 2006; Humphreys & Bock, 2005;

Vigliocco, Butterworth, & Semenza, 1995)

Psycholinguistic accounts of agreement production differ with respect to the role that syntactic structure and semantic properties play during the production process. In the Marking & Morphing model of agreement (Eberhard, Cutting, & Bock 2005), agreement is a syntactic process. Number features of the subject noun and local nouns are passed through the syntactic structure to the verb. In another psycholinguistic account, the Maximal Input/Unification model, the conceptual representation supplies the agreement information (Vigliocco & Hartsuiker, 2002; Franck, Vigliocco, & Nicol, 2002); the verb has direct access to the semantic properties of the verb. To some extent, these models correlate with linguistic theories of syntax, such that it is reasonable to say that syntactic theories correlating with these models may offer a representational foundation for grammatical encoding during language production.

### 3 Examining agreement errors in relative clause production

The first syntactic approach through which these speech errors will be examined is the traditional GB approach. Most psycholinguistic research has assumed basic GB representations, without necessarily being concerned about particular operations or transformations. Transformation-based approaches are however compatible with modular accounts of agreement production (Bock et al. 2006).

Consider the utterance, *The solution that people seem to think work are unacceptable*. The error here concerns the mismatch between the singular head solution and the main clause verb are, as well as the plural verb in the relative clause work. A reasonable source for the plural marking on the verb could be the local noun people. Assuming that this is the case, consider the steps that it would take to produce this error, using the illustration in Figure 1.

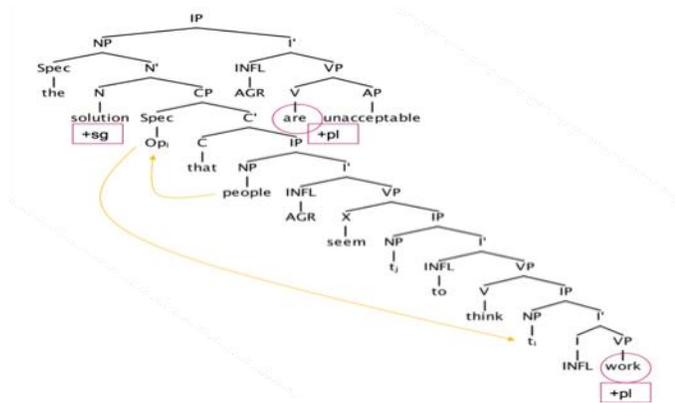


Figure 1. An attraction error involving the passing of plural features from a local noun *people* to the relative pronoun to the trace as well as to the head nominal and main verb.

First, the speaker produces the head noun solution and the coindexed operator, with a singular number value. At the point when the speaker produces the relative clause that the people... the plural feature of people passes up to the operator. As the speaker continues with the relative clause seem to think and produces the trace, the plural value of the operator is copied onto the trace, and then onto the verb work. As for the error in the main clause, the plural feature of people could be passed up to solution and then copied onto the main verb are.

The account of this error is compatible with incremental speech production and to some extent with current research in agreement production, but it does bring up a few tricky points. First of all, the plural value of the trace originates not from a local noun embedded under that node, but from outside and above the trace. Attraction in this structural relationship has not been investigated empirically. Also, this account implies that the trace is a copy of the relative pronoun, which may have implications for syntactic theory.

Now consider an error that appears to have a singular attractor: *And, you know, it, uh, it kind of knocks down two of the big risk categories for coronary artery disease which is, uh, uh, low cardiovascular fitness, and also, uh, you know, the cholesterol*, shown in Figure 2. Here, the mismatch is between the subject trace of the relative clause and the relative clause verb *is*.

