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## Two languages, two sets of interpretations: Language-specific influences of morphological form on Dutch and English speakers' interpretation of compounds

**Abstract:** The present study investigates linguistic relativity. Do form differences between Dutch and English influence the interpretations which speakers have? The Dutch element *en* in noun-noun compounds, for example in *aardbeienjam* 'strawberry jam' is homophonous and homographic with the regular plural suffix *-en*. English, in contrast, has no such typical linking elements in compounds. We therefore investigated the interpretation of Dutch modifiers in compounds and their English equivalents. We compared the plurality ratings of Dutch modifiers with and without the linking element *en* by native Dutch speakers, and the plurality ratings of English modifiers by native Dutch speakers and native English speakers. If the Dutch linking *en* induces plural meaning, we expected a difference between the plurality ratings by English speakers for English modifiers and by Dutch speakers for Dutch modifiers, such that the estimation of the number of strawberries in *strawberry jam* is lower for the English speakers than the number of aardbeien in *aardbeienjam* for the Dutch speakers. This is exactly what we found. Moreover, when native Dutch speakers rate the English equivalents, their interpretation of *strawberry jam* is the same as for native English speakers, which shows the language being used to influence semantic interpretations.

**Keywords:** Linguistic relativity, Noun-noun compounds, Linking elements, Numerosity, Morphology, Dutch, English, Bilingual speakers

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# 1 Introduction

Humans use more than 6000 languages to communicate with each other (Lewis 2009). Languages differ with respect to phonology, morphology and syntax which can in turn influence the way in which speakers interpret the world. In the present research, we investigated this phenomenon by examining the linking element *en* in Dutch noun-noun compounds, the English equivalents and perceptions of numerosity. By “linking element,” we mean the element between the two constituents, the modifier and the head, respectively, of a noun-noun compound.<sup>1</sup> An example of this linking element is *en* in the compounds *boekenkast* ‘book + *en* + case’ and *sterrenstelsel* ‘star + *en* + system’. The Dutch linking element *en* has the same form as the plural suffix *-en* in, for example, *boeken* ‘books’. In order to answer the question of whether the form similarity in Dutch and the form dissimilarity in English influences speakers’ understanding of the modifier, we compared the plurality ratings for Dutch modifiers with those for English modifiers. And we indeed found a clear interplay between form, native language and interpretation.

In the 19th century, Wilhelm von Humboldt connected language differences to differences in thought, assuming that thinking is an inner dialog using the thinker’s native language (Von Humboldt 1836; Losonsky 1999: xvi). In his view, just as sound differs from language to language, the conceptual part of language differs from language to language as well (Trabant 2000). That is, the diversity of languages represents not only a diversity of sounds (or signs in sign language) but also a diversity of world views (Losonsky 1999: xvii).

More than 75 years after Von Humboldt, Edward Sapir followed this idea:

No two languages are ever sufficiently similar to be considered as representing the same social reality. The worlds in which different societies live are distinct worlds, not merely the same world with different labels attached. (Sapir 1985 [1949])

Sapir’s student Benjamin Lee Whorf was also convinced of the influence of language on thought and compared languages to find evidence for this (Whorf 1956).

Nowadays, both linguists and psychologists are again paying attention to the idea that language might influence thought (Boroditsky 2003). Research on

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<sup>1</sup> Some linguists, such as Bauer (2003) and Booij (2007), reserve the term “linking element” for only elements which cannot have a plural meaning. We use the term to indicate the form of the element irrespective of its meaning.

linguistic relativity has concentrated on specific areas of language and cognition, namely: spatial relations (Bowerman and Choi 2007; McDonough et al. 2003); time (e.g., Boroditsky 2001; Boroditsky et al. 2011; but see January and Kako 2007 and Chen 2007 for unsuccessful attempts to replicate Boroditsky's 2001 findings); colour (Roberson et al. 2000; Roberson et al. 2004); material and shape (Lucy 1992); number (Gumperz and Levinson 1997); and objects (Miwa et al. 2008).

The influence of language on conceptualization is strikingly illustrated by the research of Roberson et al. (2004) who found different categorical perception effects for languages with the same number of colour words referring to nevertheless different categories of colour. The participants in this study were native speakers of Himba, a dialect spoken by an isolated tribe in Namibia. In Himba, there are only five colour names of which *dumbu* (shades of green, red, brown and yellow) and *burou* (other shades of green and blue) were studied by Roberson et al. When the speakers of Himba carried out similarity judgments, they showed only categorical perception for their own linguistic categories and not the linguistic categories of English or the Berinmo language, which is also a language with only five colour names but different categories of colour associated with them, presumably due to a different environment. These results led Roberson et al. to conclude that linguistic categorization is isomorphic with cognitive representation.

