Nat Lang Linguist Theory (2011) 29:1071–1086
DOI 10.1007/s11049-011-9153-1

Reaching agreement as a core syntactic process

Commentary of Bock & Middleton *Reaching Agreement*

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Received: 17 March 2011 / Accepted: 12 June 2011 / Published online: 27 October 2011

Abstract In their paper *Reaching Agreement*, Bock and Middleton (2011) review a vast array of psycholinguistic experiments on semantic influences in agreement which they argue provide critical empirical evidence to the longstanding debate about the role of meaning in syntax. The authors propose to unify these findings within the Marking and Morphing model, the reference framework for many psycholinguistic studies of agreement production. In this commentary, I discuss four concerns about the approach advocated by Bock and Middleton: (1) the pervasive confusion with respect to the definition of agreement, and its conceptual consequences on the debate about the role of meaning in syntax, (2) the infelicitous comparison between pronouns and verbs providing the empirical foundations of Marking and Morphing, (3) the existence of a set of experimental findings invalidating the assumption of the model with respect to the relation between feature transmission and morphology, (4) the lack of assumptions of Marking and Morphing with respect to the process of feature transmission, hence its inability to account for the structural effects on attraction. In response to these concerns, I present an alternative model, Selection and Copy, and sketch a line of research that explores the workings of the Copy component. I then address the criticisms raised by Bock and Middleton against this research and question the explanatory force of Marking and Morphing as a model of agreement defined as a core syntactic process.

Keywords Language production · Agreement · Number · Marking and Morphing · Selection and Copy · Production syntax

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1 Introduction

Both linguistic theory and psycholinguistic research have considered the issue of agreement in great detail. In linguistics, the study of grammatical constraints on agreement has uncovered highly specific evidence for syntactic structure, such that agreement is viewed as 'a key diagnostic in the syntactician's toolkit' (den Dikken 2003; Baker 2011; Nevins 2011). In contrast, structural constraints in agreement realization have only marginally been explored in psycholinguistic studies. Rather, research has focused on the longstanding debate about the role of meaning in syntax, as evidenced in the state of the art literature review offered by Kathryn Bock and Erica Middleton in this volume.

Agreement in number is of particular interest for the study of the relationship between syntax and semantics. As noted by Bock and Middleton, the foundations of humans' conceptualization of number are on the one hand strongly anchored in our cognitive heritage, and on the other hand part of natural languages' grammar. Hence, being represented both at the conceptual level (as a referential property of objects) and at the syntactic level (as a phi feature of nominal arguments and their dependents), number provides an ideal opportunity to explore whether and how semantics influences the 'core syntactic process' of agreement. The debate concerns the interpretation of these effects, which is the cornerstone of Bock and Middleton's paper.

Bock and Middleton provide an impressive review of empirical findings from psycholinguistic studies of agreement production showing apparent influences from number semantics on agreement across a variety of languages and structures. The authors propose to interpret the varying effects within a unified model of agreement production called *Marking and Morphing*. The major property of the model is the separation between two functionally distinct components. *Marking* is the process that imports notional number from the semantics into the syntax. It operates at the interface between the message level and grammatical encoding, and is assumed to be the locus of conceptual influences on agreement. *Morphing* is a set of interrelated operations. Its first role is to match number-relevant features from the syntax (number marking) and the lexicon (number specifications). Morphing also binds morphological information to structural positions. Finally, morphing transmits number features to structurally controlled constituents (e.g., to verbs). This model has the considerable merit of proposing a unified account of this large literature on semantic influences on agreement and is, as such, a reference framework for psycholinguistic research on agreement production.

The commentary is organized in four sections. In the first section, I discuss a pervasive confusion in the psycholinguistic literature between the linguistic phenomenon of agreement and the processes assumed to underlie its realization. Although this confusion is in some sense terminological, it has impacted on the conceptual debate, resulting in ambiguous conclusions with respect to whether or not number meaning influences the core syntactic process of agreement. In the second section, the relationship between theory and data underlying the Marking and Morphing model advocated by Bock and Middleton is analyzed. I argue that key empirical evidence that the authors use for teasing apart control and constraints models, is irrelevant for teasing apart control and constraint models. In the third section, after raising some conceptual issues in the definition of the functional properties of Morphing, I consider a set

of data on the role of morphology in attraction that is problematic for Marking and Morphing. I present an alternative model, *Selection and Copy* (Franck et al. 2008), which is not discussed in Bock and Middleton's paper, that better accounts for the data. In the fourth section, some of the experimental findings consistent with the structure-based nature of agreement are reviewed. I sketch the theoretical assumptions regarding the Copy component of the model and address the skepticism raised by Bock and Middleton with respect to the relevance of formal syntax for language production models.

