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Agreement with quantified nominals: implications for feature theory

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1 Introduction

1.1 The phenomenon

Over the last two decades, agreement has played a central role in shaping different generative frameworks. In addition to accounting for canonical agreement patterns, a syntactic model must also be able to account for various non-canonical patterns observed in natural language. This paper focuses on one area where subject-verb (or subject-Aux) agreement does not always follow the canonical pattern: the agreement triggered when the subject is a quantified noun phrase (QNP), as in the following schematic structure:

(1) [Q N] (Aux) Pred

In Modern Hebrew, two agreement patterns are attested in such cases:

1. Agreement with Q ("Q-agr")
2. Agreement with N ("N-agr")

These two patterns are illustrated below:

(2) 20 axuz-im me-ha-zman mukdašim / ?mukdaš le-kri'a.
20 percent-M.P of-DEF-time(M.S) devoted.M.P / devoted.M.S to-reading
'20% of the time is devoted to reading.' (Q-agr/?N-agr)

(3) maxacit me-ha-tošavim ovdim / *ovedet be-xakla'ut.
half(F.S) of-DEF-residents(M.P) work.M.P / work.F.S in-agriculture
'Half of the residents work in agriculture.' (N-agr/*Q-agr)

The existence of more than one agreement pattern for QNPs is not unique to Hebrew. As we show below, however, not all languages display the same alternation; from a theoretical point of view, it will be claimed that the alternation pattern in Hebrew is particularly revealing of the nature of agreement.

A third agreement pattern, which will not be discussed in this paper, is often termed 'semantic agreement'; this is illustrated in (4):

(4) ? xelek me-ha-kita higi'u be-ixur.
part(M.S) of-DEF-class(F.S) arrived.P late
'Some of the (students in the) class arrived late.'

Unlike in the previous examples, in (4) the number feature on the verb matches neither the grammatical number of the quantifier nor that of the noun. This is usually seen as an expression of the QNP's semantic number, under the interpretation given in the gloss. This paper will focus only on the two *syntactic* agreement patterns, N-agr and Q-agr. It is quite likely, however, that the analysis of QNP agreement to be proposed can also be extended to account for the semantic agreement pattern.

At this point we wish to avoid committing to one specific structural analysis of quantified noun phrases; we will therefore use the following notation, keeping open for the moment the question whether quantifiers should be analyzed as heads or as specifiers:

- 'NP': the maximal (extended) projection of the noun (which might actually be DP).
- 'QP': the maximal projection of the quantifier.
- The entire quantified nominal will be referred to informally as 'QNP'; depending on its exact internal structure, this might actually be NP, DP or QP.

1.2 The theoretical problem

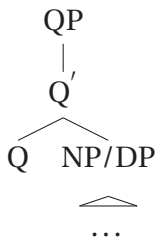
The first theoretical problem raised by the existence of two agreement patterns has to do with locality. An assumption shared by both the Minimalist framework and HPSG is that agreement is subject to strict locality constraints. Specifically, in the framework of Chomsky (2000, 2001), it is assumed that a head such as T can only agree with the *closest* matching goal. In the HPSG framework, agreement is assumed to always be with the *head* of the relevant phrase. The existence of two different agreement patterns with QNPs seems to pose a problem for these views:

1. If QP is structurally higher than NP, then N-agr seems to violate these locality conditions.
2. If NP is structurally higher than QP, then Q-agr seems to violate these locality conditions.

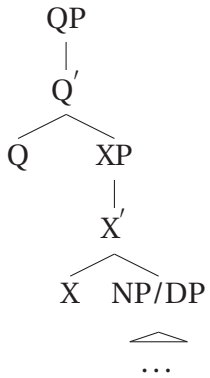
Put differently, under both Minimalist and HPSG assumptions, agreement is seen as a deterministic process that allows no optionality given the hierarchical structure and presence of features; therefore, free alternation between two well-formed agreement patterns is not predicted to be possible, unless each agreement pattern follows from a different underlying structure – a possibility to be argued against below.

Our main focus will be on QNPs for which the vast majority of previous work has argued that Q occupies a higher position than NP; hence, our goal is to account for N-agr in one of the following simplified structures:

(5) a.



b.



In what follows, we will focus mostly on providing an analysis which is compatible with Minimalist assumptions. Given the Minimalist model of agreement and no further assumptions, the prediction, which is clearly false, is that only Q-agr should be possible in configurations such as those in (5).

A second, related, problem, has to do with the relation of agreement with case. A well-established generalization is that in nominative-accusative languages, if T agrees with a single XP it is with a *nominative* one (see e.g. Bobaljik 2008). The agreeing NPs in many Hebrew QNPs allowing N-agr, however, have often been analyzed as being embedded genitives or obliques. N-agr therefore seems to involve agreement with a non-nominative XP. The question, then, is what makes this (apparent) violation of the case-agreement generalization possible in this environment.

1.3 Goals of this paper

The issues introduced above raise at least two kinds of questions:

Empirical question: What factor determines whether N-agr, Q-agr, or both will be possible for a given QNP–predicate pair?

Theoretical question: How can the syntax allow both patterns?

This paper will focus only on the *theoretical* question. More specifically, rather than using the theoretical framework as a means to analyze the data, we will attempt to use the data as a means to examine some aspects of the Minimalist framework – specifically, some aspects of its feature theory. Our main claim will be that certain assumptions about features in "standard" Minimalism make it impossible to express what might in fact be the right theory of QNP agreement; and that relatively small (and independently justified) modifications to Minimalist feature theory would make it possible to express this theory. Thus, my main goal is to highlight one specific area where, I will argue, Minimalist feature theory as it is usually used seems to be a little too restrictive.

