

Semantic integration and subject-verb agreement:

Independent effects of notional and grammatical number

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Abstract

Subject-verb agreement is influenced by both notional and grammatical number. Yet, the extent to which these two factors are independent remains unclear. Research manipulating the notional number of subject phrases has shown that notional number mismatches are mediated by grammatical number mismatches (i.e., attraction) in some studies, whereas in other studies they appear to be independent. The current study tested the independence of notional and grammatical effects on subject-verb agreement by manipulating the notional number through semantic integration in Dutch.

The participants completed auditorily presented subject phrases by selecting plural or singular verbs. Subject phrases were semantically integrated or unintegrated (the notional number manipulation) and had singular or plural local nouns (the grammatical number manipulation, e.g., *De kom met de stre(e)p(en)/lepel(s)*, “The bowl with the stripe(s)/spoon(s)”). To make the notional number more salient, pictures of the subject phrase were presented to half of the participants. The results showed no interactions between notional and grammatical number mismatches. Moreover, picture presence enhanced the notional integration effect, but not the grammatical attraction effect. These results suggest that in agreement production conceptual and grammatical factors can work independently.

Keywords: number agreement, language production, notional number, grammatical number, mental image

1. Introduction

In English and Dutch, singular subjects require singular verbs and plural subjects require plural verbs (e.g., *the dog barks*, *the dogs bark*). Speakers apply this rule fast and automatically. Errors occur occasionally and are often caused by distractor nouns that carry a grammatical number that is different from the head of the subject phrase (e.g., *the key to the cabinets are missing*, Bock & Eberhard, 1993; Bock, Nicol & Cutting, 1999; Bock & Miller, 1991; Haskell & MacDonald, 2003, 2005; Vigliocco, Butterworth & Garrett, 1996; Vigliocco, Butterworth & Semenza, 1995). This phenomenon — the verb agreeing with the grammatical number of an intervening (or local) noun instead of the grammatical number of the head noun — is referred to as *attraction* (Bock & Miller, 1991; Quirk, Greenbaum, Leech & Svartvik, 1972). Although many researchers now agree that the agreement process is not only influenced by grammatical factors, it remains unclear to what degree grammatical and notional factors interact. In this study, the attraction effect is used to investigate the independence of grammatical and notional effects on the generation of number agreement.

Although Bock & Miller's (1991) seminal study did not show any conceptual influences on agreement, later studies have shown that the grammatical process of agreement can be influenced by conceptual factors, such as the notional number of the subject noun phrase (Brehm & Bock, 2013, Humphreys & Bock, 2005; Vigliocco, Butterworth & Garrett, 1996; Vigliocco, Butterworth & Semenza, 1995). The notional number of a noun can diverge from the grammatical number of a noun. For instance, collective nouns, such as *furniture* or *family*, are grammatically singular, but notionally plural, as they refer to multiple referents: multiple pieces of furniture or multiple family members. Agreement studies have found that when these collective nouns are used as head nouns, they are more vulnerable to attraction from a plural local noun, relative to non-collective nouns (Bock et al., 1999; Deutsch & Dank, 2009; Haskell & MacDonald, 2003). Similarly, the notional number of an entire subject phrase can diverge from the grammatical number of the subject phrase. A phrase such as *the label on the bottles*, which is grammatically singular because of the singular head noun *label*, can be interpreted distributively as multiple identical labels on multiple bottles, hence, as notionally plural. Such distributive subject phrases have been shown to be more vulnerable to attraction from a plural local noun, relative to non-distributive subject phrases (Eberhard, 1999; Hartsuiker, Kolk & Huinck, 1999; Haskell & MacDonald, 2003; Vigliocco et al., 1995, 1996; Vigliocco, Hartsuiker, Jarema & Kolk, 1996).

Another phrasal-level notional influence stems from semantic integration. Semantic integration refers to the extent to which nouns within a subject phrase relate to each other conceptually (Solomon & Pearlmuter, 2004). In *the bowl with the wooden spoons*, the *bowl* and the *spoons* are unintegrated as they refer to at least three distinct objects (e.g., a bowl and two or more spoons). In contrast, in the *bowl with the red stripes*, the *bowl* and *stripes* are tightly integrated: the stripes are part of the bowl. Unintegrated subjects are more likely to be perceived as notionally plural, whereas integrated subjects are more likely to be perceived as notionally singular (Brehm & Bock, 2013). In the unintegrated case, the head noun is grammatically singular, whereas the notional number of the subject phrase is potentially plural. As with the attraction effect, when grammatical and notional number conflict, more agreement errors and longer response latencies are observed (Bock et al., 1999; Brehm & Bock, 2013; Haskell & MacDonald, 2005; Veenstra, Acheson, Bock & Meyer, 2014).