In the present research, we aimed to extend the evidence for linguistic relativity to perceptions of numerosity and the role of the linking element *en* in Dutch noun-noun compounds. As already mentioned, Dutch compounds can have a linking element which is written as *en* (e.g., *boekenplank* 'book + *en* + shelf') and takes the same form as the *-en* plural suffix (e.g., *boeken* 'books'). Such homography raises the question of whether the linking *en* and plural suffix *-en* are perceived as related (i.e., both conveying plural meaning, see for example Schreuder et al. 1998), or unrelated (Booij 2007; Verkuyl 2007). And the form differences between Dutch and English compounds allow us to investigate the answer to this question: Does the homographic linking element indeed influence ratings of plurality when native speakers versus second language speakers are compared? We expected native speakers of English to provide lower plurality ratings for modifiers when presented the English translation equivalents of words written with a linking *en* in Dutch compared to native Dutch speakers in the Dutch version of the experiment. We also wondered if similar results might be found for second language speakers. That is, when native speakers of Dutch with English as a second language are asked to rate the English translation equivalents of Dutch compounds, they could either follow the interpretation pattern of their native Dutch or the interpretation pattern of English. Our prediction was that native English

speakers when rating *strawberry jam* would consider this jam to contain fewer strawberries than native Dutch speakers rating the same English modifiers, despite the similarity of cultures and *strawberry jam* / *aardbeienjam* being essentially the same for the speakers of these two languages.

Schreuder et al. (1998) claim that the Dutch linking element *en* and the Dutch plural suffix *-en* are associated with each other by native speakers and show that one consequence of the spelling change of 1996 – where the former linking element *e* was changed to *en*, which is homographic with the plural suffix – has been an increase in the activation of plural semantics. When asked to indicate whether a compound was singular or plural as quickly and accurately as possible, a task that requires one to attend to only the final syllable of the compound (i.e., not to the modifier) ending on the plural suffix *-en* or not (*slangebeet*/*slangenbeet* ‘snakebite’ versus *slangebeten*/*slangenbeten* ‘snakebites’), Dutch participants were nevertheless influenced by the *en* in the middle of the compound. Thus, the presence of a linking *en*, rather than *e*, slowed response times for number decisions (i.e., the singular response to *slangenbeet* ‘snakebite’ was slower than the singular response to *slangebeet* ‘snakebite’). This interference effect indicates automatic activation of plural semantics and shows that the respondents were not able to ignore the word-internal linking element. Studies by Hanssen et al. (submitted), Banga et al. (in press) and Neijt et al. (2002) have similarly shown plural meaning to be involved in the processing and production of linking *en* in Dutch noun-noun compounds.

The aim of the present study is thus to determine if the homography of the Dutch linking element *en* and the Dutch plural suffix *-en* influences the way in which native speakers of Dutch rate the first part of the compound on the dimension of numerosity. In one study, we investigated the response patterns of native speakers of Dutch and native speakers of English to see if their ratings of plurality differed. In a second study, we compared the two sets of numerosity ratings to the numerosity ratings of native Dutch speakers performing the English version of the experiment and thus responding in a second language.

## 2 Study 1: Dutch and English as native languages

The main question in this study was if the numerosity judgements of Dutch and English speakers would differ when rating the plurality of the modifiers of culturally shared items. This study was thus carried out in Dutch for native Dutch speakers and in English for native English speakers.

## 2.1 Method

### 2.1.1 Participants

Two groups of participants took part in the experiment. The first group consisted of 42 adult native Dutch speakers (mean age  $M = 21$  years, standard deviation  $SD = 2.2$ ). They were undergraduates at the Radboud University Nijmegen and participated in the study as part of a course. The second group consisted of 42 adult native English speakers ( $M = 19$  years,  $SD = 0.8$ ). They were undergraduates at the university of Sheffield and participated in the study as part of a course as well.

### 2.1.2 Materials

The Dutch experiment consisted of 105 everyday Dutch noun-noun compounds; 54 with linking element *en* and 51 without linking element *en*.<sup>2</sup> These form types could be divided into two conceptual types: the modifier of the compound was either conceptually singular (e.g., *bananenschil* ‘banana skin’ and *ballonvaart* ‘balloon ride’) or conceptually plural (e.g., *aardbeienjam* ‘strawberry jam’ and *appeltaart* ‘apple pie’). The classification into these conceptual types was done by three independent linguists, who were asked to indicate whether they considered the modifier as ‘singular’, ‘plural’ or ‘do not know’. They agreed on 66% of the items. All of the items on which the judges did not agree were excluded from the analysis.

The test items thus contained four types of items: conceptually singular with a linking *en* (14 items), conceptually plural with a linking *en* (25 items), conceptually singular without a linking *en* (17 items) and conceptually plural without a linking *en* (14 items).

The different types of items were randomized in two different orders. One order resulted in two versions of the experiment: the order itself and the reversed order. In total, four versions of the experiment were used. The materials are listed in Appendix A.

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<sup>2</sup> Whether a certain lexicalized compound needs a linking *en* or not, depends on convention. Whether a novel compounds needs a linking *en* or not, depends a.o. on paradigmatic analogy (Krott et al. 2001) and prosody (Neijt and Scheuder 2007; Hanssen et al. in press). However, in the present study, only the standard forms of lexicalized compounds were used.

### 2.1.3 Procedure

All participants performed a paper- and-pencil task, which was to rate the plurality of the modifiers in the presented compounds along a 7-point scale. This was used because some modifiers containing a plural concept may evoke higher plural interpretations than other modifiers containing a plural concept. Speakers, for example, may have different plurality intuitions for an *anthill / mierenhoop*, which entails a lot of ants, versus a *shoe box / schoenendoos*, which entails a pair (two) of shoes. They were asked to mark the circle on the left if the modifier had a singular meaning and a circle to the right of this if the modifier had a plural meaning; the location of the circle to the right indicated the degree of plurality for the target word. The participants were asked to rely on their intuitions when rating the plurality of 105 modifiers in compounds, 70 of which were included in the analyses (see Section 2.1.2 and Appendix B for the instructions). Note that the participants were free to use the extreme values if – according to them – plurality can only be referred to as a dichotomy between singular and plural instead of a scale, although they were not explicitly instructed to do this. Prior to the experiment, the participants completed a questionnaire which asked for such basic information as their age and mother tongue. Completion of the task took about 15 minutes.

