The role of notional number of quantified phrases in subject-verb agreement[1]

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Subject-verb agreement relies on both syntactic and semantic information: In case a (complex) subject phrase is grammatically singular but notionally plural, people tend to continue the sentence relatively often with (grammatically erroneous) plural verbs (e.g., in distributive phrases like *the label on the bottles {*are/is}*; e.g., Vigliocco et al., 1996). In this study, we tested the effect of notional number in subject-verb agreement following quantified phrases with *each*, *every* or *one*. These quantifiers are interesting, because there is a mismatch between the grammatical number and notional number in the universal quantifiers *each* and *every*. Therefore, we may expect an increase of (erroneous) plural verb selections if the subject phrase contains *each* or *every* (cf. Eberhard, 1997; Mirkovic & MacDonald, 2013).

Across two experiments, we tested subject-verb agreement following quantified phrases using the rapid serial visual processing paradigm (Staub 2009; 2010). The subject phrases are presented word-for-word at a constant rate. Then, the participant makes a speeded decision whether this preamble should be continued with singular *is* or plural *are*. This experiment allows us to collect response times, which are informative because number attraction and conceptual number effects cause a slow-down in verb selection (Staub, 2009). The critical preambles of both experiments were complex noun phrases with two nouns (a *head* noun and a *local* noun).

In Experiment 1, the head noun was quantified (with *each, every* or *one*) and the local noun varied in grammatical number (six conditions: *{each/every/one} key to the {cabinet/cabinets}*). In Experiment 2, the head noun varied in grammatical number and the local noun was quantified (also six conditions: *the {key/keys} to {each/every/one} cabinet*). In these phrases, ambiguity arises if the head noun is singular, and the local noun is preceded by *each* or *every* (e.g., Den Dikken, 2001): Does *The key to each/every cabinet* refer to one universal key or to multiple keys? Therefore, Experiment 2 will reveal whether people construct a conceptual representation of such phrases that involves notional number information and whether these representations affect subject-verb agreement.

Experiment 1[2] (Figure 1; 102 participants) showed that the singular response was more often selected if the local noun was singular ($\chi^2(1) = 71.22$, $p < 0.001$) and if the head noun was quantified with *one* ($\chi^2(1) = 141.35$, $p < 0.001$), but there was no interaction between the two effects. The response times (Figure 2) revealed that verb form selection was slower if the local noun was plural and if the head noun was quantified with *each* or *every* ($\chi^2(1) = 37.08$, $p < 0.001$; no interaction). These results indicate that conceptual number in quantification impacts verb form selection: The notionally plural quantifiers *each* and *every* complicate singular subject-verb agreement.

Experiment 2 (Figure 3; 102 participants) showed that the singular verb was selected less often if the head noun was grammatically plural ($\chi^2(1) = 383.24$, $p < 0.001$) and if the local noun was quantified with *each* or *every* ($\chi^2(2) = 7.78$, $p = 0.020$), with no interaction between the effects. The response times (Figure 4) suggested that the grammatically correct verb form was selected faster if the head noun was plural ($\chi^2(1) = 16.85$, $p < 0.001$). The quantifier preceding the local noun did not trigger a main effect, but it did interact with head noun number ($\chi^2(2) = 11.62$, $p = 0.003$): The effect of head noun number was significantly stronger in the *each* and *every* conditions than in the *one* condition. This finding further suggest that the notional number of quantifiers affects subject-verb agreement, since the preambles that contained a singular head noun and a universally-quantifier noun are often perceived as notionally plural (e.g., *The musician at each night club*, as confirmed by a pre-experiment norming study on the stimuli), even though both the head noun and the local noun are grammatically singular.

