NUMBER AGREEMENT BETWEEN POSSESSIVE PRONOUNS AND HEAD NOUNS: AGREE OR NOT?*

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1. Introduction

The English possessive pronoun construction has been one of the central concerns in the history of generative grammar because it is potentially associated with more than one interpretation and the ambiguity poses a lot of challenging problems for the theory of adult grammar and the theory of language acquisition. For example, when a possessive pronoun occurs inside of the object noun phrase as in (1), it can be interpreted in either of the following two ways: it can be bound to the subject and given an interpretation through the binding (the bound variable interpretation), or it can be interpreted independently from the subject and given an interpretation from a discourse (the free variable interpretation).

(1) John bites his apple. (his = John or some entity given in a discourse, say, Bill)

Many proposals have been made to explain the ambiguity associated with English possessive pronouns (Chomsky (1981), Fiengo and May (1994) among others) and many studies have been conducted to investigate how English-learning children acquire such an ambiguity (Pérez-Leroux and Roeper (1999), Pérez-Leroux, Schmitt, and Munn (2002), and Foley et al. (2003) among others). However, few of them were concerned with a morpho-syntactic requirement observed within a possessive phrase: the requirement that possessive pronouns and head nouns have to agree in number.

Possessive pronouns and head nouns are required to agree in number when certain types of body-part nouns are used. To illustrate, consider the contrast between (2a) and (2b). The possessive pronoun can be interpreted as either being bound to the subject or independently from the subject when the head noun has singular morphology as in (2a). If it is bound, the sentence yields an inalienable interpretation. If it is not, the sentence yields an alienable interpretation. In contrast, when the head noun has plural morphology as in (2b), the inalienable interpretation is no longer available.

(2) a. The boy is cleaning his face. (inalienable interpretation, alienable interpretation)
     b. The boy is cleaning his faces. (*inalienable interpretation, alienable interpretation)

To my knowledge, no study has raised the issues of why adult English native speakers

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can make such judgment and when and how English-learning children obtain the adult restriction. A theory of adult grammar which assumes distinction between intrinsic and optional features on nominals, the Minimalist Program (Chomsky (1995) afterwards) as one example, allows us to open a new window when we work on these issues, and evidence from language acquisition enables us to see if given analyses or assumptions behind them are tenable or not. The aim of this paper is, as a first approach to the issues, to provide a new set of data on the acquisition of the possessive pronoun construction in English, focusing on number agreement between possessive pronouns and head nouns. First, this paper briefly summarizes the morpho-syntactic properties of this construction to be focused on and two possible analyses of them. Then, this paper presents experimental results which confirm different predictions made by the two analyses. Based on the data, this paper argues that semantic/pragmatic computation, not a syntactic operation, Agree (Chomsky (1995, afterward)), is responsible for the number agreement.

2. Number Agreement within a Possessive Phrase

English possessive pronouns are similar to reflexive anaphors in that they have to agree with their antecedents in person and number (and gender if they are singular) to have a bound variable interpretation. In (3a) and (3d), the subject is 3rd person singular (masculine). The pronominal part of the reflexive anaphor in (3a) and the possessive pronoun in (3d) agree in these features with the subject, and hence they can be bound to the subject.

(3)   a. John washed himself.
   b. *John washed herself.
   c. *John washed themselves.
   d. John, washed his, face. / John, put his, book on the shelf.
   e. John, washed her, face. / John, put her, book on the shelf.
   f. John, washed their, face. / John, put their, book on the shelf.

However, possessive pronoun phrases differ from reflexive anaphors in their grammatical status when these features mismatch. The mismatch makes a sentence with a reflexive anaphor ungrammatical as in (3b) and (3c), but it does not lead to ungrammaticality of a sentence with a possessive pronoun as in (3e) and (3f). The possessive pronoun in (3e) or (3f) is not necessarily bound to the subject, and it can be interpreted to refer to some entity given in a discourse. Therefore, bound variable interpretations are not available in (3e) and (3f), but free variable interpretations are possible.

In addition to the difference in DP-external morpho-syntactic requirements, reflexive anaphors and possessive pronoun phrases also differ in DP-internal behavior. The pronominal part and –self part of reflexive anaphors obligatorily agree in number, but the pronominal part and head of possessive pronoun phrases do not. The combination of a pronominal part with singular morphology and –self part with plural morphology, or vice versa, is illicit and ruled out by grammar as shown in (4).