## 2.2 Results

The average ratings and standard deviations provided for the four types of Dutch items (with linking *en* and without, conceptually singular and plural) by the native Dutch speakers and the English translation equivalents by the native English speakers are presented in Table 1 and Figure 1.

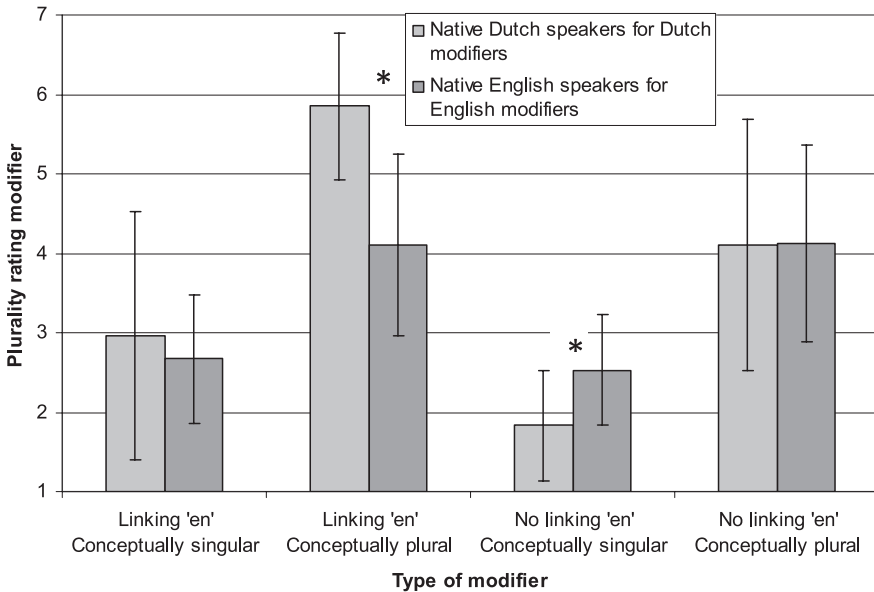
General Linear Model Repeated Measures ANOVAs were conducted with Concept (singular or plural) and Form (presence or absence of linking *en*) as within-participants and within-items factor and Language as a between-participants factor. The English modifiers did not contain a linking element but, to gain insight into the semantics of the Dutch linking *en*, we compared the English translation equivalents for the four types of Dutch modifiers to the Dutch modifiers which either did or did not contain the linking element *en*. A significant main effect of Form was found,  $F_1(1,82) = 38.149$ ,  $MSE = 1.229$ ,  $p < .001$  and  $F_2(1,26) = 36.59$ ,  $MSE = 0.528$ ,  $p < .001$ . Those modifiers containing linking *en* were rated as more plural ( $M = 3.9$ ) than those without linking *en* ( $M = 3.2$ ). Separate analyses for each group of participants showed this main effect to be caused by the native Dutch speakers,  $F_1(1,41) = 36.7$ ,  $MSE = 2.353$ ,  $p < .001$  and  $F_2(1,13) = 121.1$ ,  $MSE =$

**Table 1:** Mean ratings (standard deviations) provided by native Dutch and English speakers for modifiers referring to inherently singular or plural concepts (1 = singular; 7 = extremely plural).

Modifier with linking <i>en</i>			
Conceptually singular		Conceptually plural	
Dutch modifiers	English modifiers	Dutch modifiers	English modifiers
Native Dutch speakers	Native English speakers	Native Dutch speakers	Native English speakers
2.96 (1.56)	2.67 (0.81)	5.85 (0.92)	4.10 (1.14)

Modifier without linking <i>en</i>			
Conceptually singular		Conceptually plural	
Dutch modifiers	English modifiers	Dutch modifiers	English modifiers
Native Dutch speakers	Native English speakers	Native Dutch speakers	Native English speakers
1.83 (0.69)	2.53 (0.69)	4.11 (1.58)	4.12 (1.24)



**Fig. 1:** Mean ratings (standard deviations) provided by native Dutch and English speakers for modifiers referring to inherently singular or plural concepts (1 = singular; 7 = extremely plural)



0.280,  $p < .001$ ; this main effect was not found for the native English speakers. Thus, an interaction between Form and Language occurred as well,  $F_1(1,82) = 32.314$ ,  $p < .001$  and  $F_2(1,26) = 23.67$ ,  $p < .001$ .<sup>3</sup>

A significant main effect of Concept was also found,  $F_1(1,82) = 209.635$ ,  $MSE = 1.678$ ,  $p < .001$  and  $F_2(1,26) = 259.72$ ,  $MSE = 0.487$ ,  $p < .001$ . Those modifiers referring to inherently plural concepts were indeed rated as more plural ( $M = 4.5$ ) than those referring to inherently singular concepts ( $M = 2.5$ ). Separate analyses for each group of participants showed this main effect to be caused by the responding of both groups of participants:  $F_1(1,41) = 124.0$ ,  $MSE = 2.259$ ,  $p < .001$  and  $F_2(1,13) = 396.0$ ,  $MSE = 0.247$ ,  $p < .001$  for native Dutch speakers;  $F_1(1,41) = 87.4$ ,  $MSE = 1.097$ ,  $p < .001$  and  $F_2(1,13) = 49.7$ ,  $MSE = 0.727$ ,  $p < .001$  for native English speakers. A significant interaction between Concept and Language was found,  $F_1(1,82) = 14.370$ ,  $p = .001$  and  $F_2(1,26) = 15.54$ ,  $p = .001$ .