2 Data overview

2.1 QNP agreement in Hebrew

In Modern Hebrew, it is possible to distinguish 3 major types of QNPs:

- Construct states headed by the quantifier, as in (6a). A construct state is a prepositionless genitival constructions in which the head is immediately followed by an obligatory genitive NP/DP.
- Partitives using the preposition *me-*, as in (6b).
- Simple quantifier-noun constructions, as in (6c).[1]

(6) a. kol/maxacit ha-anašim
all/half DEF-people
'all/half the people'

b. kama/harbe me-ha-anašim
some/many of-DEF-people
'some/many of the people'

c. kama/harbe anašim
some/many people
'some/many people'

Of these, the Q-agr/N-agr alternation occurs with the first two types: construct states (which often receive a partitive interpretation when headed by a quantifier) and partitives with *me-*. This has two important outcomes:

1. The alternation is not tied to one particular type of construction, and hence any analysis of this phenomenon must be flexible enough to be applicable to both of these QNP types.
2. The alternation cannot be reduced to a semantic distinction between partitive and non-partitive QNPs (Selkirk, 1977).

Before illustrating the agreement patterns with the two QNP types that display an alternation between Q-agr and N-agr, it should be noted that the data regarding QNP agreement in Hebrew shows a very high degree of variability in at least two dimensions: first, QNPs that look quite similar, syntactically and semantically, may sometimes trigger different agreement patterns; and second, native speakers often have strikingly different judgments, and many speakers often report a difficulty in judging the grammaticality of sentences with QNP subjects. At the descriptive level, it should be kept in mind that some of examples annotated in this paper with the grammaticality judgment '?' are judged as grammatical by some (but not all) speakers; while other examples annotated in this way are more or less consistently judged as marginally acceptable. A

[1] One difference between the construct state (CS) QNP shown in (6a) and the simple QNPs in (6c) is that only the former may (and usually must) contain a definite article *following* the quantifier. In some cases, the head of a CS is also morpho-phonologically distinct from non-CS quantifiers.

proper classification of these judgments would be necessary for a full analysis of the factors favoring one agreement pattern over another; in this paper, however, we focus on the theoretical questions raised by the mere existence of both patterns.

As mentioned above, *partitive* QNPs often allow both N-agr and Q-agr. The following two examples illustrate partitives with the quantifier *xelek* ('part'); this quantifier allows both options, with the choice of preferred pattern often correlating with the type of noun: with plural count nouns, many speakers accept only the N-agr pattern, while with collective singular nouns like *oxlosiya* ('population'), *cibur* ('public) etc, many speakers accept both patterns, sometimes with a preference for Q-agr.

(7) xelek gadol me-ha-našim maskimot im de'a zo.
part(M.S) large.M.S of-DEF-women(F.P) agree.F.P with opinion this
'A large proportion of (the) women agree with this opinion.' (N-agr)

(8) xelek gadol me-ha-oxlosiya eyno megiv tov le statinim.
part(M.S) large.M.S of-DEF-population(F.S) NEG.M.S react.M.S well to statins
'A large part of the population doesn't react well to statins.' (Q-agr)

Similarly, *construct state* QNPs may trigger either N-agr or Q-agr, often with the same quantifier:

(9) maxacit ha-talmidim eynam nizkakim le-ezrat ha-mora.
half(F.S) DEF-students(M.P) NEG.M.P needy.M.P to-help DEF-teacher
'Half of the students don't need the teacher's help.' (N-agr)

(10) maxacit ha-cava niš'ara ne'emana la-melex.
half(F.S) DEF-army(M.S) remained.F.S loyal.F.S to.DEF-king
'Half of the army remained loyal to the king.' (Q-agr)

Note, however, that the alternation is not always free. Both construct state QNPs and partitive QNPs sometimes allow only the N-agr pattern:

(11) rov ha-našim mevinot / *mevin et ze.
most(M.S) DEF-women(F.P) understand.F.P / understand.M.S OM this
'Most women understand this.' (N-agr/*Q-agr)

(12) harbe me-ha-tošavim ha-mekoriyim azvu / *azav.
many of-DEF-inhabitant.P DEF-original.P left.P / left.S
'Many of the original inhabitants have left.' (N-agr/*Q-agr)

One question that might arise from example (12), which allows only N-agr, is whether this restriction has anything to do with the quantifier's morphology. Unlike many other Hebrew quantifiers, which have clear gender and number morphology, the quantifier *harbe* ('many') does not fit into any known morphological template; and as it cannot take its own modifiers, it seems like there is no way to determine whether it has any agreement features of its own, which might justify classifying this quantifier as lacking agreement features altogether. Therefore, it might seem somewhat trivial that N-agr is the only available option in this case. It should, however, be noted that Q-agr is not

always possible even for quantifiers which clearly do have their own (non-default) gender and number features; for instance, replacing the masculine quantifier *rov* in (11) with the synonymous quantifier *marbit*, which carries the feminine suffix *-it*, would still not make Q-agr possible in this case. On the other hand, the following example, with the quantifier *asirit* ('tenth'), which bears the same feminine singular morphology as *marbit*, does marginally allow Q-agr:

(13) asirit me-ha-tošavim ?tomexet / tomxim ba-haca'a.
tenth(F.S) of-DEF-residents(M.P) support.F.S / support.M.P in.DEF-proposal
'A tenth of the residents support the proposal.' (?Q-agr/N-agr)

We should therefore reject a simple morphological generalization as the basis of these facts. At this point we will not attempt to provide an alternative generalization (or an explanation) regarding the question why some QNPs allow only N-agr, some allow only Q-agr, and some allow both. The analysis to be proposed in section 5.2 might provide the basis for an answer to this question, but a full answer would be beyond the scope of the current discussion.