(4)   a. *himselves / *herselves
   b. *themself

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1 The form in (4b) has come to be used in order to avoid mentioning gender as in (i). I would like to express my gratitude to Christopher Tancredi for pointing out this possibility.

(i) If a person injures themself, they should see a doctor.
b. [John and Bill], put their book/books on the shelf.

Interestingly, when body-part nouns are used as head nouns, a requirement similar to the one imposed on reflexive anaphors seems to hold. The sentences in (6) have the body-part noun *face* in the object position. Most native speakers say that the sentence in (6a) is unnatural or even ungrammatical when it is used out of the blue.

(6)  a. John, cleaned his faces.
b. John, cleaned her faces.
c. John, cleaned their face.

However, these sentences are not completely ruled out as illicit sentences. Although they never yield “true” inalienable possessive interpretations, they can be made felicitous given appropriate contexts. For example, imagine a situation where John, who is a sculptor, carved his face in marble and made copies of the work. This situation makes the bound variable interpretation of (6a) felicitous, if he cleaned the copies. The bound variable interpretation is also possible even if the models of his works are not John himself. They can be modeled on different people, say, Mary, Sue, and Lilly. The free variable interpretation is also made felicitous if an appropriate context is provided, for example, the sculptor is a person other than John, say, Bill, and John has a responsibility to clean Bill’s works. The sentences in (6b) and (6c) also require appropriate contexts to be made felicitous, although they have only the free variable interpretation because of the mismatch in number/gender between the pronoun and the subject.

The effect of semantic properties of head nouns can also be seen in the contrast between the sentences in (6) and those in (7). In (7), the noun *ears* is used, which also denotes body parts and is marked as plural. In this case, the inalienable interpretation of the sentence doesn’t sound unnatural because we can easily imagine a situation where someone is pulling both of his/her own ears.

(7)  a. John, pulled his ears.
b. John, pulled her ears.
c. John, pulled their ears.

There is no doubt that our knowledge about head nouns plays a role in our judgment on these sentences and that body-part nouns make us sensitive to the number morphology on them when we judge the appropriateness of the sentences.

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2 This reminds us of Ringo sentences, which Jackendoff (1997:73) considers in detail. Interestingly, reflexive anaphors allow a non-coreferential use and the possibility depends on semantic properties of predicates. Suppose that Ringo Starr is in a wax museum and there is a statue of him. (i) is an acceptable utterance by a person who sees Ringo undressing the statue, but (ii) is unacceptable even if the person sees him falling on the statue.

(i) Ringo starts undressing himself.
(ii) Ringo falls on himself.

This fact is related to our discussion, but we cannot go into this topic further. A fact worth pointing out here is that the following sentence is never allowed even if there are multiple statues and Ringo undresses the all of them.

(iii) *Ringo starts undressing themselves.
3. **Two Possible Analyses of the Number Agreement and Their Predictions on the Acquisition**

Given the observations above, the following question arises.

(8) How are the morpho-syntactic similarities between reflexive anaphors and possessive pronouns with body-part nouns explained under the current theory of adult grammar?

Under the Minimalist-based theory of binding (Reuland (2001, 2011), Gallego (2010)), both DP-external and DP-internal morpho-syntactic properties of reflexive anaphors are explained in terms of a narrow syntactic operation, namely, Agree. For example, Gallego (2010) argues that the referential dependency between a reflexive anaphor and its antecedent can be established through multiple Agree in narrow syntax. In a normal transitive sentence with two referential arguments, the internal and external arguments are in an agreement relation with C and $v^*$, respectively, as in (9). The external argument agrees with C, values C’s unvalued $\phi$-features and gets its case feature valued. The internal argument agrees with $v^*$, values $v^*$’s unvalued $\phi$-features and gets its case feature valued.

(9) $\text{[CP C } \ldots \text{ [CP T } \ldots \text{ [v_p EA } v^* \ldots \text{ [VP V } \ldots \text{ IA]]]}}$ (Gallego (2010:165))

A crucial assumption here is that a reflexive anaphor is $\phi$-defective and cannot value unvalued features on $v^*$. When a transitive verb takes a reflexive anaphor as its internal argument, its unvalued features cannot get valued and it has to wait for another goal which can value and erase these features before the derivation is transferred. This is achieved via multiple Agree with the external argument and C- $v^*$ as in (10).