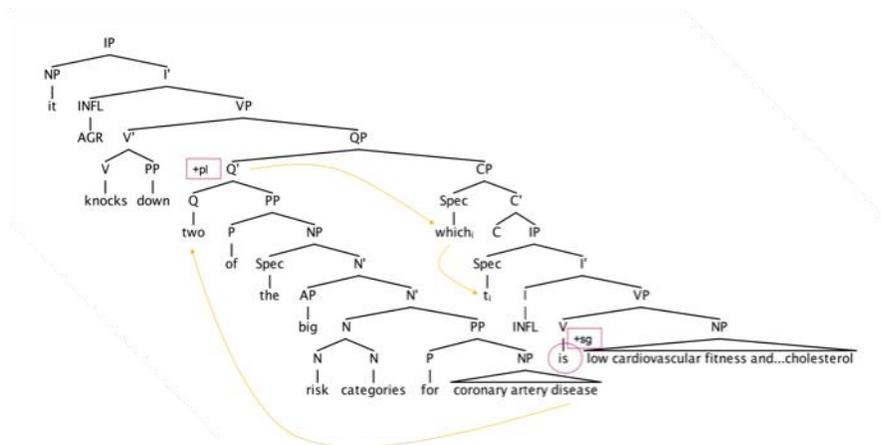


Figure 2. The path of feature-passing in attraction error in which the singular feature of *disease* interferes with the subject verb agreement in the relative clause *which is low cardiovascular fitness and...cholesterol*.

The only possible singular attractor in the subject NP is *disease*, which is local for neither the relative pronoun nor the trace. In this case, the only path along which the singular feature may be passed from *disease* to the trace is through the quantifier *two* and then to the relative pronoun and to the trace. Problems with this account include singular attractors are rare, and the attractor

disease is embedded quite low in the hierarchical structure. Furthermore, psycholinguistic research has shown the number value of pronouns to be linked to the conceptual value of the antecedent, and not affected by syntactic attractors local to the antecedent. While the categorization of this mismatch as an attraction error is compatible with incremental production, the specific mechanisms that are needed to work out the attraction story make it somewhat implausible.

A third example comes from a token where there is no possible attractor in the subject NP, but rather from the plural object: *One thing I thought about the other day were batteries*. In this case, plural feature from the object batteries would have to be copied over to the verb prior to the grammatical encoding of batteries. Object attraction has been shown with preverbal objects in Dutch (Hartsuiker, Antón-Méndez, & van Zee 2001) and inside relative clauses (English: Bock & Miller 1991; French: Franck, Soare, Frauenfelder & Rizzi 2010), but not in main clauses. The constraints on object attraction in English subject-verb agreement that could explain the patterns seen in the examples in (2) above have yet to be made explicit. One possibility, however, is that in copular equatives where the subject and its coindexed predicate nominal are separated by a relative clause, the verb may be more likely to agree with the predicate nominal than with the subject (consider that *One thing were batteries* sounds much less acceptable.)

To briefly summarize, assuming a classic GB structure to account for attraction errors in these examples requires specific assumptions about the relationship between the head nominal, relative pronoun and the trace. Specifically, they suggest that the relative pronoun features copy to the trace (and not vice versa), and that the syntactic features of relative pronouns are copied from their antecedents. And in cases such as (3), a relative clause may increase the possibility of object attraction errors. If psycholinguistic models are going to assume such representations, it may be necessary to posit agreement processes unique to relative clauses (including passing features down, rather than up, a hierarchical structure, and allowing features inside relative clauses to interfere with agreement in the main clause). Furthermore, in (1d), (1e) and (2c), attraction cannot explain the subject-verb agreement mismatch.

There is, however, an alternative to accounting for these mismatches as attraction errors. Recall that in cases where the subject head noun has an interpretation that does not match its form, subject-verb agreement may reflect a semantic, rather than syntactic number value. It may be the case that the tokens presented here are similar to collectives (e.g., the group of bills that one person has), distributives (e.g., a solution that many people think of), and other subjects with a mismatch between the semantic and grammatical number values of the subject (e.g., ‘one thing’ = batteries, having a semantically plural value). If so, a framework that separates grammatical from semantic features, along with a psycholinguistic model that gives the verb direct access to conceptual

representations, may be able to provide a unified account of these tokens. The Wechsler & Zlatić (2003) approach to agreement in HPSG provides such a framework, without requiring agreement processes that are unique to relative clauses. An example is provided in Figure 3.