In summary, the above data should make it clear that the N-agr/Q-agr alternation is a very productive alternation in Hebrew:

- It occurs with more than one syntactic type of QNP.
- Native speakers often accept both options.
- N-agr is not limited to Qs that lack their own ϕ-features.

The alternation in Hebrew thus represents a real theoretical challenge, as the data is far more complicated than what we would expect if the choice of agreement pattern were merely determined by a set of frozen idiosyncratic constructions.

2.2 QNP agreement in other languages

Alterations in QNP agreement are witnessed in many languages and are not unique to Hebrew. Nevertheless, a survey of the agreement patterns in several languages reveals some interesting differences. Below we summarize some of the QNP agreement data that has been reported for other languages, pointing out the major crosslinguistic generalizations as well as the areas where Hebrew seems to be unique among these languages.

Standard Arabic According to LeTourneau (1995), in Standard Arabic construct state QNPs headed by a quantifier alternate between N-agr and default agreement (3rd person singular masculine). Case morphology in this language makes it clear that the quantifier is nominative, while N is genitive, thus providing immediate support for the claim that N-agr is indeed agreement with an NP/DP which is embedded under QP.

Russian A similar pattern is found in Russian. As discussed in Pesetsky (1982) and Franks (1994), numerals and quantifiers in Russian that assign genitive to the noun lead to an alternation between two agreement patterns: N-agr and default agreement.

The option of Q-agr is not discussed in these works; however, as reported to me by several native speakers, Q-agr is in fact possible in Russian with quantifiers that are more 'nominal', which give rise to patterns similar to those discussed above for Hebrew.

Serbo-Croatian Other Slavic languages display somewhat different patterns of agreement. In Serbo-Croatian, as discussed in Bošković (2006) and Wechsler and Zlatić (2003), QNPs with numerals and quantifiers that assign genitive to the noun can only trigger default agreement in the normative language; for some speakers, however, this optionally alternates with N-agr.

Basque Another language with an alternating pattern is Basque. As reported in Etxeberria and Etxepare (2008) and Etxeberria and Etxepare (2009), Basque QNPs with 'vague' weak quantifiers trigger optional number agreement with the noun (i.e., either N-agr or default agreement). Unlike Hebrew and the other languages discussed above, in Basque the alternation seems to be highly dependent on semantic properties of the quantifier as well as on factors like distributivity/collectivity of the predicate.

Some generalizations In summary, we find the following similarities and differences between Hebrew and the other languages discussed:

- Many languages allow more than one agreement pattern with QNPs.
- In Hebrew, the two options are N-agr and Q-agr.
- In Arabic, Serbo-Croatian, Basque and Russian (at least with 'real' quantifiers), on the other hand, the alternation is between N-agr and default agreement.
- When there is overt case morphology, the alternation occurs in QNPs where the noun is non-nominative.

3 Against structural ambiguity

Given the data discussed so far, the question is what is it that makes two different agreement patterns possible. One approach that immediately comes to mind would be to postulate some sort of structural ambiguity. Under this approach, we might hypothesize that alternating QNPs can have two different syntactic structures, where each structure leads to a different agreement pattern. Another variation on this idea would be to argue for two distinct positions within the clause for the QNP as a whole.

Such approaches have indeed been proposed for some of the languages discussed above (see section 4.1). There are, however, some good reasons to reject this kind of analysis for Hebrew. Below I briefly discuss some arguments against this approach.

3.1 Previous work on Semitic QNPs

Over the last two decades, there has been a lot of interest in the internal structure of noun phrases, in Semitic as well as in other languages. Many previous studies have

argued for analyses in which quantifiers in Semitic are structurally higher than NP; the following is just a sample of these works:

- According to Ritter (1991), Hebrew quantifiers are heads of NumP dominating NP.
- According to Shlonsky (1991), Hebrew and Arabic quantifiers are heads of QP dominating NP.
- According to Benmamoun (1999), quantifiers in Arabic are heads of QP, with a genitive DP specifier; head movement subsequently raises Q into a higher head position.
- According to Shlonsky (2004), universal and partitive quantifiers in Semitic languages should be analyzed as heads of high functional projections (above DP).

In contrast to the large number of analyses that take Q to occupy a higher position than N, it is striking that no major works have argued for a systematic structural ambiguity in Semitic QNPs. The idea that Hebrew quantifiers are not uniform in their syntactic position has been discussed in Danon (1998), where it was claimed that quantifiers in construct state QNPs are heads that occupy a higher position than the maximal projection of the noun, whereas quantifiers in simple, non-CS, QNPs are specifiers; but even according to this proposal there should be no ambiguity for the class of QNPs that allow both N-agr and Q-agr – namely, construct state and partitive QNPs.

Thus, from the perspective of previous works on Semitic QNPs, any proposal for an ambiguity in QNPs would have to be supported by providing new empirical evidence that has not been noticed in previous work. In reality, however, the facts seem to argue in the opposite direction.

3.2 Properties of Hebrew QNPs

One property of Hebrew QNPs that argues against an ambiguity analysis is that the Q-agr/N-agr alternation is a cross-construction phenomenon. As shown in section 2.1, this alternation is not limited to one structural type of QNP, as it occurs both with *me* partitives and with construct states headed by a quantifier. In other languages, similar alternations occur even with simple QNPs. Furthermore, the same kind of alternation also occurs in Hebrew with construct state nominals headed by measure nouns, as illustrated below:

(14) zug studentim ba-texniyon gidlu samim
pair/couple(M.S) students(M.P) in.DEF-Technion grew.P drugs
še-yiv'u me-xul.
that-imported from-abroad
'A pair of students in the Technion grew drugs they imported from abroad.' (N-agr)

(15) zug studentim šaket mexapes dira.
pair/couple(M.S) students(M.P) quiet.M.S seeks.M.S flat
'A quiet couple of students is seeking a flat.' (Q-agr)

This means that an analysis of the agreement alternation in terms of structural ambiguity would have to apply not only to QNPs but also to construct state nominals headed by nouns. The problem is that this would contradict a highly accepted assumption in the vast literature on Semitic CS nominals: Despite various disputes on the exact structure of a CS, it is generally accepted that the first noun in a CS is structurally higher than the second, which is the lexical head of an embedded XP (see e.g. Ritter 1991 and Shlonsky 2004). In this respect, the theoretical price for adopting an ambiguity analysis seems to be particularly high.