A significant interaction between Form and Concept was found,  $F_1(1,82) = 5.265$ ,  $MSE = 0.197$ ,  $p = .024$  and  $F_2(1,26) = 0.785$ ,  $MSE = 0.532$ ,  $p = .384$ , in addition to a significant interaction between Concept, Form and Language,  $F_1(1,82) = 15.376$ ,  $p < .001$  and  $F_2(1,26) = 1.850$ ,  $p = .185$ . Given that language is a significant factor in the comparison of the English and Dutch data, we first discuss the interaction from this language-point of view. For the modifiers without linking *en* and a singular concept, the native Dutch speakers in the Dutch version of the experiment rated them less plural ( $M = 1.8$ ) than the native English speakers in the English version of the experiment ( $M = 2.5$ ),  $t_1(38) = 3.695$ ,  $p = .001$ ,  $t_2(14) = 1.654$ ,  $p = .122$ . For the modifiers with linking *en* and a singular concept, no differences were found between the groups of participants. This was also found to be the case for the modifiers without linking *en* and a plural concept. However, for the modifiers with linking *en* and a plural concept, the native Dutch speakers in the Dutch version of the experiment rated the modifiers as more plural ( $M = 5.9$ ) than the native English speakers in the English version of the experiment ( $M = 4.1$ ),  $t_1(38) = 6.612$ ,  $p < .001$ ,  $t_2(24) = 10.610$ ,  $p < .001$ .

The native Dutch speakers rated the modifiers with a singular concept as more plural when the modifier contained the linking element *en* ( $mean = 3.0$ ) as

<sup>3</sup> We also did an analysis for the factor Form with all the 105 items. The results were the same as for the subset of the items in the main text. There was a main effect for Form,  $F_1(1,82) = 50.035$ ,  $MSE = 0.566$ ,  $p < .001$  and  $F_2(1,100) = 22.988$ ,  $MSE = 1.593$ ,  $p < .001$ , and an interaction between Form and Language,  $F_1(1,82) = 57.232$ ,  $p < .001$  and  $F_2(1,100) = 24.265$ ,  $p < .001$ . Also for the analysis with all 105 items, separate analyses for each group of participants showed the interaction between Form and Language to be caused by the ratings provided by the native Dutch speakers,  $t_1(41) = 7.442$ ,  $p < .001$  and  $t_2(50) = 6.642$ ,  $p < .001$ , such an effect was not found for the native English speakers,  $t_1(41) = 1.359$ ,  $p = .182$  and  $t_2(50) = 0.096$ ,  $p = .924$ .

opposed to no such element ( $M = 1.8$ ). This was also the case for modifiers with a plural concept (linking element *en*:  $M = 5.9$ , no such element:  $M = 4.1$ ). For the native English speakers, no significant differences were found between the numerosity judgements for the translation equivalents with conceptually singular modifiers with and without linking element *en* in the Dutch translation equivalents, neither between the translation equivalents with conceptually plural modifiers with and without the linking element *en* in the Dutch.

## 2.3 Discussion

In Study 1, native Dutch speakers were compared to native English speakers to determine if the presence of the linking *en* which is homographic with the Dutch plural *-en* suffix influences the ratings of numerosity by the Dutch speakers in particular. This is exactly what we found. For conceptually plural modifiers accompanied by a linking *en*, the Dutch ratings of numerosity were higher than the English ratings; for conceptually singular modifiers without a linking *en*, the English ratings of numerosity were higher than the Dutch ratings. For the other two types of modifiers, no significant differences were found. Note that the native English speakers did not rate all modifiers as singular, presumably due to their knowledge of the world: Speakers know that strawberry jam contains more than one strawberry irrespective of linguistic marking of such information.

The findings from Study 1 further show the influence of Form (i.e., presence or absence of linking *en*) on the native Dutch speakers' ratings of numerosity to be constrained by the influence of Concept. While the native Dutch speakers could have interpreted the factor Form as a sign of singular or plural more or less across the board, they did not. They were found to respond the same as the native English speakers when the Dutch form information was in conflict with the conceptual information. As expected, the native English speakers were not influenced by the factor Form, which only was present in the Dutch version of the experiment. That is, conceptually plural modifiers without a linking *en* and conceptually singular modifiers with a linking *en* were rated the same.

For native Dutch speakers, the factor Form appears to strengthen the factor Concept resulting in 'super plural' interpretations for conceptually plural modifiers with linking *en* and 'super singular' interpretations for conceptually singular modifiers without linking *en*. In other words, native Dutch speakers appear to interpret linking *en* to be a sign of plural meaning and this shows language to influence the interpretation of everyday noun-noun compounds. However, we

could not determine if the influence of language on the Dutch speakers' perceptions of numerosity was caused by their native Dutch knowledge or the Dutch used in the experiment. This is why we carry out the English experiment with responding of native Dutch speakers when presented with materials in English (i.e., a second language). This way, we investigated whether their plurality ratings would resemble the responding of the native Dutch speakers in Study 1 or the responding of the native English speakers in Study 1. If the responding of the native Dutch speakers when presented English translation equivalents is the same as the responding of native Dutch speakers when presented Dutch stimuli, then their responding in English is presumably caused by their native Dutch knowledge (i.e., the influence of their internalized Dutch knowledge). If the responding of the native Dutch speakers when presented English translation equivalents is the same as the responding of the native English speakers when presented the same English translation equivalents, then the responding of the Dutch native speakers is presumably caused by the language itself (i.e., the language of the experiment itself, namely English).