2 On the uses and misuses of agreement: a pervasive confusion

In the psycholinguistic literature, 'agreement' is commonly used to refer to both the linguistic phenomenon (the observable sharing of features between, for example, the subject and the verb in a sentence), and the psycholinguistic process underlying its realization (the non-observable underlying cognitive function). However, at least two distinct processes are involved in agreement production. The first process is responsible for selecting agreement features from the mental lexicon, under the guidance of semantics (plural is selected if the speaker wants to refer to a plural entity). In so-called *control models*, like the Marking and Morphing model, only features of the subject are selected. In contrast, *constraint models* assume that features of both the subject and of the verb are selected under semantic guidance. The second process is responsible for linking the subject and the verb to establish an agreement relation based on their features. Whereas control models assume that features from the subject are copied onto the verb, constraint models assume that features from the subject and the verb are put together and unified. It is important to note here that although control and constraint models differ with respect to whether semantics guides feature selection of the verb or not, both types of models assume a distinction between a process responsible for selecting features in the lexicon and a process responsible for linking syntactically dependent units. Critically, only the latter process refers to the 'core syntactic process' taken to characterize agreement, and is therefore potentially relevant to shed light on the debate about the role of meaning in syntax.

Thus, the use of 'agreement' to refer to both processes, as is often the case in the psycholinguistic literature including Bock and Middleton's work, gives rise to a significant confusion in the interpretation of semantic effects on agreement: do they affect the core syntactic process of feature copy and therefore constitute evidence for semantic influences on syntax, or do they rather affect the lexical process of feature selection? The conceptual confusion arising from applying the same term, *agreement*, to refer to two fundamentally different processes is pervasive in the debate. Indeed, if agreement refers to both the lexical and syntactic components, then one is forced to conclude from the observed semantic effects on agreement that meaning influences syntax *in one way or another*. In fact, this is the type of argument presented by Bock and Middleton:

> The question addressed in this paper is whether the mechanisms of a core syntactic process, number agreement, depend *in any important way* on the conceptual underpinnings of number... Arguments and empirical evidence for an

> effect of notional number on agreement are hard to dismiss... What these findings [reported in their paper] suggest is that notional number intrudes on agreement processes in English and other languages, though its effects are small. Furthermore, the effects become progressively smaller as the richness of verbal morphology increases (Foote and Bock in press; Lorimor et al. 2008). Still, regardless of magnitude, the presence of such influences indicates that number meaning somehow affects the implementation of agreement in language production.
>
> (Bock and Middleton 2011)

Importantly, the numerous experimental studies by Bock, Middleton, and other researchers to assess the magnitude of distributivity effects, i.e., the graded relationship between referential number and semantic agreement, or the varying influence of number semantics across languages, as fine as they may be, are irrelevant to the debate about the influence of meaning on syntax as long as these studies fail to tease apart the lexical and syntactic components of agreement. So are the studies that comparatively examine the impact of number meaning in other types of agreement dependencies, such as between pronouns and their antecedents, which are conceived as key to the debate (see next section).

The fundamental difficulty in understanding agreement errors is that the available output of the process reflects the involvement of both the lexical and the syntactic components. Nevertheless, a particular set of studies are directly relevant to the debate, which are those studies that examine how semantics influences *attraction* in agreement. Attraction, being the phenomenon in which the specific process of feature copy (in control models) or unification (in constraint models) is assumed to err, is a privileged window over the syntactic component of agreement, because factors that modulate attraction are those that can reasonably be thought to guide feature transmission. In this view, attraction is not just "a tool to increase the general incidence of plural agreement, enhancing any tendency for notional plurality to drive plural verb agreement" (Bock and Middleton 2011), it provides the key test case to assess whether number meaning affects the core syntactic process of agreement.

The critical finding of these studies, which are also reviewed by Bock and Middleton, is that attraction is not modulated by the notional number of the attractor. On the basis of this subset of studies, one can conclude that the core syntactic process of agreement seems to be immune to semantic influences. This conclusion does not require the wide array of experimental evidence reviewed by Bock and Middleton with respect to distributivity, cross-linguistic variation or pronoun/verb comparison, which clouds the issue and misleads the reader into a sometimes confusing line of argumentation.

In the next section, I consider the comparison between verb and pronoun agreement developed in depth by Bock and Middleton, and discuss its relevance to the debate on control and constraint models of agreement.