(10) $\text{[CP C } \ldots \text{ [CP T } \ldots \text{ [v_p EA } IA [v^* \ldots \text{ [VP V } \ldots \text{ tIA]]]}}$ (Gallego (2010:165))

Under this system, the reflexive anaphor is in an indirect Agree relation with the subject. As a result of the Agree relation, syntactic dependency is established, which is mapped onto the same variable at the C-I interface. Although there are some differences in technical details, especially in the reason why $–self$ has to be adjoined to the verb, Reuland (2001) also proposes an analysis in which the referential dependency between the subject and the reflexive anaphor is established in narrow syntax through Agree.

If we assume that Agree as the only possible way to encode syntactic dependency, we are left with two options for explaining the number agreement between possessive pronouns and head nouns as in (11).

(11) a. Analysis 1: The agreement between possessive pronouns and head nouns results from a syntactic operation Agree.
    b. Analysis 2: The agreement between possessive pronouns and head nouns results from semantic/pragmatic computation.

Analysis 1 attributes the number agreement between possessive pronouns and head nouns to the narrow syntactic operation, Agree. This analysis enables us to subsume the requirement for the number agreement under the theory of binding. In doing so, however, an additional assumption is required that both a possessive pronoun and a head noun are $\phi$-defective and cannot value unvalued features on $v^*$. If they are not, their $\phi$-features give values to the
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features on v* and there is no possibility for them to be in an Agree relation with the external argument. Such assumptions might not be an implausible when cross-linguistic variations are taken into consideration and if a theory of adult grammar is adapted which assumes distinction between intrinsic and optional features.

Many languages have two possessive forms; one without full φ-feature specification (possessive anaphor) and the other with full specification (possessive pronoun). In some of them, one-to-one form-meaning correspondence is observed. For example, consider the following Japanese sentence.

(12) Taroo-ga zibun-no/kare-no e-o kai-ta.
    Taro-Nom self’s/his picture-Acc drew

‘Taro drew his picture.’ (Haegeman (1991:232))

The possessive form zibun-no is not fully specified for its φ-features; it is singular, but neutral about gender (and person). The possessive form kare-no, on the other hand, has full specification; it is singular, masculine and 3rd person. The sentence yields a bound-variable interpretation with zibun-no and a free-variable interpretation with kare-no. If such distinction is available as a UG-option, it would be possible that English also has two possessive forms, which happen to have the same phonetic realization.

The distinction between intrinsic and optional features makes it possible for nominals to be inserted into a derivation without specification of number features. Number is not an intrinsic property of nominals but optional, and hence its value is not specified in the lexicon. Although it is not a standard Minimalist assumption, let us tentatively assume that only certain semantic types of nominals can be inserted into a derivation without specification of number features.3

Under these assumptions, the number agreement between possessive pronouns and head nouns follows as a result of multiple Agree. To illustrate, let us consider the derivation of the sentence in (2a). The transitive verb clean takes his face as its internal argument. Its unvalued features cannot get valued because his face does not have fully specified φ-features. The verb has to wait for another goal which can value the unvalued features. This can be achieved multiple Agree as illustrated in (13). As a result, the possessive pronoun and the head noun are in an indirect Agree relation with the external argument the boy.4

(13) [CP C … [CP T … [v*P the boy his face [v* … [VP cleaned … t[his face]]]]]

Analysis 2, on the other hand, attributes the requirement for the agreement to semantic/pragmatic computation. Under Analysis 2, the seemingly obligatory agreement follows from our world knowledge about body-part nouns. The contrast between body-part and non-body-part nouns in the acceptability of sentences is observed not only in the possessive pronoun construction but also in the bare plural object construction as in (14).

3 Or alternatively, adopting the layered structure within DP (Munn and Schmitt (2005), Watanabe (2006)), we can assume that nominals can be inserted into a derivation without projections above NumP, which hosts number features. Contrary to this, Chomsky (1995) argues that optional φ-features on nominals are specified upon numeration. See Chomsky (1995: 235-237) for detail.