## 3 Study 2: English as a second language

### 3.1 Method

A third group of participants took part in Study 2: 40 adult native speakers of Dutch ( $M = 23$  years,  $SD = 3.0$ ). They were undergraduates at the Radboud University Nijmegen and participated voluntarily. Their task was the same as for the native English speakers: They were asked to rate the plurality of the modifiers in the English translation equivalents for the Dutch compounds. All of the participants, just as Dutch students in general and those in Study 1, had a fairly high level of English as a second language.

### 3.2 Results

We first compared the plurality ratings provided by the native Dutch speakers for the English modifiers (this Section: Study 2) with those provided by the native Dutch speakers for the Dutch modifiers (see Section 2: Study 1). We then compared the plurality ratings provided by the native Dutch speakers for the English modifiers (this Section: Study 2) with those provided by the native English

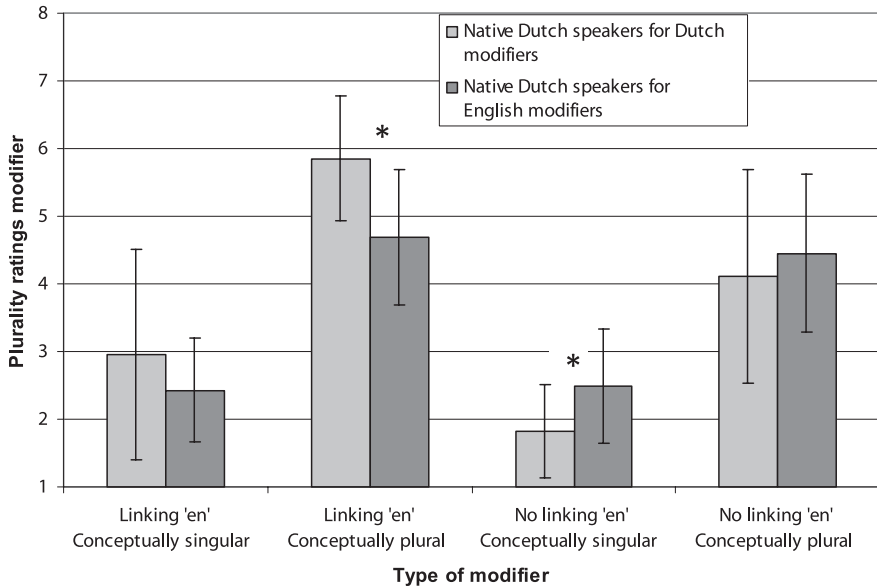
**Table 2:** Mean ratings (standard deviations) provided by native Dutch speakers responding to English modifiers and native Dutch speakers responding to Dutch modifiers for four types of items (1 = singular; 7 = extremely plural).

<b>Modifier containing linking <i>en</i></b>			
<b>Conceptually singular</b>		<b>Conceptually plural</b>	
<b>English modifiers</b>	<b>Dutch modifiers</b>	<b>English modifiers</b>	<b>Dutch modifiers</b>
Native Dutch speakers	Native Dutch speakers	Native Dutch speakers	Native Dutch speakers
2.43 (0.77)	2.96 (1.56)	4.69 (1.00)	5.85 (0.92)
<b>Modifier without linking <i>en</i></b>			
<b>Conceptually singular</b>		<b>Conceptually plural</b>	
<b>English modifiers</b>	<b>Dutch modifiers</b>	<b>English modifiers</b>	<b>Dutch modifiers</b>
Native Dutch speakers	Native Dutch speakers	Native Dutch speakers	Native Dutch speakers
2.49 (0.84)	1.83 (0.69)	4.45 (1.17)	4.11 (1.58)

speakers for the English modifiers (see Section 2: Study 1). The plurality ratings for four types of items were thus analyzed: conceptually singular items with a linking *en*; conceptually plural items with a linking *en*; conceptually singular items without the linking element; and conceptually plural items without the linking element.

In Table 2 and Figure 2, the average ratings and standard deviations provided by the native Dutch speakers responding to the English modifiers (this Section: Study 2) and the native Dutch speakers responding to the Dutch modifiers (see section 2: Study 1) are presented for the four types of items.