The differences in results across these studies raise questions about the extent to which grammatical and notional factors have independent influences on the agreement process. In the collectivity and distributivity examples mentioned above, the notional influence is mediated by the grammatical influence: notionally plural nouns or noun phrases are more vulnerable to grammatical attraction than notionally singular nouns or noun phrases. With regard to semantic integration, the pattern is less clear: Brehm & Bock (2013) found independent effects in one of their two experiments, and explain this by the Marking and Morphing model (Eberhard, Cutting & Bock, 2005), which also predicts independent effects. However, in a second experiment, they found an interaction between the grammatical and notional number effects. This finding led Brehm and Bock to argue that a grammatical/notional number mismatch in the case of unintegrated subjects makes the agreement process unstable and creates room for grammatical attraction to occur, thus leading to a grammatical/notional number interaction. Veenstra et al. (2014), on the other hand, using Dutch translations of Brehm and Bock's (2013) English items, found additive effects of notional and grammatical number in three separate experiments. The authors argue that grammatical and notional effects might work independently.

The aim of the current study was to determine whether notional number influences on subject-verb agreement can be modulated independent of grammatical number influences. Following Sternberg's logic of additivity (Sternberg, 1969), if notional and grammatical number are independent, it should be possible to boost one factor while keeping the other constant. Similarly to Veenstra et al. (2014), in the current study semantic integration and local noun

number were factorially manipulated within a forced-choice paradigm (Staub, 2009, 2010).

Previous studies that have examined effects of notional number have done so by manipulating the grammatical form of the subject phrase and assuming that participants would reach the desired notional number interpretation. For example, to get the distributed reading (Bock & Miller, 1991; Vigliocco, Butterworth & Garrett, 1996), *the label on the bottle* is meant to be interpreted as notionally singular, whereas *the label on the bottles* is meant to be interpreted as notionally plural. However, to get to this shift in notional number interpretation, the grammatical number of the local noun needs to be changed from singular to plural. Such an approach may have confounded grammatical form and conceptualization of the subject phrase. In contrast, with manipulations of semantic integration (e.g., *the bowl with the stripes/spoons*), the difference in notional number comes from a difference in meaning of the entire noun phrase rather than the grammatical number of the local noun.

In the current study, we manipulated the strength of semantic integration through the use of pictures that encouraged participants to form a mental image of the subject phrase. Previous work studying notional effects on agreement have also used pictures, but with mixed results. Eberhard (1999) found in one experiment that notional effects could be enhanced by presenting pictures accompanying distributive and non-distributive preambles. However, a second experiment without pictures showed that the effect was due to increased conceptual accessibility: only depictable items (e.g., *the picture on the postcard*) could be used, which are inherently more conceptually accessible than abstract items (e.g., *the memo from the accountant*, which would not depict the local noun, *accountant*; from Bock & Miller, 1991). In another study, Bock and colleagues found no effect of pictures on the strength of attraction from collective local nouns (e.g., *army*, *team*; Bock, Eberhard, Cutting, Meyer & Schriefers, 2001). For collective nouns, one would predict an effect of picture since the collected individuals are all present in the picture. However, collective local nouns generally do not increase error rates above and beyond the attraction effects of their grammatical number (e.g., Bock & Eberhard, 1993; Bock & Miller, 1991; Deutsch & Dank, 2009). Presenting pictures may not have led to a visible increase of the effect.

Using semantic integration avoids some of these problems. First, in contrast to pictures corresponding to distributive noun phrases, pictures of semantically integrated and unintegrated noun phrases unambiguously show a single object or multiple objects, respectively. Second, unlike the effects of collectivity from local nouns, semantic integration reliably affects agreement errors and response times; hence there is less of a concern for floor effects.

We predict that the notional number of a subject phrase will have a stronger effect when a picture is shown, thus enhancing the semantic integration effect: more errors for unintegrated than integrated subject phrases. Any potential ambiguity about the notional number might be solved by the pictures as well. At the same time, if the grammatical effect from the grammatical number of the local noun is independent from the notional effect, this should not be affected by the presentation of a picture, because plural grammatical markers are already sufficiently salient (and not ambiguous) in spoken language. In general, pictures might help keep the referent active in memory and reduce overall error rates, and prevent subjects from employing a syntactic strategy in which only grammatical cues are taken into account.

2. Experiment

The participants selected singular or plural verb forms to continue singular preambles that were integrated/unintegrated with singular/plural local nouns. The picture manipulation was between participants, with half of them assigned to the Picture Present condition, and half of them assigned to the Picture Absent condition.

2.1. Method

2.1.1. Participants

Fifty-three adult native speakers of Dutch were recruited from the Max Planck Institute subject database, receiving €4 for their participation. All gave written, informed consent prior to participation. Data from five participants were excluded due to recording errors. Forty-eight participants (41 female) remained, of which 24 participated in the Picture Present condition. The average age was 34 years ($SD = 16.5$). Approval to conduct this study was given by the Ethics Board of the Social Sciences Faculty of Radboud University, Nijmegen.

2.1.2. Materials

There were 60 experimental items, 59 of which were taken from Veenstra et al. (2014), see Appendix A. Seventeen items differed only in preposition (*van (of)* versus *met (with)*, e.g., *the drawing of/with the flower(s)*), 43 differed only in local noun to mark the distinction between integrated and unintegrated (e.g., *the bowl with the stripe(s)/spoon(s)*). Each item appeared in four versions, crossing integration and local noun number, see Table 1:

Local Noun Number	Integration	
	Integrated	Unintegrated
Singular	De kom met de rode streep 	De kom met de houten lepel 
Plural	De kom met de rode strepen 	De kom met de houten lepels 
	<i>The bowl with the red stripe(s)</i>	<i>The bowl with the wooden spoon(s)</i>

Table 1. An Experimental Item in Four Versions
Note. Pictures appeared only in the Picture Present condition.