One possible objection regarding the examples in (14)–(15) is that according to some speakers there is a semantic contrast associated with the agreement contrast in this case: while the dominant reading in (14) is the one in which *zug* receives a quantificational reading (roughly equivalent to that of the numeral '2'), the dominant reading in (15) is the one in which the couple is taken as a single entity. The question is whether this is a general property of the alternation, and whether this poses a problem to the hypothesis that there is no structural ambiguity involved here.

Regarding the first question, it should be noted that, unlike what has been reported for instance for Basque, in Hebrew there is often no truth conditional difference between QNPs triggering N-agr and those triggering Q-agr. Thus, many QNPs allow a free alternation with no clear semantic effects. This is illustrated in example (2b), repeated below as (16):

(16) 20 axuz-im me-ha-zman mukdašim / ?mukdaš le-kri'a.
20 percent-M.P of-DEF-time(M.S) devoted.M.P / devoted.M.S to-reading
'20% of the time is devoted to reading.' (Q-agr/?N-agr)

Many native speakers accept both N-agr and Q-agr in this case, with no noticeable semantic difference.

It should further be noted that the choice of agreement pattern shows no obvious correlation with semantic properties of the quantifier. There is, however, a certain correlation with the properties of the *noun*: in some cases, singular 'collective nouns' like *oxlosiya* ('population') and *cibur* ('public') in a QNP are much more acceptable with Q-agr than plural, individual-denoting, nouns. We return to these semantic issues in section 5.2. For now, what is important is the fact that these subtle semantic effects do not provide any immediate evidence for the existence of two different syntactic structures; in fact, if the difference in the interpretation of the QNP can be traced back to a lexical property of the quantifier or of the noun, it is quite likely that this is independent of any kind of structural ambiguity.

We conclude that unless strong evidence to the contrary can be found, lack of structural ambiguity is the null hypothesis. The alternative, which will be pursued here, is a feature-theoretic analysis in which the two agreement patterns (and hopefully also the subtle semantic effects associated with them) follow from a single structure, with a different distribution of features associated with each of the agreement patterns.

4 Towards an analysis

In the previous sections we have seen that, given previous evidence that Q occupies a higher head position than N, represented schematically as in (5), the existence of N-agr

raises the following problems:

Locality: How can T agree with the lower NP, 'skipping over' the higher QP?

Case: How can T agree with NP that isn't nominative?

We will start by quickly surveying the major previous analyses of QNP agreement in other languages; while none of the analyses discussed in section 4.1 can account for the Hebrew data, certain insights from these analyses are in fact present in the proposal that I eventually argue for.

4.1 Previous accounts

One of the most influential analyses of QNP agreement is the one proposed in Pesetsky (1982) for Russian; this analysis was later modified and extended by Franks (1994) to other Slavic languages. These authors argue that in Russian and Serbo-Croatian there is a categorial difference (NP/DP versus QP) between agreeing and non-agreeing QNPs; furthermore, they argue that agreeing and non-agreeing QNPs occupy two different subject positions – one giving rise to agreement with the noun, and one giving rise to default agreement.

There are, however, several reasons why this kind of analysis cannot work for Hebrew. First, in Hebrew there is no evidence for a categorial difference or for a positional difference between QNPs that trigger N-agr and those that trigger Q-agr; the various tests given by Pesetsky, which nicely show that agreeing and non-agreeing QNPs in Russian behave differently in a variety of ways, fail to show any similar distinctions in Hebrew. Furthermore, the alternation in Hebrew, unlike in Russian, is not between agreement and lack of agreement, but between two 'real' agreement patterns; thus, an analysis designed to capture the existence of a no-agreement pattern is simply not suited for the task of explaining the Hebrew pattern.

In another analysis of a Slavic language, Bošković (2006) argues that N-agr in Serbo-Croatian is a two-step process: first, Q agrees with NP; then, T agrees with QP. Following the hypothesis that agreement and case are tightly related, Bošković claims that instances where there is no agreement (default agreement) correlate with lack of a case feature on QP.

Trying to apply this kind of analysis to Hebrew, we encounter two major problems. First, as in the case of the previous approach, the fact that in Hebrew no default agreement is possible undermines the whole goal of this analysis. Other than this, in Hebrew Q and N may have different features, which means that this kind of two step agreement 'chain' analysis does not straightforwardly work for Hebrew N-agr, as it seems that the 'percolation' step should be blocked if Q has its own features.

Another work that shares many of the basic insights of Bošković's is LeTourneau (1995). LeTourneau argues that in Standard Arabic, there is optional agreement (feature sharing) between Q and NP/DP in a construct-state QNP. As this is claimed to be optional, when this agreement does not take place, Q receives default features. In both cases, T in this analysis agrees with the entire QNP, hence avoiding both the locality problem and the case problem raised by N-agr.

The objections to applying this analysis to Hebrew are mostly the same as those for applying Bošković's analysis: in Hebrew, no default agreement is possible; and furthermore, Q and N may have different features, which means that neither N-agr nor Q-agr in Hebrew follow directly from this analysis. Note also that N-agr in Hebrew is possible not only in construct-state QNPs, and hence for this kind of analysis to work the feature-sharing step cannot be taken as a construction-specific operation but must be generalized to other kinds of QNPs.