General Linear Model Repeated Measures ANOVAs were conducted with Concept (singular or plural) and Form (presence or absence of linking *en*) as within-participants and within-items factors and Language as a between-participants factor. A significant main effect of Form was found,  $F_1(1,88) = 37.35$ ,  $MSE = 1.270$ ,  $p < .001$  and  $F_2(1,26) = 43.72$ ,  $MSE = 0.528$ ,  $p < .001$ . Those modifiers containing linking *en* were rated as more plural ( $M = 4.0$ ) than those modifiers without linking *en* ( $M = 3.2$ ). Separate analyses for each group of participants showed that this main effect was caused by the native Dutch speakers rating the Dutch modifiers,  $F_1(1,41) = 36.7$ ,  $MSE = 2.353$ ,  $p < .001$  and  $F_2(1,13) = 121.1$ ,  $MSE = 0.280$ ,  $p < .001$ ; no effect was found for the native Dutch speakers rating the English modifiers. A



**Fig. 2:** Mean ratings (standard deviations) provided by native Dutch speakers responding to English modifiers and native Dutch speakers responding to Dutch modifiers for four types of items (1 = singular; 7 = extremely plural)

significant interaction between Form and Language thus occurred as well,  $F_1(1,88) = 32.31, p < .001$  and  $F_2(1,26) = 22.47, p < .001$ .<sup>4</sup>

A significant main effect of Concept was found,  $F_1(1,88) = 209.6, MSE = 2.035, p < .001$  and  $F_2(1,26) = 602.4, MSE = 0.277, p < .001$ . Those modifiers referring to plural concepts were indeed rated as more plural ( $M = 4.8$ ) than those modifiers referring to singular concepts ( $M = 2.4$ ). Separate analyses for each group of participants showed this main effect to be caused by the responding of both groups,  $F_1(1,41) = 124.0, MSE = 2.259, p < .001$  and  $F_2(1,13) = 396.0, MSE = 0.247, p < .001$  for

<sup>4</sup> We also did an analysis for the factor Form with all the 105 items. The results were the same as for the subset of the items. There was a main effect for Form,  $F_1(1,80) = 58.995, MSE = 0.590, p < .001$  and  $F_2(1,100) = 34.79, MSE = 1.270, p < .001$ , and an interaction between Form and Language,  $F_1(1,80) = 42.023, p < .001$  and  $F_2(1,100) = 24.91, p < .001$ . Also for the analysis with all the 105 items, separate analyses for each group of participants showed that this interaction was caused by the native Dutch speakers rating the Dutch modifiers,  $t_1(41) = 7.442, p < .001$  and  $t_2(50) = 6.642, p < .001$ , whereas this effect was not found for the native Dutch speakers rating the modifiers in the English version of the experiment,  $t_1(39) = 2.649, p = .120$  and  $t_2(50) = 0.792, p = .432$ .

native Dutch speakers rating Dutch modifiers; and  $F_1(1,39) = 98.6$ ,  $MSE = 1.800$ ,  $p < .001$  and  $F_2(1,13) = 228.6$ ,  $MSE = 0.307$ ,  $p < .001$  for native speakers of Dutch rating English modifiers. A significant interaction between Concept and Language occurred as well,  $F_1(1,88) = 14.37$ ,  $p < .001$  and  $F_2(1,26) = 4.16$ ,  $p = .052$ . The Dutch participants rated the English conceptually singular modifiers as more plural than the Dutch conceptually singular modifiers. Conversely, they rated the Dutch conceptually plural modifiers as more plural than the English conceptually plural modifiers.

A significant interaction between Form and Concept was also found,  $F_1(1,88) = 5.265$ ,  $MSE = 0.145$ ,  $p = .024$  and  $F_2(1,26) = 4.71$ ,  $MSE = 0.376$ ,  $p = .039$ , in addition to a significant interaction between Concept, Form and Language,  $F_1(1,88) = 15.38$ ,  $p < .001$  and  $F_2(1,26) = 0.251$ ,  $p = .620$ .

For the native Dutch speakers asked to perform the English version of the experiment, no differences were found in their responding to the conceptually singular translation equivalents which would either have a linking element in Dutch or no such linking element; there were also no difference in their responding to the conceptually plural translation equivalents which would either have a linking element in Dutch or no such linking element (Bonferroni correction). As already mentioned, for the native Dutch speakers performing the Dutch version of the experiment (see Section 2: Study 1), the conceptually singular modifiers and conceptually plural modifiers were both rated more extremely when they contained the matching linking element: no linking *en* in the case of the singular and the linking *en* in the case of the plural.

For the conceptually singular modifiers with no linking *en*, the ratings provided by the native Dutch speakers in the Dutch version of the experiment were lower ( $mean = 1.83$ ) than the ratings provided by the native Dutch speakers in the English version of the experiment ( $M = 2.49$ ),  $t_1(38) = 4.212$ ,  $p < .001$ ,  $t_2(14) = 3.842$ ,  $p = .001$  (one-tailed). For the conceptually singular modifiers with linking *en*, no significant differences were found between the Dutch and English versions of the experiment. There were also no significant differences found for the responding of the two groups to the conceptually plural modifiers without a linking *en*. However, for the conceptually plural modifiers with a linking *en*, the native speakers of Dutch rated the modifiers in the Dutch version of the experiment as more plural ( $M = 5.85$ ) when compared to the native speakers of Dutch in the English version of the experiment ( $M = 4.69$ ),  $t(38) = 5.399$ ,  $p < .001$ ,  $t_2(24) = 10.610$ ,  $p < .001$ .

In light of the many differences found for the responding of the native Dutch speakers in the Dutch versus English versions of the experiment, it appears that the responding of the native Dutch speakers in the English version of the experiment resembles the responding of the native English speakers in the English version of the experiment more than the responding of the Dutch speakers in the

**Table 3:** Mean ratings (standard deviations) provided by native Dutch speakers responding to English modifiers and native English speakers responding to English modifiers for four types of items (1 = singular; 7 = extremely plural).