The pictures were colored line drawings, drawn for the experiment by an artist. In addition to the experimental items, 60 filler items were designed to elicit a plural response (e.g., *the socks of the director*), see Appendix B. There were also 24 catch trials with varying subject numbers (see Procedure, Appendix C), and 12 practice items (a mixture of items similar to experimental items, filler items and catch trials), see Appendix D.

The items were presented in four blocks: a practice block of 12 items, followed by three blocks, each consisting of 15 experimental items, 15 filler items, and 8 catch items. The trials in each block were individually randomized but the order of the blocks was fixed. Eight counterbalanced lists were constructed.

2.1.3. Procedure

The participants were tested individually in a soundproof booth. The trials in the Picture Present condition had the following structure: First, a fixation cross (0.5° visual angle) was presented in the centre of the screen for 500 ms, followed by a blank screen for 150 ms. Then a 500 x 500 pixel picture appeared for 2000 ms in the centre of the screen, after which the preamble was played. The picture stayed on the screen until the preamble finished. The preamble recordings were made by a female native speaker of Dutch and originally included a continuation of the fragment which was cut off to maintain natural prosody. As soon as the sound file finished, the picture disappeared and the singular and plural forms of the verb to be, *is* and *zijn*, were presented simultaneously to the left and right of centre (see Fig. 1). Earlier research (see Veenstra et al., 2014) has shown that the position of the singular and plural option does not have any effect. However, to control for the possible effect of spatial-numerical association of response codes (SNARC), singular was always presented on the left (Dehaene, Bossini &

Giroux, 1993). The participants were instructed to indicate as quickly as possible which of the two forms would be the correct continuation of the preamble by pressing either the left or the right key on a button box. Feedback was provided if the response was incorrect using the word *FOUT* (*wrong*) displayed in red. The next trial began 1500 ms after the response.

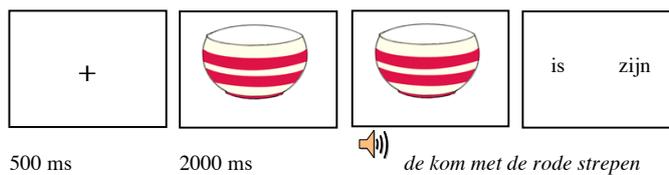


Figure 1. Picture Present trial structure.

The Picture Absent condition was similar except that a fixation cross was presented on the screen for the duration of the sound recording instead of a picture.

The procedure of the catch trials followed that of the experimental trials, except that instead of a verb option, the word *herhaal!* (*repeat*) was presented. This prompted participants to repeat the entire fragment aloud and complete it into a full sentence (instead of pressing a button). The catch trials were randomly distributed across the experiment, and encouraged participants to pay attention to every single preamble as though they would produce it.

2.1.4. Scoring and Analysis

Statistical analyses were run in R version 2.14 using linear mixed effects models with crossed effects of subjects and items using the lme4 package (Bates, 2005; R Development Core Team, 2011). In order to avoid collinearity and to maximize the likelihood of model convergence, variables such as List, Block, Integration and Local Noun Number were mean centred prior to analysis (Baayen, 2008). Negative regression coefficients thus indicate earlier blocks, tighter integration and singular local nouns.

The fixed effects were Picture Presence (present vs. absent), Integration (integrated vs. unintegrated), Local Noun Number (singular vs. plural), and Block (1 through 3). The number of the list that the participants saw was initially included as a fixed effect. However, as it did not contribute significantly to any of the models, we removed it. Random intercepts were included for subjects and items, as well as random slopes to subjects and items for the fixed factors where

possible (Barr, Levy, Scheepers & Tiley, 2013). The interaction between Integration and Local Noun Number, as well as the interactions with Picture Presence were kept for theoretical reasons. Error rates were analysed using a logistic linking function (e.g., Jaeger 2008).

2.2. Results

Every plural response to an experimental trial was an agreement error. In total, 178 out of 2880 trials were agreement errors, divided over the conditions as follows (see Fig. 2):

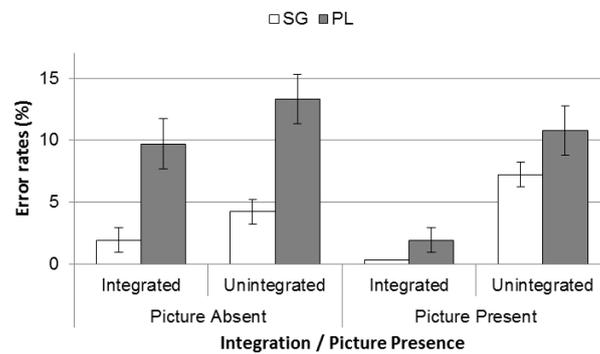


Figure 2. Error rates for Integration as a function of Local Noun Number in the Picture Absent and Picture Present conditions. Error bars represent *SE* of the mean across subjects. SG = singular local noun, PL = plural local noun.