4 Under Analysis 1, the unavailability of the inalienable interpretation in (2b) is explained as follows. Number features of head nouns are valued as a result of Agree, and hence a sentence with a singular subject and a plural head noun can never be derived.
Most adult native speakers judge sentence (14a) unnatural, but they accept sentences (14b) and (14c) without any question and it is felicitous for them to answer “Yes, one” to the question (14b) or to raise their hands for (14c) even if they have only one child. According to semantic literature (Sauerland (2003) for example), bare plurals allow singular reference and its availability is contextually determined. Our knowledge tells us that dogs have only one tail and this makes it infelicitous for adult speakers to ask a question like (14a) (Sauerland et al. (2005)). The same reasoning applies to the case under consideration. Our knowledge tells us that human beings have only one face, and hence, the singular form of the body-part noun is preferable under the inalienable interpretation as in (2a).

These two analyses provide different predictions on the acquisition of the number agreement between possessive pronouns and head nouns as in (15).

(15) a. Analysis 1: Children would show sensitivity for number agreement between possessive pronouns and head nouns as soon as they have learned number morphology on nominal expressions.
   b. Analysis 2: Children would not show sensitivity for number agreement between possessive pronouns and head nouns even if they have learned number morphology on nominal expressions.

Under Analysis 1, the agreement follows as a result of a syntactic operation, Agree. The operation is given in UG and available from the onset of language acquisition. Children do not have to learn any language-specific or construction-specific rules except for the number morphology in their target language. Hence, it is predicted that English-learning children would show fully adult-like knowledge about the agreement as soon as they have learned the number morphology on nominals in English. Under Analysis 2, on the other hand, the agreement does not follow from a syntactic operation. Rather, the requirement is imposed by semantics/pragmatics, whose rules have to be learned on the basis of language specific evidence. Then, it might take long for children to get adult-like knowledge about the requirement and there might not be any correlation between the acquisition of the number morphology and the requirement.

4. Experiment 1: Children’s Knowledge about Number Morphology

4.1. Procedure and Subjects

In order to see the correlation between the acquisition of number morphology and that of the number agreement under consideration, two experiments were conducted. The first experiment investigated whether children could interpret number morphology on nominals in an adult-like manner. This experiment was intended to gather base-line information before the second experiment. In accordance with children’s responses in this experiment, they were divided into two groups.

This experiment had three test conditions, which differed in the morphological property of the object: the indefinite singular condition, the bare plural condition, and the definite plural condition. Children were shown two pictures sequentially and asked a simple yes-no question. For example, while a picture was presented on a screen of a lap-top computer, an instruction about the picture was given as in (16a). Then, the second picture showed up, and a question about the picture was given as in (16b). The question included any one of the
following: the indefinite singular, bare plural, or definite plural object. In all the second pictures, the person was holding one of the two items given (for example, in (16b). Suzi was holding one of the two dolls). Thus, the expected response should be “yes” in the indefinite singular condition, but “no” in the bare plural and definite plural conditions. Each condition had two items, and the test items amounted to six in total.

(16) a. This is Suzi. She is looking at dolls that she likes.
   b. Did Suzi take {a doll/dolls/ the dolls}?

Previous studies on the acquisition of number morphology (Sauerland et. al. (2005), Nakato-Miyashita (2011a, b) among others) have shown that English-learning children have difficulty making a singular-plural distinction even around the age of six, if number is marked only on nominals. Because of this, children older than six were recruited in this experiment. Fifty-two children participated in this experiment, whose ages range from 6;01 to 8;08 (16 6-year-olds, 19 7-year-olds, and 17 8-year-olds). They all speak English as their native language. They were tested individually in a quiet room at an elementary school. One experimenter, a native speaker of English, gave the instructions and the questions, and the other experimenter kept records.

4.2. Results

The result of the first experiment is summarized in Table 1. As expected, it seemed difficult for children to make a singular-plural distinction solely based on the number morphology on nominals. It is generally said that children tend to give yes-responses if they are uncertain about their responses, and the tendency was observed in our experiment, too. Admitting that only one no-response out of four was not strong enough to ensure that children had learned the semantics associated with the number morphology, we classified the children who could say “no” to at least one of the four test items into the N(o)-group and those who could do so for none of the four items into the Y(es)-group.