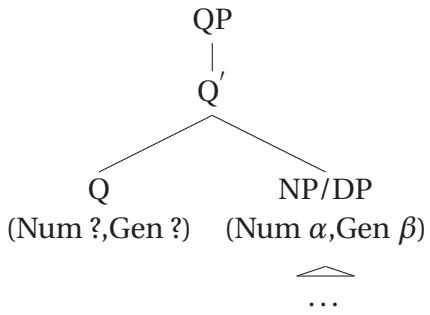
Finally, Etxeberria and Etxepare (2008,2009) account for the N-agr/default agreement alternation in Basque by arguing that in Basque, NumP is not always present in a QNP; lack of NumP leads to default number agreement and to a variety of semantic effects. Extending this analysis to Hebrew is problematic in at least two ways: First, the specific systematic semantic effects reported for Basque are not witnessed in Hebrew; and second, the N–agr/Q-agr alternation in Hebrew applies not only to number but also to gender, and hence we would have to assume an optional functional projection associated with gender, whose presence or absence coincides with the presence/absence of NumP.

4.2 Feature percolation

A dominant idea in much of the previous work surveyed above is that N-agr is the result of N's features somehow 'percolating' upwards (possibly via agreement) to the whole QNP. Under this approach, default agreement is in fact lack of agreement, which is caused either by a failure of this feature percolation to take place, or by independent factors. This line of reasoning can be found in LeTourneau (1995) for Standard Arabic; Franks (1994) for Russian/Serbo-Croatian; and Bošković (2006) for Serbo-Croatian.

Using Minimalist notation, a schematic, somewhat naive, representation of this kind of percolation analysis of N-agr, might involve an intermediate representation like the following:

(17)

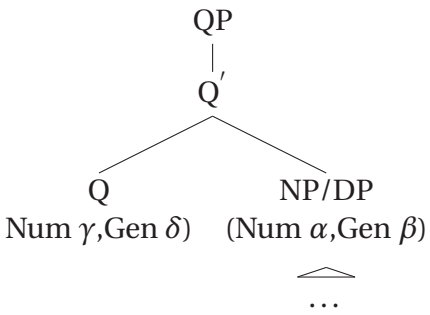


N-agr, in this approach, would be the result of a two-step derivation:

1. Q enters the derivation with unvalued gender and number
2. Q's features are valued via agreement with NP/DP

As discussed above, the main reason why, without further modifications, this kind of analysis of N-agr cannot work for Hebrew is that Q in Hebrew often has lexically-specified gender and number; in this case, N's features cannot be copied to Q because no agreement configuration exists:

(18)



In order to make an analysis of this kind work for Hebrew, what we need is a way to let features of NP be 'copied' to QP *while co-existing with Q's lexically-specified features*. In other words, what we need is for QP to have *two* separate feature sets.

This indeed has been proposed in the HPSG literature; in the next section, we briefly summarize the main points of this proposal that will be relevant for the proposed analysis of QNP agreement.

5 INDEX and CONCORD features

5.1 INDEX and CONCORD in HPSG

Perhaps the most direct piece of evidence in favor of the hypothesis that NPs carry not one, but two, sets of agreement features comes from the phenomenon of split agreement found in languages such as Serbo-Croatian. Wechsler and Zlatić (2000, 2003) discuss examples like the following:

(19) Ta dobra deca su došla.
that.F.S good.F.S children(F.S) AUX.3P come-PPRT.N.P
'Those good children came.' (Wechsler and Zlatić 2000)

The agreement in this sentence raises the question what is the gender/number of the noun *deca*: on the one hand, based on the agreement on the demonstrative and on the adjective, we may want to claim that this noun is feminine singular; but on the other hand, based on the agreement on the auxiliary and participle we may claim that it is neuter plural. Similar examples can be found in other languages; in Biblical Hebrew, for instance, the noun *'am* ('people') triggers singular agreement on demonstratives and adjectives, but may simultaneously trigger *plural* pronominal agreement:

(20) … hineni ma'axil-am et ha-'am ha-ze la'ana…
AUX.1S feed-them(M.P) OM DEF-people DEF-this(M.S) wormwood
'…I will feed this people wormwood…'

Following earlier proposals by Pollard and Sag (1994) and Kathol (1999), Wechsler and Zlatić (2000, 2003) propose that the solution is that an NP carries not one, but *two* sets of *syntactic* agreement features, referred to as INDEX and CONCORD features:

INDEX features constrain the NP's referential index, and are relevant to pronoun binding and subject-predicate agreement.

CONCORD features are more closely related to the noun's morphology, and are relevant to NP-internal concord.

According to Wechsler and Zlatić (2000, 2003), several constraints typically apply to INDEX and CONCORD features:

INDEX-CONCORD: INDEX and CONCORD features match each other

INDEX-SEMANTICS: INDEX features match the noun's semantics

CONCORD-DECLENSION: CONCORD features match the noun's morphology

In most cases, all 3 constraints apply, giving rise to 'consistent' NPs for which there is no direct evidence for the existence of two distinct sets of features. But for 'exceptional' nouns, not all of these constraints apply, and this gives rise to various kinds of mismatches.

Going back to the split agreement facts illustrated in (19) above, according to the analysis of Wechsler and Zlatić (2000, 2003), the gender and number features of a noun like Serbo-Croatian *deca* are:[2]

INDEX: neuter plural

CONCORD: feminine singular

In this case, what is reflected in the noun's morphology is only the CONCORD features; as in other cases of INDEX-CONCORD mismatches, evidence for the value of the NP's INDEX features comes only from the agreement that it triggers.