Figure 2 shows that with a picture present, the participants made fewer errors than without picture. In addition, in both picture conditions, unintegrated preambles increased error rates relative to the integrated preambles (the facilitatory effect of integration) and plural local nouns increased error rates relative to singular local nouns (the grammatical attraction effect). The results of the linear mixed effects regression analysis (Table 2) confirmed these patterns:

Variable	Coefficient	SE	z-value	Pr(> z)	Random Slope
(Intercept)	-3.06	0.33	-9.05	<.001***	subjects, items
Picture Presence	-0.72	0.27	-2.71	0.006**	subjects, items
Integration	1.19	0.24	4.95	<.001***	subjects, items
Local Noun Number	0.71	0.21	3.36	<.001***	subjects, items
Block	-0.47	0.13	-3.69	<.001***	subjects, items
Picture*Integration	0.80	0.24	3.41	<.001***	subjects, items
Picture *Noun Number	-0.05	0.20	-0.22	0.824	
Integration*Noun Number	-0.30	0.20	-1.48	0.139	
Picture*Integration*Number	-0.10	0.20	-0.52	0.605	

Note. * $p < .05$; ** $p < .01$; *** $p < .001$. Coefficients correspond to Logits.

Table 2. Results of the Logistic Mixed-Effects Regression Model

There were four significant main effects: Picture Presence, Integration, Local Noun Number, and Block. When there was a picture present, the participants made 2% fewer errors than when there was no picture ($SD_d = 1.5\%$). The main effect of Integration was driven by a 5% increase in errors ($SD_d = 1.4\%$) for unintegrated relative to integrated sentences. We also found attraction effects as the participants made 6% more errors for plural relative to singular local nouns. Finally, the main effect of Block was driven by an improved performance as the participants made 2% fewer errors ($SD_d = 2\%$) with each successive block. There was no interaction between Integration and Local Noun Number, and no interaction between Picture Presence and Local Noun Number.

Critically, we found that Picture Presence interacted reliably with Integration. As predicted, the magnitude of the Integration effect on the error rates was larger when pictures were present relative to when they were absent. Separate models for the Picture Absent and the Picture Present condition confirmed that the integration effect was strongest in the Picture Present relative to the Picture Absent condition ($\beta = 2.09$; $SE = 0.47$; z -value = 4.42; $p < .0001$ versus $\beta = 0.38$; $SE = 0.14$; z -value = 2.60; $p < .009$). In the Picture Present condition, unintegrated preambles yielded 8% more errors than integrated preambles ($SD_d = 6.3\%$), whereas in the Picture Absent condition, unintegrated preambles yielded only 3% more errors than integrated preambles ($SD_d = 7.4\%$).

3. General Discussion

The present study investigated the independence of notional number and grammatical number mismatches affecting the generation of subject-verb agreement. In contrast to the traditional sentence completion paradigm, the present study also presented pictures. It was hypothesized that enhancing the mental image of a preamble would make the notional number of the subject

phrase more salient (or less ambiguous), thereby increasing the notional number effect on agreement while leaving grammatical attraction unaffected.

Using semantic integration to manipulate notional number, we replicated previous results demonstrating independent effects of notional number and grammatical number (Veenstra et al., 2014). Plural notional number and plural local noun number made singular agreement more difficult compared to singular notional number and singular local nouns. As predicted, results showed that the integration effect (more errors for unintegrated than integrated preambles) was stronger when there was a picture present. Critically, the grammatical number effect (i.e., attraction) was equally strong in both conditions and was not affected by the activation of the mental image.

The current results support a view of agreement in which notional and grammatical effects work independently and possibly at different time points (Anton-Mendez & Hartsuiker, 2010; Veenstra et al., 2014). The integration effect conceivably comes about during the message formulation stage, with the present results showing that this process can be enhanced by factors that make the notional number of the message more salient. The attraction effect comes about during the grammatical encoding stage, when grammatical number markers from sentence parts other than the subject head noun interfere with the verb. Following serial production models (Bock & Levelt, 1994; Garrett, 1988), notional number exerts its effect on agreement before and independent of grammatical effects. Similarly, the Marking and Morphing model assumes that notional number is marked before the grammatical number is morphed onto the verb (Eberhard et al., 2005).

Importantly, conceptual and grammatical influences on agreement need not work independently. In addition to the collectivity and distributivity effects that increase grammatical attraction, local nouns that are plausible subjects of a predicate yield stronger attraction effects than those that are less plausible (Thornton & MacDonald, 2003). Similarly, local nouns that are semantically related to the head noun yield stronger attraction effects than local nouns that are unrelated to the head noun (Barker, Nicol & Garrett, 2001). Notably, these studies demonstrate that conceptual factors unrelated to the conceptual number of the subject phrase influence grammatical attraction. In contrast, the current study directly manipulated the notional number of the subject phrase, with results indicating that conceptual influences can be independent from those that cause attraction. One implication of this finding is that there may be instances in which grammatical factors alone can independently affect the agreement process.