5 With respect to permissible responses to the bare plural condition, individual differences were observed even among adult native speakers. As illustrated in (14), bare plurals sometimes allow singular reference. In fact, some adult native speakers said that they were not sure about their responses to this condition. For them, both yes- and no-responses were permissible.

6 In both of the two experiments, some filler items were also included in order to make sure that children could give no-responses if they were certain about their responses.

7 For one of the reasons we applied this evaluation standard, see note 5.
Table 1: The number of children classified into N-/Y-groups

<table>
<thead>
<tr>
<th></th>
<th>Y-group</th>
<th>N-group</th>
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</thead>
<tbody>
<tr>
<td>6-year-olds</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>7-year-olds</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>8-year-olds</td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>

Most of the sixteen 6-year-old children could not say “no” to the bare plural and definite plural conditions. Only three could say “no” to at least one of the four items. More than half of the nineteen 7-year-old children could not say “no” to the plural conditions, either. Eight children could say “no” to at least one of the four items. More than half of the seventeen 8-year-old children could say “no” to the plural conditions. At this age, most of the children could consistently say “no” to the plural conditions. Twelve children were classified in the N-group.

5. **Experiment 2: Children’s Knowledge about the Number Agreement**

5.1 **Procedure and Subjects**

The second experiment was intended to investigate when children acquire fully adult-like knowledge about the agreement between possessive pronouns and head nouns. Children were given a picture in which two people were doing some action and were asked a yes-no question about the picture. This experiment had eight test items and they were divided into two types: four were target items which were intended to induce no-responses from children and four were control items which were biased toward yes-responses. The target items had singular marking on potential antecedents, verbs, and possessive pronouns (the singular condition) and the control items had plural marking on them (the plural condition). All eight questions had body-part nouns as head nouns, but they were divided into two sub-types by the semantic properties (or pragmatic presuppositions) associated with the head nouns: four of them had body-part nouns which human beings have one of (the non-pair condition) and the remaining four had those which human beings have two of (the pair condition). The examples of our target and control items are given in (17). As shown in (17), all the entities depicted in the pictures were doing the actions denoted by the predicates. In the singular conditions ((17a) and (17b)), the subjects, verbs and possessive pronouns had singular morphology. In order to make singular marking felicitous, the distributive quantifier each was used. Only the head nouns had plural morphology, which is not permissible in adult grammar. In the plural conditions ((17c) and (17d)), all the subjects, verbs, possessive pronouns, and head nouns had plural morphology, which is perfectly fine in adult grammar. In the non-pair condition ((17a) and (17c)), body-part nouns which presuppose one-to-one correspondence between body-parts and individuals were used. In the pair condition ((17b) and (17d)), those which presuppose two-to-one correspondence were used.

(17) Target Items: Singular Condition
   a. Non-pair Condition:
      Is each boy touching his heads?
   b. Pair Condition:
      Is each boy pulling his ears?
Control Items: Plural Condition
c. Non-pair Condition;  
Are the boys cleaning their faces? 

The experiment had two items for each condition (the singular/non-pair, singular/pair, plural/non-pair, plural/pair conditions), which accounted for the eight items in total. This experiment consisted of two sessions and each session had one item for each condition. In these two sessions, the four questions were given in different orders so that children would not be biased by the order.

Based on the result of the first experiment, thirty-five out of the fifty-two children were asked to participate in the second experiment. In addition to three 6-year-olds, eight 7-year-olds, and eight 8-year-olds from N-group, three 6-year-olds, eight 7-year-olds, and five 8-year-olds from Y-group were also recruited as a control group. Four of them could not complete the experiment and thirty-one children completed the experiment, with ages ranging from 6;05 to 8;08 (five 6-year-olds, fifteen 7-year-olds, and eleven 8-year-olds, with the mean age of 7;08). As the first experiment, each child was tested individually. One experimenter, a native speaker of English, gave a question and the other kept records.

5.2. Results

The percentages of adult-like responses (“no” to the singular condition and “yes” to the plural condition) are summarized in Table 2.