3 Marking and Morphing: revisiting the link between theory and data

Bock and Middleton distinguish between control and constraint accounts of agreement with respect to how they explain semantic effects on agreement. Semantic ef-

fects find a natural explanation within a constraint view of agreement, since agreement features are being assigned in parallel to the subject and the verb directly from semantics. However, as the authors note, the control accounts can also explain semantic effects. Indeed, if the number of the subject noun phrase depends on number meaning, and if these number features in turn control verb number, then verb number will necessarily reflect the number meaning, although the relationship between number meaning and verb feature here is mediated by subject number. Hence, how can constraint and control models be empirically evaluated? According to Bock and Middleton:

> A key to evaluating the merits of constraint and control accounts of verb agreement is whether the impact of number meaning is the same for other types of number agreement, such as between pronouns and their antecedents. In constraint accounts, the mechanisms of subject-verb number agreement and pronoun-antecedent number agreement should be the same: both involve the reconciliation of referential indices (Pollard and Sag 1994). This leads to the expectation that these two kinds of number agreement will pattern in similar ways. In contrast, control accounts tend to treat the principles, operations, and domains of verb agreement and pronoun agreement differently, with the consequence that number inflections for verbs and pronouns diverge in important ways (see Corbett 2006, for an overview).
>
> (Bock and Middleton 2011)

The comparison between verbs and pronouns raises issues with respect to its relevance for teasing apart control and constraint models, as well as to its theoretical implications for models of agreement. I discuss these two issues in turn.

The first issue concerns the relevance of the comparison between pronouns and verbs for teasing apart control models from constraint models. There is a fundamental difference between pronouns and verbs, which is that pronouns' number is represented at the semantic level (like nouns' number) whereas verbs' number does not have any interpretive consequence. Thus, that "pronoun number predominantly reflects the notional number of its antecedent" is a given, not something that needed to be demonstrated by a range of experimental studies as reviewed in Bock and Middleton. In other words, it is a fact that both constraint and control models of agreement have to deal with, not a criterion for teasing them apart.

However, Bock and Middleton grant distinctive predictions to control and constraint models (see quote above), in particular, constraint accounts are argued to predict that pronoun and verb agreement will pattern in similar ways since both involve the reconciliation of referential indices. Besides the fact that this prediction is already invalidated on the basis of the difference between pronouns and verbs just outlined, it is not warranted given theoretical assumptions of constraint models. Constraint models may easily account for the fact that pronouns show a stronger influence from semantics than verbs under the hypothesis that although both get directly valued from the semantics, semantics plays a stronger role in the process of selecting the number features of pronouns, or that pronouns' features have a stronger role to play with respect to the controller in the unification process. The assumption that different kinds of information have different 'weights' in processing is actually typical of constraint

models (e.g., Haskell and MacDonald 2003). Yet, the assumption of a graded effect is actually adopted by Bock and Middleton to fit their control model of pronoun agreement: "Pronoun number is likewise affected by the number of the antecedent (e.g., a subject noun phrase of a previous or current clause), but only weakly, because of the strength of the constraint that comes from coreferentiality between pronouns and their antecedent." (Bock and Middleton 2011). Hence, the strength of the semantic effect in pronoun and verb agreement is not a valid empirical argument to the debate opposing constraint and control models since both can account for the different strengths under an assumption of graded semantic influences (albeit at different levels of processing).

In fact, Bock and Middleton do acknowledge the possibility to fit graded effects within constraint models in the end. As a result, they propose to evaluate it through the study of attraction, in pronoun and verb agreement. This is indeed the key argument, as I argued in the previous section, but this argument does not rely on *the comparison* between pronouns and verbs. That is, research on pronoun agreement would be relevant to the debate opposing control and constraint models in so far as it provides converging evidence with research on verb agreement.

The second issue raised by the comparison between pronouns and verbs concerns its theoretical implications for models of agreement. The first difficulty in understanding the theoretical framework proposed to account for pronoun and verb agreement comes from the fact that Bock and Middleton follow an inconsistent interpretation of the relationship between theory and data. On the one hand, they argue that constraint models predict that pronouns and verbs should pattern alike, whereas control models predict that they should pattern differently (see quotation above, repeated further: "The challenges to the Constraint view come from the clear differences between verbs and pronouns in notional number agreement"). On the other hand, in their discussion of the data, the authors follow the opposite logic. They use the observation of a difference (stronger notional effects for pronouns than for verbs) to support the existence of a constraint mechanism in pronoun agreement ("the major relationship between antecedent and pronoun number is one of constraint"), whereas they use the observation of a similarity (similar lack of sensitivity to notional number in pronoun attraction and verb attraction) to support the control model of Marking and Morphing.