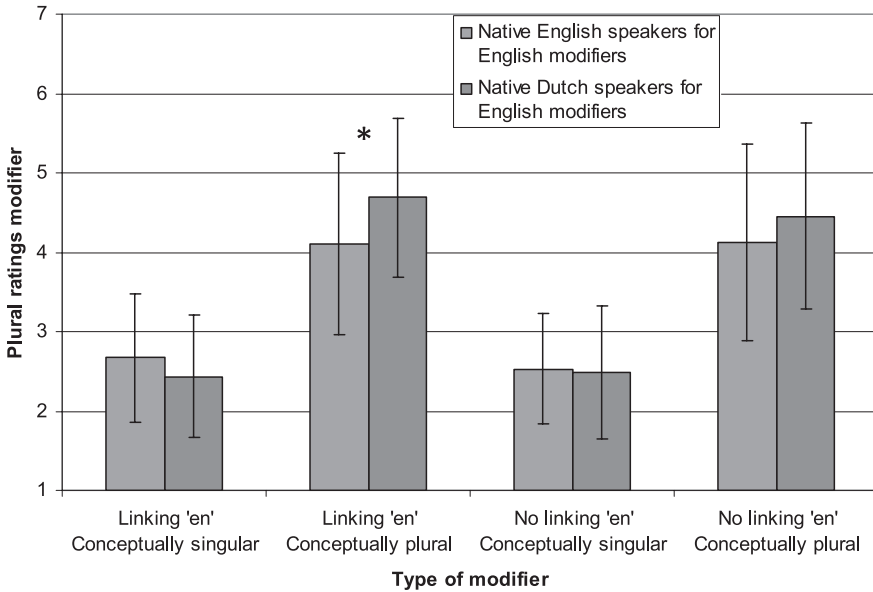
<b>Modifier containing linking <i>en</i></b>			
<b>Conceptually singular</b>		<b>Conceptually plural</b>	
<b>English modifiers</b>	<b>English modifiers</b>	<b>English modifiers</b>	<b>English modifiers</b>
Native Dutch speakers	Native English speakers	Native Dutch speakers	Native English speakers
2.67 (0.81)	2.43 (0.77)	4.10 (1.14)	4.69 (1.00)
<b>Modifier without linking <i>en</i></b>			
<b>Conceptually singular</b>		<b>Conceptually plural</b>	
<b>English modifiers</b>	<b>English modifiers</b>	<b>English modifiers</b>	<b>English modifiers</b>
Native Dutch speakers	Native English speakers	Native Dutch speakers	Native English speakers
2.53 (0.81)	2.49 (0.84)	4.12 (1.24)	4.45 (1.17)

Dutch version of the experiment. Such a pattern of findings suggests that interpretation is shaped by the forms of the language being used on a given occasion rather than by one's native language.

To test this hypothesis, we next compared the plurality ratings provided by the native Dutch speakers for the English translation equivalents with those provided by the native English speakers for the same English translation equivalents. In Table 3 and Figure 3, the average ratings provided by the native Dutch speakers responding to the English modifiers (this Section: Study 2) and the native English speakers responding to the English modifiers (see Section 2: Study 1) are presented for the four types of items.

General Linear Model Repeated Measures ANOVAs were conducted with Concept (singular or plural) and Form (presence or absence of linking *en*) as a within-participants and within-items factor and Language as a between-participants factor. No main effect of Form was found,  $F_1(1,80) = 3.736$ ,  $MSE = 0.118$ ,  $p = .057$  and  $F_2(1,26) = 1.60$ ,  $MSE = 0.736$ ,  $p = .217$ , and there was also no significant interaction between Form and Language,  $F_1(1,80) = 0.131$ ,  $p = .718$  and  $F_2(1,26) = 0.068$ ,  $p = .796$ .<sup>5</sup>

<sup>5</sup> We also did an analysis for the factor Form with all the 105 items. The results were almost the same as for the subset of the items. There was no main effect for Form too,  $F_1(1,80) = 1.615$ ,



**Fig. 3:** Mean ratings (standard deviations) provided by native Dutch speakers responding to English modifiers and native English speakers responding to English modifiers for four types of items (1 = singular; 7 = extremely plural)

A significant main effect of Concept was found,  $F_1(1,80) = 186.2$ ,  $MSE = 1.439$ ,  $p < .001$  and  $F_2(1,26) = 260.2$ ,  $MSE = 0.517$ ,  $p < .001$ . Those modifiers referring to plural concepts were indeed rated as more plural ( $M = 4.3$ ) than those modifiers referring to singular concepts ( $M = 2.5$ ). Separate analyses for each group of participants again showed this main effect to be caused by both groups of participants. However, a significant interaction between Concept and Language occurred as well,  $F_1(1,80) = 5.052$ ,  $p = .027$  and  $F_2(1,26) = 5.44$ ,  $p = .028$ . The English participants rated the English conceptually singular modifiers as more plural than the Dutch participants. Conversely, the Dutch participants rated the conceptually plural modifiers as more plural than the English conceptually plural modifiers.

$MSE = 0.048$ ,  $p = .207$  and  $F_2(1,100) = 0.159$ ,  $MSE = 1.156$ ,  $p = .691$ . There might be a marginal interaction between Form and Language,  $F_1(1,80) = 8.665$ ,  $p = .004$  and  $F_2(1,100) = 0.305$ ,  $p = .582$ . However, separate analyses for each group of participants showed that this effect disappears when analyzing both groups separately: for the native English speakers rating the English modifiers,  $t_1(41) = 1.359$ ,  $p = .182$  and  $t_2(50) = 0.096$ ,  $p = .924$ , and for the native Dutch speakers rating the modifiers in the English version of the experiment,  $t_1(39) = 2.649$ ,  $p = .012$  and  $t_2(50) = 0.792$ ,  $p = .432$ .