The combination of these results shows that generation of subject-verb agreement involves a complex interplay between semantic and grammatical influences, and such influences are subject to linguistic and experimental

context. The current study manipulated the latter, and demonstrates that when language users are provided with a strong message (e.g., a salient notional number), notional and grammatical influences during subject-verb agreement can be dissociated.

References

- Anton-Mendez, I. & Hartsuiker, R. J. (2010). Morphophonological and conceptual effects on Dutch subject-verb agreement. *Language and Cognitive Processes*, 25(5), 728-748.
- Baayen, R. H. (2008). *Analyzing linguistic data: A practical introduction to statistics*. Cambridge: Cambridge University Press.
- Barker, J., Nicol, J. & Garrett, M. (2001). Semantic factors in the production of number agreement. *Journal of Psycholinguistic Research*, 30(1), 91-114.
- Barr, D. J., Levy, R., Scheepers, C. & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, 68(3), 255-278.
- Bates, D. M. (2005). Fitting linear mixed models in R: Using the lme4 package. *R News: The Newsletter of the R Project*, 5(1), 27-30.
- Bock, K. & Eberhard, K. M. (1993). Meaning, sound and syntax in English number agreement. *Language and Cognitive Processes*, 8(1), 57-99.
- Bock, K., Eberhard, K. M., Cutting, J. C., Meyer, A. S. & Schriefers, H. (2001). Some attractions of verb agreement. *Cognitive Psychology*, 43(2), 83-128.
- Bock, K. & Levelt, W. J. M. (1994). Language production: Grammatical encoding. In M. A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 945-984). San Diego, CA: Academic Press.
- Bock, K. & Miller, C. A. (1991). Broken agreement. *Cognitive Psychology*, 23(1), 45-93.
- Bock, K., Nicol, J. & Cutting, J. C. (1999). The ties that bind: Creating number agreement in speech. *Journal of Memory and Language*, 40(3), 330-346.
- Brehm, L. & Bock, K. (2013). What counts in grammatical number agreement? *Cognition*, 128(2), 149-169.
- Dehaene, S., Bossini, S. & Giraux, P. (1993). The mental representation of parity and number magnitude. *Journal of Experimental Psychology: General*, 122(3), 371.
- Deutsch, A. & Dank, M. (2009). Conflicting cues and competition between notional and grammatical factors in producing number and gender agreement: Evidence from Hebrew. *Journal of Memory and Language*, 60(1), 112-143.
- Eberhard, K. M. (1999). The accessibility of conceptual number to the processes of subject-verb agreement in English. *Journal of Memory and Language*, 41(4), 560-578.
- Eberhard, K. M., Cutting, J. C. & Bock, K. (2005). Making syntax of sense: Number agreement in sentence production. *Psychological Review*, 112(3), 531-559.
- Garrett, M. (1988). Processes in language production. In B. Butterworth (Ed.), *Linguistics: the Cambridge survey. Vol. III. Biological and psychological aspects of language*. Cambridge, MA: Harvard University Press.

- Hartsuiker, R. J., Kolk, H. H. J. & Huinck, W. J. (1999). Agrammatic production of subject-verb agreement: The effect of conceptual number. *Brain and Language*, 69(2), 119-160.
- Haskell, T. R. & MacDonald, M. C. (2003). Conflicting cues and competition in subject-verb agreement. *Journal of Memory and Language*, 48(4), 760-778.
- Haskell, T. R. & MacDonald, M. C. (2005). Constituent structure and linear order in language production: Evidence from subject-verb agreement. *Journal of Experimental Psychology-Learning Memory and Cognition*, 31(5), 891-904.
- Humphreys, K. R. & Bock, K. (2005). Notional number agreement in English. *Psychonomic Bulletin & Review*, 12(4), 689-695.
- Jaeger, T. F. (2008). Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models. *Journal of Memory and Language*, 59(4), 434-446.
- Quirk, R., Greenbaum, S., Leech, G. & Svartvik, J. (1972). *A grammar of contemporary English*. New York: Seminar Press.
- R Development Core Team. (2011). *R: A language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing.
- Solomon, E. S. & Pearlmutter, N. J. (2004). Semantic integration and syntactic planning in language production. *Cognitive Psychology*, 49(1), 1-46.
- Staub, A. (2009). On the interpretation of the number attraction effect: Response time evidence. *Journal of Memory and Language*, 60(2), 308-327.
- Staub, A. (2010). Response time distributional evidence for distinct varieties of number attraction. *Cognition*, 114(3), 447-454.
- Sternberg, S. (1969). The discovery of processing stages: Extensions of Donders' method. *Acta Psychologica*, 30(0), 276-315.
- Thornton, R. & MacDonald, M. C. (2003). Plausibility and grammatical agreement. *Journal of Memory and Language*, 48(4), 740-759.
- Veenstra, A., Acheson, D. J., Bock, K. & Meyer, A. S. (2014). Effects of semantic integration on the production of subject-verb agreement: Evidence from Dutch. *Language, Cognition and Neuroscience*, 29(3), 355-380.
- Vigliocco, G., Butterworth, B. & Garrett, M. F. (1996). Subject-verb agreement in Spanish and English: Differences in the role of conceptual constraints. *Cognition*, 61(3), 261-298.
- Vigliocco, G., Butterworth, B. & Semenza, C. (1995). Constructing subject-verb agreement in speech: The role of semantic and morphological factors. *Journal of Memory and Language*, 34(2), 186-215.
- Vigliocco, G. & Franck, J. (1999). When sex and syntax go hand in hand: Gender agreement in language production. *Journal of Memory and Language*, 40(4), 455-478.
- Vigliocco, G. & Hartsuiker, R. J. (2002). The interplay of meaning, sound, and syntax in sentence production. *Psychological bulletin*, 128(3), 442.
- Vigliocco, G., Hartsuiker, R. J., Jarema, G. & Kolk, H. H. J. (1996). One or more labels on the bottles? Notional concord in Dutch and French. *Language and Cognitive Processes*, 11(4), 407-442.