Another difficulty comes from Bock and Middleton's suggestion that pronoun agreement involves a combination of control and constraint mechanisms: "pronoun number is the joint product of a control process and a constraint process that involves co-indexation. The control process makes a contribution to pronoun number that reflects the same combination of marking and morphing as for verbs, and yields pronoun attraction. The constraint process involves co-indexation, and adds a notional influence to pronoun number that is created by meaning-driven lexical selection of the pronoun itself." (Bock and Middleton 2011). Given that, by the definition of the authors, control and constraint mechanisms are fundamentally opposed with respect to the role of semantics in the valuation of the agreement target (and the authors' aim was to tease apart the two), it is hard to conceptualize how a joint product of the two mechanisms can operate.

In summary, pronouns critically differ from verbs in that their number feature is represented conceptually. Hence, it is not surprising that pronouns, as agreement tar-

gets, are more sensitive to the notional number of their antecedent than verbs are sensitive to the notional number of their subject. This observation is, by itself, compatible with both constraint and control accounts. The gist of psycholinguistic experiments on attraction in pronoun and verb agreement is that they went beyond that preliminary observation by showing that neither verbs nor pronouns are sensitive to the notional features of the attractor noun. Both agreement types therefore appear to involve a processing component that operates on the sole basis of grammatical features, blind to semantic information, in line with control accounts, and contra constraint accounts. It seems reasonable to assume that this component involves the process of transmitting the controller's features to the target, since this is precisely the process that fails in attraction.

4 Agreement and morphology: empirical evidence and theoretical implications

The functional role of Morphing is unclearly stated in Bock and Middleton's paper. In the description of their model, the authors focus on the 'determinants' of subject number, which are: (1) notional number: Marking is the process by which the notional feature comes into play at the conceptual-syntactic interface; (2) grammatical number of the head of the subject noun phrase: "Grammatical number is a product of morphological number specifications, taken to be part of the lexical representation of words and other morphemes"; and (3) Attraction, determined by: "(a) the grammatical number specifications of the morphemes integrated into the structural representation of an utterance (just as for head nouns), but outside the immediate head noun phrase; and (b) the hierarchical distances from these morphemes to the root of the subject noun phrase (or to the root of the entire sentence).". Since Marking involves (1), it is likely that Morphing involves (2) and (3). A more explicit definition of Morphing is provided in Eberhard et al. (2005), who wrote:

> In the marking and morphing framework, morphing is a set of interrelated operations that (a) bind morphological information to structural positions, (b) reconcile number-relevant features from the syntax (number marking) and the lexicon (number specifications), and (c) transmit number features to structurally controlled morphemes (e.g., to verbs). In short, morphing operates during structural integration to select and position the number morphology that surfaces with pronouns and verbs.
>
> (Bock and Middleton 2011)

Thus, Morphing appears to consist of various mechanisms which involve (at least) the retrieval of the morphological specification of number features and the transmission of these features to the agreement target. That is, the model involves no clear functional distinction between the process retrieving number morphemes and the process transmitting features to agreement targets. Linguistic theory provides arguments for the independence of the syntactic component of agreement from its morphological realization (e.g., Cardinaletti 1997; Schütze 1997; Guasti and Rizzi 2002; see also Baker 2011). Psycholinguistic models also typically implement a distinction between syntactic representations and morphological representations (e.g., Bock and

Levelt 1994; Garrett 1980). Nevertheless, it is only in view of empirical evidence that the merits of that standpoint should be assessed.

My colleagues and I discussed this issue some years ago, and concluded that empirical evidence actually invalidates the assumption of an interrelated process of Morphing involving both morphological specification and feature transmission (Franck et al. 2008). We argued that such a view predicted that attraction be sensitive to the morphological specification of the attractor, not just to its grammatical feature. Psycholinguistic research on the influence of morphological form on agreement is much less extensive than that on the influence of semantics. Nevertheless, a number of studies conducted in various languages have reported systematic influences from number and gender morphological markers on the subject head noun on verb agreement (Vigliocco et al. 1995; Hartsuiker et al. 2003), pronoun agreement (Meyer and Bock 1999), and predicative adjective agreement (Vigliocco and Zilli 1999; Franck et al. 2008). However, and critically, the few studies that manipulated morphological markers on the attractor failed to find an effect on attraction (Bock and Eberhard 1993; Vigliocco et al. 1995; Franck and Bock 2003). The most compelling evidence came from the study by Vigliocco and colleagues (1995) who reported that the very same morphological factor (the morphological regularity of the nominal ending) that influences agreement when manipulated on the subject head noun fails to influence attraction when manipulated on the attractor (see Franck et al. 2008 for a more detailed presentation of these studies).

Thus, attraction appears to be triggered by the grammatical representation of the attractor's agreement feature, independently of its semantic representation and of its specification in the word form. Hence, in line with arguments from syntactic theory, psycholinguistic experiments suggest that two functionally distinct components are involved in the morphological specification of number features and in the transmission of these features, contra the assumption of the Marking and Morphing model.