Altogether, our results show that the notional number of quantified phrases affects subject-verb agreement: Even though *each* and *every* are grammatically singular, these quantifiers elicit plural verb selection more than the grammatically and notionally singular quantifier *one*. This is further evidence that conceptual number representations of quantification are used in processing of the syntax-semantics interface and thus that semantic processing influences agreement computation.
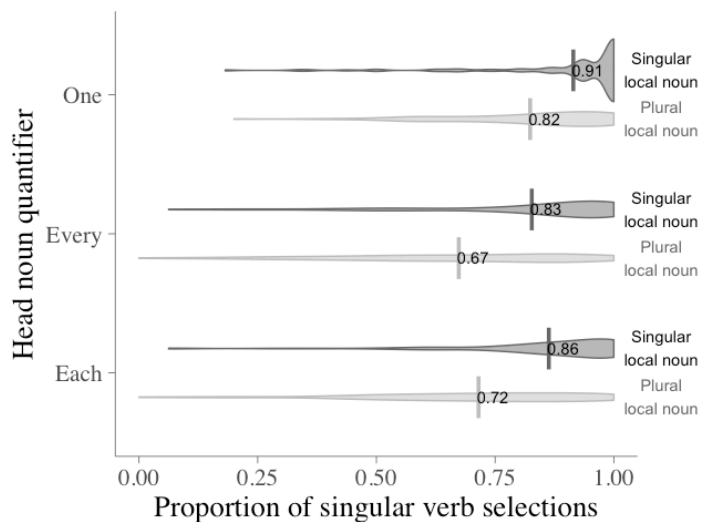
Figure 1. Rate of singular verb selections in Experiment 1. The outline of the plot represents the density of the data, and the vertical bars represent the mean.
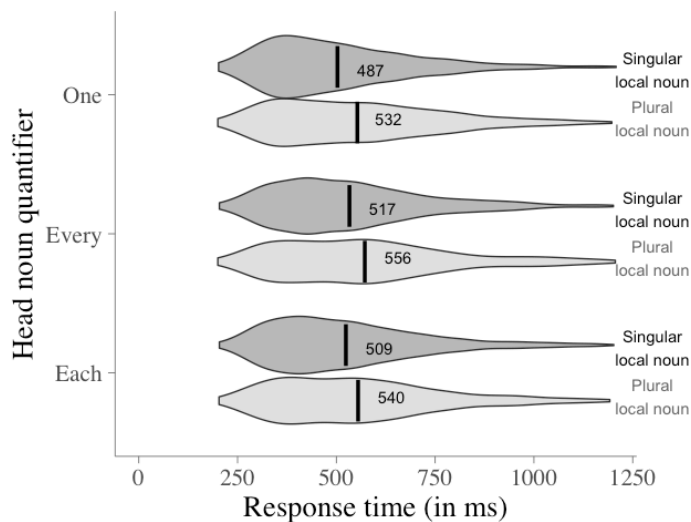

Figure 2. Response times in Experiment . The outline of the plot represents the density of the data, and the vertical bars represent the mean (responses that were quicker than 200 ms were excluded from analysis).
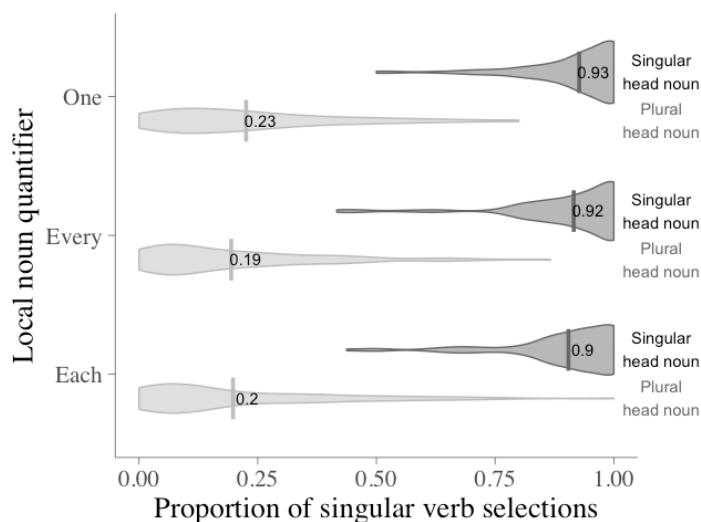

Figure 3. Rate of singular verb selections in Experiment 2. The outline of the plot represents the density of the data, and the vertical bars represent the mean.
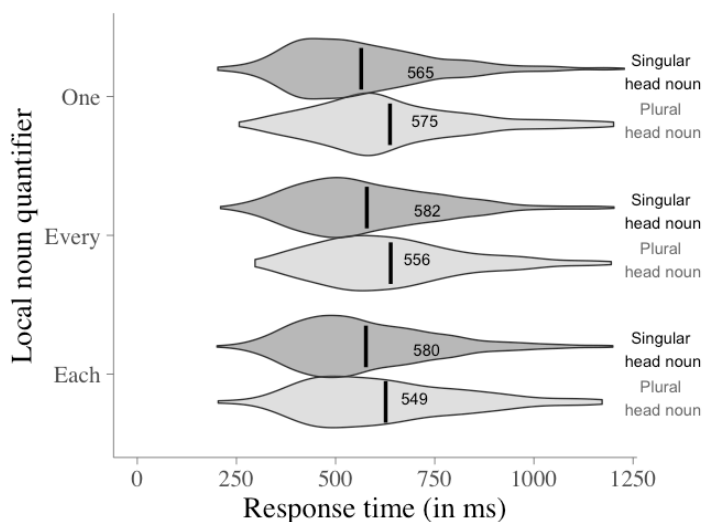

Figure 4. Response times in Experiment 2. The outline of the plot represents the density of the data, and the vertical bars represent the mean (responses that were quicker than 200 ms were excluded from analysis).

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