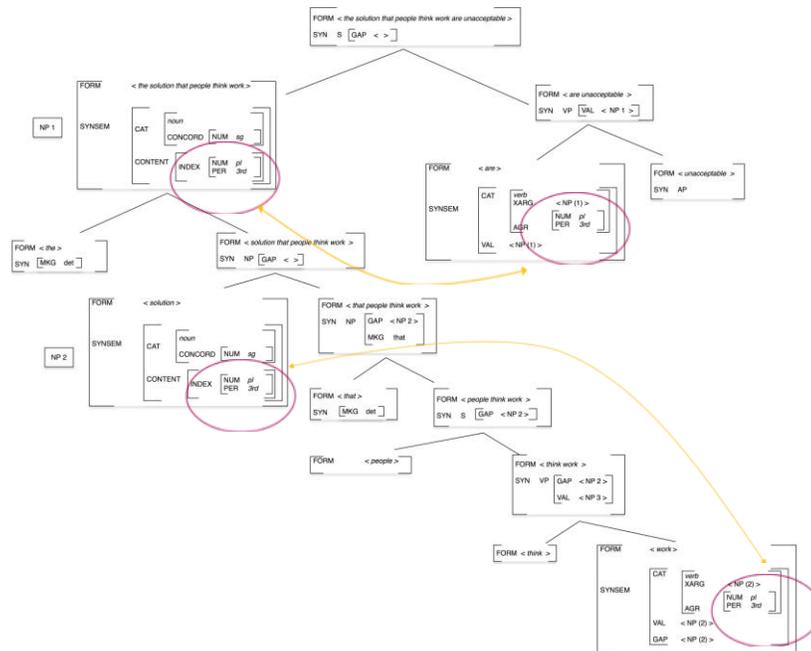


Figure 3. Subject-verb agreement in and underspecified HPSG representation of *The solution that people think work are unacceptable*. In HPSG, subject-verb agreement is constrained by Index features that correlate with semantic information about referent number, while morphological form is constrained by Concord features that correlate to syntactic number values.

The GB representations may still provide a plausible account of these errors, under the assumption that the modified head nominal has a semantic number value differing from the syntactic value. One might, for example, discard the notion of the trace being a syntactic copy of either the relative pronoun or the operator, and treat it rather as a reactivation of the head nominal referent with fully intact semantic and syntactic features but with the phonological representation suppressed. This move might allow the use of GB representations within a primarily semantic account of agreement, and may in practice be little different from an HPSG account, although adopting an HPSG representation is likely more efficient, as HPSG already handles semantic agreement.

To fully merge HPSG representations with production models of these mismatches we must more fully specify the constraints on mismatches between

semantic and syntactic agreement features. Adding constructional constraints, as in Sign-Based Construction Grammar (SBCG, a construction grammar approach using HPSG feature structures (Sag, to appear)), may allow us to better predict when speakers might produce such utterances. Fully specifying the relative clause constructions that elicit these mismatches is a necessary next step.

## 5 Conclusions and future directions

The largest remaining question about the relative-clause tokens reviewed in this paper is what exactly is driving the agreement mismatches involved. If the primary factor is attraction, then a GB approach may be appropriate, and may provide directions for further work in psycholinguistic modeling of relative clause production. If the primary factor is semantic interpretation of the subject head noun, then HPSG/SBCG formalisms may better represent the type of relative clause structures that speakers make use of during production. Definitively choosing between syntactic representations for psycholinguistic purposes will require experimental investigation. A research program that addresses this question may include judgment or rating tasks, as well as reaction-time studies, to determine whether or not speakers entertain various semantic interpretations of such subject referents and how relative clauses influence such interpretations; elicited production studies to investigate whether speakers, when biased toward particular semantic interpretations of subject referents produce these agreement patterns; and behavioural studies to address the questions raised concerning the relationship of syntactic to semantic features among structural components involved in relative clause production.

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