On the basis of these findings, my colleagues and I proposed an alternative model that accounts for the general findings that (1) agreement is sensitive to the semantic and morphological number features of the subject head noun, whereas (2) attraction is only guided by the grammatical feature of the attractor and its structural position in the sentence (see below). This model, dubbed Selection and Copy, is theoretically anchored in modern theoretical syntax (e.g., Chomsky 1995) and in psycholinguistic models of word production (e.g., Rapp and Goldrick 2000). The model implements the fundamental distinction between interpretable features (on the noun) and uninterpretable features (e.g., on the verb or adjective) proposed in theoretical syntax by assuming two different processing components that ensure feature specification at these two syntactic positions: Feature Selection and Feature Copy (see Fig. 1 from Franck et al. 2008 for an illustration of gender agreement which basically operates in the same way as number agreement).

The first component, Feature Selection, is responsible for selecting nominal features within the lexicon (left side of Fig. 1). Thus, Feature Selection is conceived of as a process of lexical selection which selects an entry in a memory store of functional units on the basis of semantic guidance (or lexical guidance in the case of grammatical gender). This assumption is in line with the hypothesis that grammatical features are retrieved automatically as part of the lexical selection process (e.g., Caramazza et al. 2001). Feature Selection is assumed to be the locus of conceptual and

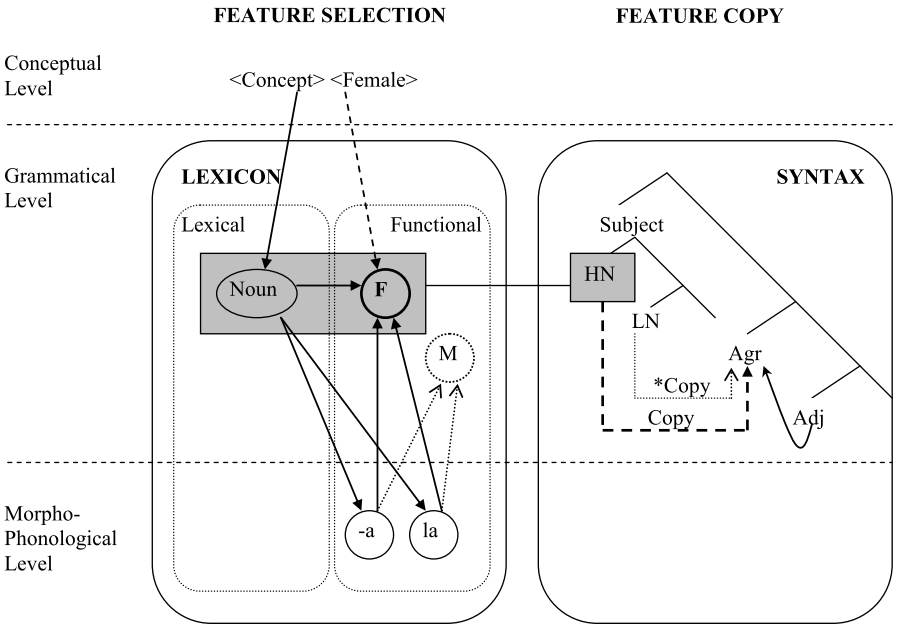

Fig. 1 Components involved in the Feature and Copy model of agreement. The Figure illustrates gender agreement of a predicative adjective with a feminine noun in a language like Spanish. Feature selection takes place in the Lexicon. The feminine gender node (F) receives activation from the Female notion at the Conceptual level if the concept to be expressed is animate, as well as from the Noun lemma at the Grammatical level, and from the feminine suffix (-a) and feminine article (la) at the Morphophonological level via feedback connections within the Functional lexicon. These connections also weakly activate the masculine gender node (M) due to the few grammatically masculine Spanish nouns taking the suffix -a or the article la.
The feature, once selected in the Lexicon, serves as input to the operation of Feature copy, which takes place in the Syntax. The feature on the head noun (HN) is copied to a gender agreement node (Agr) to which the adjective moves to get valued. If a local noun (LN) is present, its feature is selected in the same way and occasionally erroneously copied to Agr, triggering attraction

morphophonological effects on agreement. This assumption is in line with research on lexical selection which has provided ample evidence of word form (morphological/phonological) influences on lemma selection, validating the hypothesis of local interactivity in the process of lexical selection (e.g., Dell 1986; Rapp and Goldrick 2000; Goldrick 2006). Given the activation feedback that it receives from the morphological level, a syntactic feature strongly associated to a morphological marker is more likely to be selected than a feature only weakly associated to such a marker. Experimental reports of conceptual and morphological effects on agreement therefore find a natural explanation in the view that feature selection is similar in nature to lexical selection, or even part of it.