Appendices

Appendix A. Experimental items

Integrated/Unintegrated Singular local noun (Plural local noun)

- 1 De tekening van/met de bloem(en) - *The drawing of/with the flower(s)*
- 2 De afbeelding van/met de edelsteen (edelstenen) - *The picture of/with the gem(s)*
- 3 De sculptuur van/met de sleutel(s) - *The sculpture of/with the key(s)*
- 4 De schets van/met de boekenkast(en) - *The sketch of/with the bookcase(s)*
- 5 De beeltenis van/met de ballon(nen) - *The picture of/with the balloon(s)*
- 6 De foto van/met de akte(s) - *The photo of/with the certificate(s)*
- 7 De afdruk van/met de memo('s) - *The print out of/with the memo(s)*
- 8 De illustratie van/met de landkaart(en) - *The illustration with/of the map(s)*
- 9 De fotokopie van/met de publicatie(s) - *The photocopy of/with the publication(s)*
- 10 De reproductie van/met de prent(en) - *The reproduction of/with the engraving(s)*
- 11 De fax van/met de blauwdruk(ken) - *The fax of/with the blueprint(s)*
- 12 De uitvergroting van/met de brief (brieven) - *The enlargement of/with the letter(s)*
- 13 De dia van/met de krant(en) - *The slide of/with the newspaper(s)*
- 14 De uitdraai van/met de scriptie(s) - *The print out of/with the thesis/theses*
- 15 De polaroidfoto van/met de postzegel(s) - *The polaroid of/with the stamp(s)*
- 16 De ansichtkaart van/met de schoen(en) - *The postcard of/with the shoe(s)*
- 17 De poster van/met de kroon (kronen) - *The poster of/with the crown(s)*
- 18 De dichtbundel met de omgevouwen bladzijde(n)/rode pen(nen)
The volume of poems with the torn page(s)/red pen(s)
- 19 De panty met de rare opdruk(ken)/vieze handdoek(en)
The tights with the crazy print(s)/dirty towel(s)
- 20 De ring met de nep-diamant(en)/gouden armband(en)
The ring with the fake diamond(s)/gold bracelet(s)
- 21 De appel met de bruine plek(ken)/verse perzik(en)
The apple with the brown spot(s)/fresh peach(es)
- 22 De stropdas met de lelijke streep (strepen)/katoenen blazer(s)
The tie with the hideous stripe(s)/cotton blazer(s)
- 23 De klok met de missende wijzer(s)/zwarte portemonnee(s)
The clock with the missing hand(s)/black wallet(s)
- 24 De jas met de kapotte rits(en)/natte paraplu('s)
The jacket with the faulty zipper(s)/wet umbrella(s)
- 25 De kam met de gebroken tand(en)/lege tube(s)
The comb with the broken tooth (teeth)/empty tube(s)
- 26 De sleutel met de gekartelde rand(en)/glanzende munt(en)
The key with the jagged edge(s)/shiny coin(s)
- 27 De fauteuil met de krakende veer (veren)/grote boekenkast(en)
The chair with the creaky spring(s)/tall bookcase(s)
- 28 De telefoon met de missende toets(en)/kapotte broodrooster(s)
The phone with the missing button(s)/broken toaster(s)
- 29 De bedsprei met de vieze vlek(ken)/wollen deken(s)
The bedspread with the dirty stain(s)/woolen blanket(s)
- 30 De kroonluchter met de felle lamp(en)/antieke pianokruk(ken)
The chandelier with the harsh light(s)/antique music-stool(s)