Table 2: Percentages of adult-like responses

<table>
<thead>
<tr>
<th></th>
<th>Plural Condition</th>
<th>Singualr Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-year-old N-group</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>6-year-old Y-group</td>
<td>83.3</td>
<td>16.7</td>
</tr>
<tr>
<td>7-year-old N-group</td>
<td>93.8</td>
<td>18.9</td>
</tr>
<tr>
<td>7-year-old Y-group</td>
<td>96.4</td>
<td>14.3</td>
</tr>
<tr>
<td>8-year-old N-group</td>
<td>85.7</td>
<td>42.9</td>
</tr>
<tr>
<td>8-year-old Y-group</td>
<td>93.8</td>
<td>18.8</td>
</tr>
</tbody>
</table>

The children were asked to say “yes” or “no” to the questions, but some of them gave additional comments after their yes-responses. For example, one child from the 8-year-old group gave the comment in (18a) after giving a yes-response to the question in (17c). Another child from the 7-year-old group gave the comment in (18b) after giving a yes-response to the question in (17b).

(18) a. Yes, … but a person has only one face.  
     b. Yes, … but he only has one.

These might indicate that the children wanted to reject the sentences. Therefore, the
percentages are recalculated: the responses with these comments are subtracted from the yes-responses in the plural condition and added to the no-responses in the singular condition. The recalculated percentages are summarized in Table 3.

Table 3: Percentages of adult-like responses based on children’s additional comments

<table>
<thead>
<tr>
<th>Group</th>
<th>Plural Condition</th>
<th>Singular Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-year-old N-group</td>
<td>100</td>
<td>12.5</td>
</tr>
<tr>
<td>6-year-old Y-group</td>
<td>83.3</td>
<td>33.3</td>
</tr>
<tr>
<td>7-year-old N-group</td>
<td>93.8</td>
<td>43.8</td>
</tr>
<tr>
<td>7-year-old Y-group</td>
<td>96.4</td>
<td>28.6</td>
</tr>
<tr>
<td>8-year-old N-group</td>
<td>85.7</td>
<td>42.9</td>
</tr>
<tr>
<td>8-year-old Y-group</td>
<td>87.5</td>
<td>31.3</td>
</tr>
</tbody>
</table>

In all groups, the children could give yes-responses to the plural conditions highly above the chance-level (50% in this case). They had difficulty giving no-responses to the singular conditions and the rates of adult-like responses stayed below chance-level even at the age of eight (see Table 2 and Table 3). When the responses like (18) were taken as rejections, a slight difference was observed between the 6-year-old group, and the 7-year-old and 8-year-old groups (see Table 3). The children in the 7- and 8-year-old N-groups gave much more no-responses than the others. However, statistical analysis revealed that there was no correlation between Y-/N-group and their response pattern to the target items. ANOVA was used to test for differences among the groups. No significant difference was observed between N-group and Y-group for both conditions (Plural Condition: F(1,29)=0.000, p>0.05, Singular Condition: F(1,29)=0.651, p>0.05). This suggests that children cannot detect a number-mismatch between possessive pronouns and head nouns even if they have learned number morphology.

6. Conclusion

This paper has focused on the number agreement observed in English possessive pronoun phrases. After providing two possible analyses and their predictions, this paper has presented the results from the experiments which investigated children’s knowledge about the number agreement. The results have shown that the number agreement between possessive pronouns/antecedents and head nouns is not easy for children to acquire. Children have difficulty detecting the number mismatch even if they seem to be fully aware of number morphology on nominals. The statistical analysis has not shown any correlation between the acquisition of number morphology and that of the number agreement, which suggests that the prediction given by Analysis 2 is borne out, not the one by Analysis 1. This leads us to claim that the agreement between possessive pronouns and head nouns is not a result of the narrow-syntactic operation, Agree.

Our claim has the following theoretical implication: the reason why body-part nouns are quite often used as reflexive-markers cannot be straightforwardly attributed to the inalienable interpretation of these nouns (cf. Pica (1987), Reuland (2011)). In some languages, such as Basque, body-part nouns are used as pure reflexive-markers as English reflexive anaphors. Such an explanation would be plausible under Analysis 1, which could not be supported from our experimental results. Of course, our experimental results are not sufficient enough to reach a firm conclusion, since our experimental procedure itself is not exempt from problems. Another study will be awaited, so this paper leaves the issues open for further investigation.
References