The second component, Feature Copy, is responsible for transmitting the feature selected to the agreement target, and takes place within the syntax (right side of Fig. 1). I will get back to the properties of this process in the next section, but what is crucial here is that in contrast to Feature Selection, which operates at the lexical level, guided by principles of interaction with semantic and morphological levels, Feature

Copy operates at the syntactic level under the guidance of syntactic factors, and in isolation from non-syntactic factors. In our model, attraction occurs as the feature of a word structurally intervening on the agreement relationship is incorrectly copied to the agreement position (see Fig. 1).

Our model is acknowledged in a parenthesis by Bock and Middleton, who argue that it shows "substantial similarities to the morphing components of Marking and Morphing". Although the two models are similar in that they both decompose agreement in two functionally distinct mechanisms, they differ in two major respects. The first difference lies in the way the two models conceive the relationship between syntax and morphology: whereas the syntactic process of feature transmission is intrinsically linked to morphological specifications in Morphing, it is blind to it in Feature Copy.

The second difference between the two models lies in the account of the transmission process itself. The Marking and Morphing model is predominantly concerned with the factors at play in determining the subject's feature (the three 'determinants' illustrated in Fig. 1 of Bock and Middleton's paper). The model does not take a position with respect to the workings of the transmission process itself. The Selection and Copy model, in contrast, incorporates detailed assumptions as to the Copy component responsible for the transmission process, which has been detailed within what Bock and Middleton dubbed the Production Syntax model. In the next section, I outline some of the key empirical evidence which served as the foundations of Production Syntax, sketch how the model accounts for it, and then address Bock and Middleton's concerns with the model.

5 Production syntax as a model of structural effects in agreement

Following the initial report by Bock and colleagues showing structural effects on attraction (e.g., Bock and Miller 1991; Bock and Cutting 1992), my colleagues and I conducted a number of studies designed to investigate more finely the syntactic determinants of agreement as a feature transmission process. In an initial study, we reported that attractors situated high within the subject phrase (*flights* in *the helicopter for the flights over the canyons*) trigger more attraction than attractors situated low (*canyons* in the same example; Franck et al. 2002). Pursuing our investigations of the role of hierarchical structure, we conducted various experiments showing that attraction is not a privilege of attractors situated within the subject constituent. Clausal adjuncts and verbal objects under particular structural conditions were found to yield significant attraction, to a similar extent or even stronger than attraction from subject modifiers, in adults (Franck et al. 2006, 2007, 2010) and in children (Franck et al. 2004).

Moreover, we found evidence that attraction is sensitive to abstract steps and properties in the derivation of sentences, under linguistically motivated assumptions. Reference to abstract derivational steps is invoked by the contrastive finding with Verb-Subject questions in English as in (1) (Vigliocco and Nicol 1998) and in Verb-Subject free inversion in Italian as in (2) (Franck et al. 2006). Experimental evidence showed

that attraction only arises in the former, not in the latter, despite their superficial similarity.[1] The crucial difference between those structures has to do with the different way in which the VS order is derived in the two languages. In English interrogatives, inversion is derived from the normal declarative order, a structure in which the attractor intervenes between the head noun of the subject and the verb. If agreement is computed on such an abstract representation, attraction is expected to occur. In contrast, in Italian VS declaratives such as (2) the subject never leaves the low clause final position; here the attractor (*i vicini*) never intervenes between the inflected verb and the head noun of the subject, hence attraction is expected not to occur.

(1) *ARE the helicopter for the flights safe?

(2) TELEFONERA l'amica dei vicini.
will-phone.Sg the friend of the neighbors
'The friend of the neighbors WILL.Sg phone.'

Finer aspects of the syntactic hierarchy were also put forth as explanatory in attraction. In particular, the c-command/precedence distinction was argued to account for the finding of stronger attraction with accusative clitics (3), intervening in terms of c-command on the Subject-Verb dependency, as compared to dative clitics (4) and PP modifiers (5), which intervene in terms of precedence (modulo some assumptions for dative clitics, see Franck et al. 2010).

(3) *Le professeur les LISENT.
the teacher them read.Pl
'The teacher READ them.'

(4) *Le professeur leur ONT parlé.
the teacher to them have.Pl talked
'The teacher HAVE talked to them.'

(5) *Le professeur des enfants LISENT.
'The teacher of the children READ.'