5.2 An INDEX/CONCORD analysis of QNPs

In section 4.2, the main difficulty that we saw with applying a feature percolation analysis of N-agr to the Hebrew facts was that the percolating features had to somehow coexist with the lexical-morphological features of the quantifier. The INDEX-CONCORD hypothesis provides an immediate solution to this problem. In fact, Wechsler and Zlatić (2003) discuss the QNP agreement facts in Serbo-Croatian and propose an analysis which, with very small modifications, can also be applied to the Hebrew data.

Adapting the analysis in Wechsler and Zlatić (2003) to a derivational framework, the analysis to be discussed can be summarized as following:

- Subject-verb agreement (in Hebrew) is *always* INDEX agreement with the QNP; thus, even 'N-agr' involves no direct agreement between T and the noun.[3]
- The QNP's INDEX features (which are the same as those of its head, the Q) do not always match the Q's CONCORD features; specifically, N-agr is always the result of such a mismatch.

[2] We ignore at the moment person features, which are part of the INDEX feature; and case features, which are part of CONCORD.

[3] In the remainder of this paper, I follow standard assumptions in the Minimalist literature and refer to 'subject-verb' agreement as agreement between the subject and the functional head T; there is nothing in the proposed analysis, however, that hinges on this assumption.

- Different agreement patterns follow from different mechanisms for assigning values to the QNP's INDEX features; while the grammar itself has no 'preference' for one mechanism over another, the resulting structures differ in their feature composition in a way that might be relevant at the interface with semantics.

Starting with the case of Q-agr, the derivation would thus proceed as following:

1. Q enters the derivation with lexically specified INDEX features which match its CONCORD features.
2. The QNP gets the INDEX features from its head, Q.
3. T agrees with QNP, giving rise to T carrying the same features as those specified in the lexicon for the Q.

Note that in this derivation there is no locality or case problem: what the T agrees with is the entire (nominative) QNP's INDEX features.

The case of N-agr, which seems like the one that poses the real challenge, would proceed as following:

1. Q enters the derivation with *unvalued* INDEX features.
2. The INDEX features of the Q *agree with the* INDEX *features of NP* (='percolation'); as a result, they may differ from the Q's CONCORD features.
3. The QNP gets the INDEX features from its head, the Q.
4. T agrees with QNP.

In this derivation, too, there is therefore no locality or case problem, as agreement is once again with the entire (nominative) QNP's INDEX features. This is despite giving the impression of agreement with the more deeply embedded NP.

We thus have a relatively straightforward analysis, in which the only factor that differs between the N-agr and the Q-agr case is the source of Q's INDEX features, which are valued either in the lexicon or in the syntax, via agreement. Unlike the analysis of Wechsler and Zlatić (2000, 2003), in which identity between INDEX and CONCORD is the default option, in the derivational analysis proposed above there is no default; empirically, this seems to be supported by the fact that there is no general preference for either N-agr or Q-agr in Hebrew QNPs.

There are a number of immediate advantages to this analysis:

- It is based on the INDEX/CONCORD dichotomy, which is independently motivated by the existence of mixed/split agreement constructions.
- Subject-verb agreement receives a uniform analysis, even for QNPs: It is always INDEX agreement with the whole QNP.
- Because of the ways in which INDEX and CONCORD features are related to semantics, morphology and to each other, this analysis provides a framework for analyzing the effect of interfaces with semantics, morphology and the lexicon on QNP agreement.

The issue of interactions with the semantics is particularly intriguing. Since INDEX features are not mere symbols, but constraints on the referential index, we should expect a certain semantic difference between the case in which Q and NP share INDEX features (N-agr) and the case in which each has its own (Q-agr). This might provide the basis for an explanation of the fact that N-agr is sometimes judged as marginal with singular count nouns, as illustrated in the following contrast:

(21) xeci me-ha-mexonit nirtav / ??nirteva.
half(M.S) of-DEF-car(F.S) got.wet.M.S / got.wet.F.S
'Half of the car got wet.' (Q-agr/??N-agr)

(22) xeci me-ha-anašim nirtevu / *nirtav.
half(M.S) of-DEF-people(M.P) got.wet.P / got.wet.M.S
'Half of the people got wet.' (N-agr/*Q-agr)

The salient reading of the fully grammatical Q-agr case in (21) is that in which it refers to some identifiable half of the car (the left half, the front half, etc). In contrast, the salient reading of (22) is the 'true' quantificational one ('the number of people who got wet is half the total number of people'). Under the proposed analysis, this might follow from the hypothesis that (21) has a distinct INDEX on the Q, thus making it more referential. It is beyond the scope of the current paper to fully develop this semantic analysis; but I believe that an analysis along these lines could provide an elegant account for some of the subtle semantic consequences of the N-agr/Q-agr alternation. Furthermore, the same kind of reasoning could account for the loss of agreement with certain nouns like *min* ('kind', 'sort') when used non-referentially in constructions like the following:[4]

(23) hayta li min txuša mešuna.
was.F.S to.me kind(M.S) feeling(F.S) strange.F.S.
'I had a kind of strange feeling.'

While the noun phrase in (23) has the form of a construct state headed by the masculine noun *min*, verb agreement in this case is with the feminine *txuša*. Applying the same analysis as for QNPs, this could be explained as being the result of *min* lacking in this case independent INDEX features and sharing the same INDEX as the referential noun that follows it. Thus, while normally nouns would enter the derivation with INDEX features valued to match the noun's CONCORD features, certain nouns used modificationally may enter the derivation with unvalued INDEX, which would then be valued via agreement with a structurally lower noun phrase. The generalization that seems to emerge is that a referential head enters the derivation with its own valued INDEX features, while a non-referential head (whether quantificational or not) may value its INDEX features via agreement.