- 31 De krant met de kleurige advertentie(s)/koffiemok(ken)
The newspaper with the colorful ad(s)/coffee mug(s)
- 32 De trui met de losse zoom (zomen)/zwarte pantalon(s)
The sweater with the loose hem(s)/black slack(s)
- 33 De rekening met de hoge prijs (prijzen)/afgesloten doos (dozen)
The receipt with the high price(s)/sealed box(es)
- 34 De boom met de dode tak(ken)/lage struik(en)
The tree with the dead branch(es)/small shrub(s)
- 35 De pizza met de lekkere topping(s)/frisse dorstlesser(s)
The pizza with the tasty topping(s)/fresh beverage(s)
- 36 De melk met de aardbei(en)/bosbessenmuffin(s)
The milk with the strawberry (strawberries)/blueberry muffin(s)
- 37 De gitaar met de kapotte snaar (snaren)/luide trommel(s)
The guitar with the loose string(s)/loud drum(s)
- 38 De deken met de losse draad (draden)/schone rok(ken)
The blanket with the loose thread(s)/clean skirt(s)
- 39 De beker met de lange scheur(en)/kristallen kom(men)
The mug with the lengthy crack(s)/crystal bowl(s)
- 40 De fiets met de verbogen spaak (spaken)/surfplank(en)
The bike with the bent spoke(s)/surfboard(s)
- 41 De stoel met de losse poot (poten)/oude tafel(s)
The chair with the wobbly leg(s)/old table(s)
- 42 De koe met de zwarte vlek(ken)/zwarte geit(en)
The cow with the black spot(s)/goat(s)
- 43 De plant met de mooie bloem(en)/ronde steen (stenen)
The plant with the pretty flower(s)/round rock(s)
- 44 De cd met de rustige ballade(s)/spannende roman(s)
The cd with the slow ballad(s)/exciting novel(s)
- 45 De piano met de losse toets(en)/scheve kruk(ken)
The piano with the loose key(s)/lopsided stool(s)
- 46 De schoen met de kapotte veter(s)/schone sok(ken)
The shoe with the broken lace(s)/clean sock(s)
- 47 De kom met de rode streep (strepen)/houten lepel(s)
The bowl with the red stripe(s)/wooden spoon(s)
- 48 De jongedame met de zere vinger(s)/hond(en)
The young lady with the sore finger(s)/dog(s)
- 49 De bal met de rode stip(pen)/sportschoen(en)
The ball with the red dot(s)/sports shoe(s)
- 50 De kerstboom met de slinger(s)/kerststal(len)
The Christmas tree with the garland(s)/nativity scene(s)
- 51 De kat met de scherpe nagel(s)/witte muis (muizen)
The cat with the sharp nail(s)/white mouse/mice
- 52 De tegel met de spreuk(en)/fotolijst(en)
The tile with the proverb(s)/photo frame(s)
- 53 De laptop met de verlichte knop(pen)/broodtrommel(s)
The laptop with the illuminated button(s)/bread bin(s)
- 54 De woning met de rode deur(en)/vrijstaande garage(s)
The residence with the red door(s)/detached garage(s)
- 55 De spijkerbroek met de scheur(en)/trui(en)
The jeans with the tear(s)/sweater(s)
- 56 De blouse met de gouden knoop (knopen)/leren handschoen(en)

- The blouse with the golden button(s)/leather glove(s)*
 57 De kandelaar met de witte kaars(en)/zilveren schaal (schalen)
The chandelier with the white candle(s)/silver platter(s)
 58 De zakdoek met de geborduurde letter(s)/rode kauwgombal(len)
The handkerchief with the embroidered character(s)/red bubble gum(s)
 59 De auto met de lekke band(en)/bestelbus(sen)
The car with the flat tire(s)/delivery truck(s)
 60 De taart met de kers(en)/champagnefles(sen)
The pie with the cherry (cherries)/champagne bottle(s)

Note. Items were taken from Veenstra, Acheson, Bock & Meyer (2014), except for item 60.

Appendix B. Filler items

- 1 De sokken van de directeur - *The socks of the director*
- 2 Het toetsenbord en de muis van de computer - *The keyboard and the mouse of the computer*
- 3 De pakjes voor de kinderen - *The presents for the children*
- 4 De schommel en de wip in de pas aangelegde speeltuin - *The swing and the seesaw in the new playground*
- 5 De sandwich en de chocolade muffin - *The sandwich and the chocolate muffin*
- 6 De inbrekers met de bivakmutsen - *The burglars with the balaclavas*
- 7 De klanten van de telefoon-maatschappij - *The customers of the phone company*
- 8 De achtbaan en het reuzenrad - *The rollercoaster and the big wheel*
- 9 De eenden in het park - *The ducks in the park*
- 10 De jongetjes op de kleuterschool - *The boys at the kindergarten*
- 11 De raamkozijnen van het kantoor - *The window frames of the office*
- 12 De pennen uit het etui - *The pens from the case*
- 13 De reizigers op het vliegveld - *The travelers at the airport*
- 14 De bus en de trein richting het noorden - *The bus and the train heading north*
- 15 De bierglazen op de plank - *The beer glasses on the shelf*
- 16 De kevers op de tak - *The bugs on the branch*
- 17 De voetballers in de lastige wedstrijd - *The soccer players in the tough game*
- 18 De pantoffels met de rode stippen - *The slippers with the red dots*
- 19 De bloemen in de mooie vaas - *The flowers in the pretty vase*
- 20 Het album en de cd-single van de nieuwe popgroep - *The album and the cd single of the new pop group*
- 21 De potloden van de ijverige scholier - *The pencils of the diligent pupil*
- 22 Het paspoort en de id-kaart - *The passport and the ID card*
- 23 De sperziebonen uit de supermarket - *The green beans from the supermarket*
- 24 De ballonnen voor het feestje - *The balloons for the party*
- 25 De tanden van de Hollywood acteur - *The teeth of the Hollywood actor*
- 26 Het gerecht en de saus - *The dish and the sauce*
- 27 De schat en de schatkaart - *The treasure and the map*
- 28 De helm en de linker kniebeschermer - *The helmet and the left knee-guard*
- 29 De wortels uit de groentetuin - *The carrots from the vegetable garden*
- 30 De gasten voor de trouwerij - *The guests for the wedding*
- 31 De slagerij en de kapsalon - *The butcher's shop and the hairdresser's shop*
- 32 De salade en het verse fruit - *The salad and the fresh fruit*
- 33 De piano's van de muziekschool in de stad - *The pianos of the music school in town*