Further experiments on object interference suggested that movement of the object is a necessary condition to attraction. Significant object attraction was indeed observed in structures involving object movement, as in cleft constructions[2] (6) (Franck

[1] B&M note a perplexing finding in the Italian experiment, according to which there was more attraction to singular nouns than to plural local nouns. In fact, the data show no difference between these two conditions of attraction. Moreover, although attraction in English does indeed trigger a strong asymmetry between singular and plural attractors, a lack of asymmetry has often been reported in other languages (see Franck et al. 2002, for a discussion).

[2] B&M propose to reinterpret the high error rate we reported in object cleft constructions with Verb-Subject inversion as reflecting the fact that these structures are "harder to deal with, for reasons unrelated to agreement". The first empirical argument they bring in favor of this hypothesis is that participants also produced errors when the attractor's number matched the number of the subject head. What the authors do not say, is that the error rate in the match condition (2.5%) is strikingly small in comparison to the 32% errors reported in the number mismatch condition. The second argument given by the authors is that participants produced lots of miscellaneous errors. Again, what is critical here is that these errors were not distributed according to the critical factor of number match, attesting that even though a general factor of complexity

et al. 2006) or object relative clauses (7) (Franck et al. 2010). In contrast, no object attraction was found in structures that fail to involve object movement, as in canonical sentences with post-verbal objects or in complement clauses in which the non-displaced object of the main verb fails to interfere with the agreement of the embedded verb, as in (8) (Franck et al. 2010). The contrast between the significant attraction found in (7) and the lack of attraction in (8), in spite of their superficial similarity, was of particular importance in arguing for the role of object movement.

(6) *C'est les boxeurs que l'adolescente SEDUISENT.
'It's the boxers that the adolescent SEDUCE.'

(7) *Jean parle aux patientes que le médicament GUERISSENT.
'Jean speaks to the patients who(m) the medicine CURE.'

(8) Jean dit aux patientes que le médicament GUERIT.
'Jean tells the patients that the medicine CURES.'

Finer experimental tests of object attraction showed that displaced objects trigger attraction independently of whether they trigger participial agreement or not, since significant attraction was found in the causative construction, which fails to involve participial agreement (9). Attraction was also found to be independent of argumenthood, since it was observed in clausal complement constructions like (10) in which the moved element is the object of the subordinate verb, not of the target verb, and is therefore not part of the argument structure of the agreeing verb (Franck et al. 2010).

(9) *Le professeur les FONT partir.
the teacher them MAKE.Pl go
'The teacher MAKE them go.'

(10) *Voilà les patientes que le médecin ADMETTENT que tu soignes t.
'Here are the patients that the doctor ADMIT that you cure.'

The systematic finding of object attraction in structures involving object movement like (6), (7) and (10), contrasting with the lack of attraction in the absence of object movement as in (8), was argued to find a natural explanation under the hypothesis that the object moves locally and first transits via an intermediate position which intervenes between the subject and the verb in the hierarchical structure. Importantly, this hypothesis is independently motivated by a variety of linguistic facts (e.g., *wh*-agreement with the moved object in Austronesian, Chung 1998; "reconstruction sites" in the positions of intermediate traces, Legate 2003).

In sum, under the assumption that performance errors in attraction reflect properties of the grammar, Production Syntax explains the structural effects on attraction by way of key conceptual tools of formal syntax regarding hierarchical structure,

surely played a role (which we discuss), it does not account for the effect of number. The authors point at two reasons why Verb-Subject sentences may be harder to deal with: (1) they are harder to understand and agreement is harder to formulate in these sentences; (2) the fact that preambles were presented with an underscore at the position of the verb to insert is intuitively harder to do. However, the authors do not say how these two factors would explain the presence of a number effect in agreement errors and its absence in miscellaneous errors.

the c-command/precedence distinction, and movement. The strength of the model lies in two important properties of scientific models: (1) it relies on independent assumptions from linguistics, based on the observation of syntactic regularities outside agreement phenomena across natural languages; (2) it makes non-obvious predictions as to how structure will determine the strength of attraction in performance. More critically, Production Syntax provides a model of the core syntactic component of feature transmission, which was convincingly argued to be immune to semantic influences in Bock and Middleton's paper. In contrast, the Marking and Morphing model remains agnostic with respect to this process. As a result, Marking and Morphing, in its current format, is unable to account for the various syntactic effects on attraction which constitute the empirical foundation of Production Syntax, in particular: (1) the fact that elements from outside the subject clause cause attraction, sometimes even stronger than clausal elements, (2) the fact that fine variations in the structural configuration of intervention modulate the strength of attraction.