[4] I am grateful to Olivier Bonami for pointing my attention to these facts by providing me with similar French data involving the noun *espèce* ('sort'). The fact that a nearly identical pattern is found in two unrelated languages such as Hebrew and (informal) French is of course expected under the proposed analysis, which relies on the core properties of supposedly universal features rather than on any language-specific phenomenon.

5.3 Adapting the analysis to the Minimalist framework

The analysis presented so far is essentially the analysis of Wechsler and Zlatić (2000, 2003). While implementing this analysis within the HPSG framework, for which it was originally proposed, is straightforward, the question that the remainder of this paper will focus on is whether it is possible to formulate the same kind of analysis within the Minimalist framework.

Before addressing this question, we must first of all answer a much more fundamental question: What is a feature? Somewhat surprisingly, the Minimalist framework does not have an integral, explicit feature theory; the following 3 basic questions are still, to a large extent, without formal and universally-accepted answers within mainstream Minimalism:

1. Are features atomic symbols or ordered pairs of symbols (attribute-value pairs)?
2. Can/do features have their own features or sub-features?
3. Does the grammar contain a mechanism (beyond legibility at the interfaces) for constraining possible feature combinations?

Obviously, the first two questions are tighly related: in a grammar where features are atomic symbols (i.e., in a grammar using privative features), features obviously have no sub-features. Let us therefore focus on the view that 'features' are ordered pairs of symbols, an attribute and a value:

Attribute: the feature 'name', e.g., *case*, *number*, etc

Value: the feature value, e.g., *nominative/accusative...*; *singular/plural*; etc

While attributes are more or less universally assumed to be atomic symbols, it is less obvious how complex the values may be. While constraint-based formalisms such as HPSG and LFG explicitly define values recursively as potentially complex, there has been very little explicit discussion in Minimalism of the possibility of assuming complex features. While in common practice, Minimalist analyses almost always limit themselves to values that are atomic symbols, very little has been said about whether the value of a feature could also be a *set* of symbols, or a set of attribute-value pairs.

One of the few works that have addressed this question explicitly is Adger (2010). According to Adger, features have no hierarchical structure, i.e., values cannot be attribute value pairs; Adger argues for this view as part of the hypothesis that Merge is the only mechanism for creating structure in human language. Hence, Adger explicitly hypothesizes that complex features are not necessary for formulating adequate Minimalist theories of natural language phenomena.

In another paper, Adger and Svenonius (2009) propose a somewhat more complicated answer to the question 'what is a (syntactic) feature?', which makes a distinction between several types of features:

- First order features, which are atomic symbols
- Second order features, which are also atomic symbols

- Complex features, which are a combination (an ordered pair) of a first order feature and a second order one

To take one concrete example, Adger and Svenonius claim that T is a first order feature, EPP is a second-order feature, and T_{EPP} is a complex feature ('T that has an EPP feature'). While this notion of 'complex feature' is much more restricted than the kind of complex feature assumed in HPSG/LFG, Adger and Svenonius' proposal does bring forth the fact that an attempt to formalize some uses of the term 'feature' in Minimalism might require some amount of complexity that goes beyond simple atomic features. Some other Minimalist notions that seem to imply a certain amount of complexity within features are feature strength, feature interpretability, and features that are dependent on other features (such as tense, which depends on finiteness).

Back to the issue of formulating an INDEX/CONCORD analysis of QNPs within the Minimalist framework, the question is whether this can only be done using complex features. For the analysis of N-agr in terms of INDEX agreement between Q and NP, we want to be able to say things like:

Informal statement: In a partitive QNP with a plural noun, a quantifier like *xelek* ('part') has an INDEX plural feature and a CONCORD singular feature.

This means that we need to allow *two separate number features* on the same head. The question is whether this can be done without complex features. What is quite clear is that this cannot be done using privative (monovalent) features, as allowing PLURAL and SINGULAR to co-exist on the same node would lead to meaningless or contradictory representations if nothing distinguishes the two features from each other.[5] Similar objections apply to the possibility of allowing for the co-existence of [NUMBER *plural*] and [NUMBER *singular*] on the same node as simple features in a multivalent (attribute-value) system; grammars formalizing features as attribute-value pairs usually explicitly prohibit the option of a node carrying two attribute-value pairs with the same attribute but with two different values.

One technical way to avoid this problem, without assuming complex features, would be to use two different attribute names. Thus, something like [NUMBERI *plural*] and [NUMBERC *singular*] (using two different feature labels) would not be a contradictory representation. The problem with this approach, however, is that, if nothing else is added, it would lead to a grammar that does not *explicitly* express the fact that both of these are NUMBER features, instead leaving this fact as an implicit 'understood' property of the formulation of the analysis. The only way to make such an approach fully explicit would be to augment it with an additional module (outside of 'narrow syntax') to express relationships and dependencies between different features, perhaps along the lines of the 'Feature Co-occurrence Restrictions' of the GPSG framework of Gazdar et al. 1985; or, simply, by explicitly specifying as part of the grammar all the possible values of each feature, hence grouping together both number features by virtue of having the property of allowing the same possible values (which would mean that this approach is not compatible with a grammar based on binary features, where all features can have the values '+' or '-'[6]). From the point of view of the architecture

[5] There have been proposals to account for things like dual number in terms of coexisting singular and plural, but this is irrelevant to the kind of phenomenon under discussion here.

[6] This has been pointed out to me by Olivier Bonami.

of Minimalist grammar, such 'auxiliary' modules would imply a relatively high price in terms of the overall complexity of the theoretical framework; whether this is better than the alternative to be discussed below is left as an open question.