- 34 De worstjes op de barbecue - *The sausages on the barbecue*
 35 De documenten voor de sleuteloverdracht - *The documents for the handover of the keys*
 36 Het hert en het everzwijn - *The deer and the wild boar*
 37 De spijker en de schroef in de buitenmuur - *The nail and the screw in the outer wall*
 38 De wolken in de donkere lucht - *The clouds in the dark sky*
 39 De jas en de broek - *The jacket and the pants*
 40 De supporters van de voetbalclub - *The supporters of the football club*
 41 De sterren aan de hemel - *The stars in the sky*
 42 De tomaat en de appel - *The tomato and the apple*
 43 De badkamer en de keuken van het oude huis - *The bathroom and the kitchen of the old house*
 44 De voeten van de marathon-loper - *The feet of the marathon runner*
 45 De juryleden van het tv-programma - *The members of the jury of the television program*
 46 De broek en het shirt van de atleet - *The pants and the shirt of the athlete*
 47 De tractor en de hijskraan - *The tractor and the hoisting crane*
 48 De film en het boek - *The movie and the book*
 49 De gebakjes op het feest - *The cakes at the party*
 50 De schuur en de koeienstal - *The barn and the cowshed*
 51 De bewoners van de grote boerderij - *The inhabitants of the big farm*
 52 De bergbeklimmers op de top van de berg - *The mountaineers on the top of the mountain*
 53 De vork en het mes - *The fork and the knife*
 54 De beek en de rivier - *The brook and the river*
 55 De eieren in het ontdekte eendennest - *The eggs in the discovered duck nest*
 56 De brief en de ansichtkaart - *The letter and the postal card*
 57 De oma en de opa - *The grandmother and grandfather*
 58 De straat en het steegje - *The street and the alley*
 59 De snoepjes uit de snoepjespot van de meester - *The candy out of the candy jar of the teacher*
 60 De danseressen in de voorstelling - *The dancers in the show*

Appendix C: Catch items

- 1 De trainingsbroeken - *The sweatpants*
 2 De kleuren van de regenboog - *The colors of the rainbow*
 3 De nagellak en de lippenstift - *The nail polish and the lipstick*
 4 De heks en de tovenaer - *The witch and the wizard*
 5 De pop met de armen en benen - *The doll with the arms and legs*
 6 De hond van de burens - *The dog of the neighbors*
 7 De frikadel en de kroket uit de muur - *The snacks out of the wall*
 8 De ruiter en het paard - *The rider and the horse*
 9 Het signaal van de telefoon - *The signal of the telephone*
 10 De winkel met de deuren - *The store with the doors*
 11 De boom bij de vijver en de steen - *The tree near the pond and the rock*
 12 De stofzuigers van de speciaalzaak - *The vacuum cleaners from the specialist shop*
 13 De theezakjes uit het kerstpakket - *The tea bags from the Christmas package*
 14 De strandjutter en zijn hond - *The beachcomber and his dog*
 15 De kattenbak en de vogelkooi - *The litter tray and the bird cage*
 16 Het schip en de onderzeeër - *The ship and the submarine*
 17 De moeder met de kinderwagen - *The mother with the pram*
 18 De bril van de kunstenaar - *The glasses of the artist*
 19 De meloen met de mango en de avocado - *The melon with the mango and the avocado*

- 20 De deur van de auto - *The door of the car*
- 21 De mannen met de baarden - *The men with the beards*
- 22 De dakpannen op het fietsenhok - *The roof tiles on the bike shed*
- 23 Het kind met de knikkers - *The child with the marbles*
- 24 De kastanje uit het park - *The chestnut from the park*

Appendix D: Practice items

- 1 De computers van de middelbare school - *The computers of the high school*
- 2 De bovenarm van de sporter - *The upper arm of the athlete*
- 3 De blaadjes van het jonge boompje - *The leaves of the young tree*
- 4 De zolder van het oude huis - *The attic of the old house*
- 5 Het slootwater en het zeewater - *The ditch water and the sea water*
- 6 De vis in de kom - *The fish in the bowl*
- 7 De vlag en de wimpel - *The flag and the pennant*
- 8 De mieren in het keukenkastje - *The ants in the kitchen cupboard*
- 9 De verzameling van speelgoed-autootjes - *The collection of toy cars*
- 10 De muntjes op de toonbank - *The coins on the counter*
- 11 De koffer van de toerist - *The suitcase of the tourist*
- 12 De gympen van de gevangene - *The sneakers of the prisoner*

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