Finally, in their review of agreement models, Bock and Middleton raise an important objection to Production Syntax that has to do with the fact that it lacks explanations for how production can proceed within the time constraints on normal speaking. This objection is directly related to Bock and Middleton's skepticism with respect to research that takes linguistic theory as a formalism to account for language processes:

> Against a processing architecture in which complete structures are derived through movements that originate at the ends of sentences, or call on the phonological forms of words that are destined for the ends of sentences (Franck et al. 2010), there are barriers that include (a) the need to formulate utterances in real time; (b) the incremental nature of language production; (c) the unrelenting necessity of implementing agreement; and (d) the rates at which agreement can be realized.
>
> (Bock and Middleton 2011)

Although Production Syntax does not implement time within the model, additional assumptions may be put forth to link representational constructs to online constraints of language production. We suggested that a structure-based memory component may play a crucial role in the process of grammatical encoding (Franck et al. 2010). We argued that memory constraints operate on structures involving movement, such that once an element (the object here) has been encoded grammatically, it is passed on for phonological encoding and articulation while the rest of the sentence is still being planned. We hypothesized that even though the object has been encoded and passed on for articulation, it is kept active in some temporary memory buffer and regularly reactivated until its base position (or gap site) has been reached. This assumption is motivated by the fact that in the timeline of sentence production, some of the elements encoded early have to remain available for further syntactic operations. For example, the subject needs to remain available for verb agreement even if the two elements are not linearly contiguous; similarly, the object moved preverbally needs to be available for past participle agreement in French. Hence, the encoder would ensure that it has everything it may potentially need at disposal, even if these elements are unnecessary for the actual structure produced (as suggested by the fact that displaced objects interfere with agreement in structures that do not show participle agreement).

Importantly, our assumption is that reactivation in memory is not blind to syntactic structure; rather, it operates under fine structural guidance such that moved elements are reactivated at specific sites corresponding to the intermediate traces identified by syntactic theory. In this view, intermediate traces are conceived of as processing devices in response to memory limitations, allowing the grammatical encoder to keep track of displaced elements in complex sentences involving long-distance dependencies.

It is worth noting that Marking and Morphing actually faces exactly the same challenges highlighted by Bock and Middleton in points (a), (b), (c), and (d) of the quote above. Indeed, time is only weakly specified in the Marking and Morphing model:

> Morphological specifications carry the greatest weight in number determination, which is psycholinguistically justifiable in terms of the timing of their entry into agreement implementation. . . Because the morphological specifications enter into implementation later than notional features, in company with lexical retrieval processes, they may be active in working memory at a point when feature transmission to agreement targets (another of the morphing mechanisms in Marking and Morphing) occurs. However, the timing of these processes (about which virtually nothing is known) is not directly represented in the model.
>
> (Bock and Middleton 2011)

Admittedly, morphological specifications may enter into implementation later than notional features, but this remains to be demonstrated empirically. The difficulty for all production models of agreement is, as noted by Bock and Middleton, that virtually nothing is known about the timing of agreement. Amongst the wide array of psycholinguistic experiments on agreement production available to date, none provides online timing measures. This shortcoming constitutes a major challenge for future experimental research in agreement production. In this regard, the online response time measures provided by recent work on agreement in sentence comprehension, and the explanatory hypotheses developed in these studies are promising (e.g., Wagers et al. 2009; Staub 2009, 2010). They provide new constraints on agreement processes and may yield to the development of integrative frameworks for syntactic production and syntactic comprehension, two areas of psycholinguistic research which would benefit from talking to each other.

6 Concluding remarks

In their review of psycholinguistic models of agreement, Bock and Middleton convincingly illustrated the relevance of a model that distinguishes between two components: one situated at the interface with semantics and responsible for incorporating number meaning into the syntax, the other one blind to semantic representations. The Marking and Morphing model implements this distinction, explaining a wide range of data showing variable semantic influences on verb and pronoun agreement. A similar functional distinction is implemented in the Selection and Copy model (Franck et al. 2008) and the Production Syntax model which specifically accounts for the

Copy component (Franck et al. 2006, 2010). These models contrast with Marking and Morphing in two respects. First, morphological influences on agreement arise independently from the syntactic component of feature transmission. Second, the feature transmission process is finely accounted for.

The major challenge of Marking and Morphing is that it fails to account for key empirical evidence attesting of the structure-based nature of attraction phenomena, the model being, in its current format, undetermined with respect to the very process of agreement, which is feature transmission. What the Marking and Morphing model tells us is that feature transmission *is not* determined by semantic influences. 'Reaching agreement' requires accounting for what *is* actually determining it.

Acknowledgements I am grateful to Jeff Bowers, Robert Franck, Luigi Rizzi, and Akira Omaki for helpful comments and discussion, and Marcel den Dikken for reviewing the initial version of this paper.

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