An alternative way to express the INDEX/CONCORD distinction would be to use complex features (as in the original HPSG analyses), which would make forming an explicit and coherent representation quite straightforward: there is no incompatibility or contradiction between [INDEX [NUMBER *plural*]] and [CONCORD [NUMBER *singular*]], where the fact that both of these are number features is stated explicitly. The intermediate conclusion is that expressing an INDEX/CONCORD analysis of QNP agreement in a fully explicit manner requires either complex features, or having the grammar augmented by some additional system that would state relationships between features that have distinct labels in their syntactic representation.

We should note, on the other hand, that even though the discussion above points towards the need for a certain amount of complexity in the representation of features, the amount of complexity that is required in this case is quite minimal. Specifically, the problem of QNP agreement does not seem to require *unlimited recursion* in the feature system, of the type used in HPSG and LFG, but only a fixed amount of structure. Thus, what is proposed here does not entail turning Minimalism into something like a derivational version of HPSG, but merely adopting one specific formal detail that is used in the latter framework into the former. It should also be noted that this kind of structure within the feature system is, in fact, already implicit in most Minimalist analyses that involve rules that refer specifically to the cluster of ϕ-features, as opposed to all other features; the degree of complexity that is argued for in this paper would also allow for this kind of 'clustering' of features to be formally and explicitly expressed with no need for any additional machinery.

5.4 The mechanism of agreement

While allowing complex features is a crucial step towards making the proposed analysis compatible with the Minimalist framework, there is an additional issue that we need to consider, which has to do with the mechanism of agreement.

According to Chomsky (2000, 2001), following successful Agree, the features of the probe are deleted and are no longer available for further operations. This, however, poses a problem to the proposed analysis of N-agr. According to the analysis proposed above, N-agr follows from agreement between Q and NP:

1. Q enters the derivation with unvalued INDEX features.
2. Q's INDEX features are valued by Agree with NP's INDEX features.
3. T's (INDEX) features are valued by Agree with the QNP's INDEX features.

The problem with this derivation is that if Q's features are deleted after the second step, as expected under Chomsky's formulation of the Agree operation, they should not be available as goals for T's features in step 3. More generally, deletion following Agree seems not to be compatible with any kind of bottom-up feature percolation analysis.

Luckily, there is an alternative view of the operation Agree which does not raise this problem. According to Frampton and Gutmann (2006) and Pesetsky and Torrego

(2007), Agree is a *feature sharing* operation, and not feature copying; and, what is crucial to the current discussion, these authors argue that features are *not* deleted following Agree, but remain present on all nodes on which the features are shared, with various interface conditions determining where each feature is to be interpreted.

Under this formulation of Agree, the proposed analysis of N-agr is straightforward:

1. Q enters the derivation with unvalued INDEX features.
2. Q and NP agree (share INDEX features)
3. T and QNP agree (share INDEX features)

Thus, using feature sharing, the apparent non-local agreement between T and N can be accounted for in this way as a sequence of two local agreement operations, thus providing a current formal account of the intuition that N-agr involves some sort of upwards feature percolation. We hence conclude that the patterns of QNP agreement provide additional evidence in favor of the feature sharing model of Agree as opposed to the copy-and-delete model.

6 Conclusion

This paper has argued that the facts of Hebrew QNP agreement, which seem at first to pose a real problem to the the hypothesis that agreement is subject to strict locality constraints, can in fact be shown to be compatible with these constraints if one adopts some sort of upwards feature percolation analysis of N-agr; this, in turn, was shown to require the use of two distinct sets of agreement features which co-exist on the same node. Thus, if, as we have claimed, there is no structural ambiguity in alternating QNPs, analyzing N-agr in Hebrew requires the framework to allow a certain amount of complexity in its feature system – either by using complex features, where sets of features can be 'embedded' as values of other features, or by augmenting 'narrow syntax' with an 'external' system specifying constraints on what values each feature can take. However, I have argued that even under the complex feature approach, only a minimal amount of feature-internal complexity is required, and that the data under discussion does not provide evidence that unlimited recursion is required in the feature system.

A second general theoretical conclusion has to do with the model of agreement and feature valuation. I have shown that for the proposed analysis to work, an INDEX feature on a QNP must not be deleted after it has been valued by agreement with the lower nominal. This, in turn, supports the recently-proposed feature sharing formulations of Agree, which make it possible to implement the analysis of N-agr without running into the problems that arise if this analysis is implemented using Chomsky's (2000, 2001) model of Agree as copying and deletion.

Even though the motivation for the proposed analysis was based purely on syntactic considerations, it naturally leads to interesting questions regarding feature interpretability. If we distinguish between INDEX and CONCORD features, the question that arises under a modular model of grammar is where each of these features is interpreted. The natural hypothesis, which mirrors the role of these features in the HPSG

framework, is that INDEX features are interpretable at the syntax-semantics interface, while CONCORD features can only be (optionally?) interpretable at the syntax-morphology interface. This implies that either 'interpretability' cannot be defined as only 'LF interpretability'; or, that *all* CONCORD features – and not only Case (which has not been discussed in this paper, but is classified as a CONCORD feature in the HPSG literature) – are uninterpretable. Either way, the distinction between the two types of features might lead to a more structured account of the ways in which features are mapped from syntax to other modules, with each of the two feature 'clusters' acting in a uniform manner.

Back to the empirical problem of QNP agreement, the INDEX/CONCORD analysis provides a simple way to account for the availability of both N-agr and Q-agr, where the source of the alternation between the two agreement patterns is simply that Q's INDEX features are only optionally valued in the lexicon. Under this analysis, N-agr does not really pose a problem to standard assumptions regarding the locality of agreement and the interaction between agreement and case. Thus, while the analysis does incur a certain theoretical 'price' in terms of the complexity of features, this allows us to maintain other central hypotheses for which otherwise the data under consideration might seem to pose a counterexample.

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