No interaction between Form and Concept was found,  $F_1(1,80) = 0.521$ ,  $MSE = 0.179$ ,  $p = .473$  and  $F_2(1,26) = 0.223$ ,  $MSE = 0.514$ ,  $p = .640$ . However, a marginally significant interaction between Concept, Form and Language was found,  $F_1(1,80) = 5.801$ ,  $p = .018$  and  $F_2(1,26) = 0.913$ ,  $p = .348$ . No differences were found between the two groups for conceptually singular modifiers without linking *en*, conceptually singular modifiers with linking *en* or conceptually plural modifiers without linking *en*. For the conceptually plural modifiers with linking *en*, however, the native speakers of Dutch rated the English modifiers as more plural ( $M = 4.69$ ) when compared to the native speakers of English ( $M = 4.10$ ),  $t_1(39) = 2.383$ ,  $p = .022$ ,  $t_2(24) = 4.767$ ,  $p < .001$ .

### 3.3 Discussion

To investigate whether the differences between the native Dutch speakers in the Dutch version of the experiment and the native English speakers in the English version of the experiment of Study 1 were caused by their native language knowledge or by the language of the experiment, we next conducted the English experiment with native Dutch speakers who thus had English as a second language. The ratings provided by the group of Dutch speakers in the English-language experiment (this Section: Study 2) were then compared to the ratings provided in Study 1 (see Section 2).

First, we compared the native Dutch speakers in the English version of the experiment with the native Dutch speakers in the Dutch version of the experiment. No differences were found for the ratings of conceptually singular modifiers with a linking *en* in Dutch or conceptually plural modifiers without a linking *en* in Dutch. However, the ratings in the Dutch version of the experiment were higher than in the English version of the experiment for the conceptually plural modifiers with a linking *en* and lower than in the English version of the experiment for conceptually singular modifiers without a linking *en*. These findings suggest that the native Dutch speakers did not bring along the semantics of Dutch linking *en* in their interpretation of the English modifiers.

Second, we compared the native Dutch speakers in the English version of the experiment with the native English speakers in the English version of the experiment to test whether their patterns of responding were similar. With respect to the factor Form, this was the case. The native Dutch speakers interpreted the English modifiers similar to native English speakers, again suggesting that the native Dutch speakers do not bring along the semantics associated with Dutch linking *en* to interpret English modifiers. Although both groups show a similar pattern

with respect to Concept, they marginally differ in the degree to which they distinguish conceptually singular modifiers and conceptually plural modifiers. However, they only differ in the interpretation of conceptually plural modifiers with a linking *en*; the native Dutch speakers produce higher ratings than the native English speakers. Thus, the native Dutch speakers in the English experiment do not interpret this condition the same as the native English speakers or as the native Dutch speakers in the Dutch experiment.

Closer inspection of the English compounds rated by the native Dutch speakers showed the majority of the ratings to reflect the pattern produced by the native English speakers (i.e., be lower than the Dutch ratings), but a small portion of the ratings were found to reflect the pattern produced by the native Dutch native speakers for Dutch modifiers (i.e., higher than the English ratings). Examples of items following the English pattern are *banana skin*, *bookshelf*, *animal day* and *dovecote*. Examples of items following the Dutch pattern are *strawberry jam*, *rabbit hutch* and *pin-head*.

We globally inspected the frequency of the target word by the naked eye because high frequency English words may be more likely to follow the English pattern for Dutch native speakers than low frequency English words. However, this did not appear to be the case. The Google frequencies for the items rated in accordance with the English pattern by the native Dutch speakers were 125000 (*banana skin*), 4680000 (*bookshelf*), 48700 (*animal day*) and 715000 (*dovecote*) whereas the Google frequencies for the items rated in accordance with the Dutch pattern were 256000 (*strawberry jam*), 2600000 (*rabbit hutch*) and 100000 (*pin-head*) (for the frequencies, see Appendix A). If the English frequency influenced the response patterns, we would expect the frequencies of the compounds following the Dutch pattern to be lower than the frequencies of the compounds following the English pattern. This was not found to be the case, so the frequency of the English compounds did not apparently influence the responding of native Dutch speakers to the everyday noun-noun compounds included in our study.

These findings show the native Dutch speakers in the English version of the experiment, which relied upon translation equivalents from the Dutch experiment, to differ from the native Dutch speakers in the Dutch experiment. And although their responding also differed from how native English speakers interpreted the conceptually plural modifiers which would take a linking *en* in Dutch, the response pattern of the native Dutch speakers in the English version of the experiment was most similar to the response pattern of the native English speakers in the English version of the experiment. These findings suggest that interpretation may be influenced by the morphological form available in a language.

## 4 General discussion

In the present study, we investigated whether different forms for the modifiers in Dutch and English compounds influence speakers' interpretation. We first examined the interpretation of four types of items by native Dutch speakers. The items could be divided into two conceptual types: one in which the modifier of the compound was conceptually singular (e.g., *bananenschil* 'banana skin' and *ballonvaart* 'balloon ride') and one in which the modifier was conceptually plural (e.g., *aardbeienjam* 'strawberry jam' and *appeltaart* 'apple pie'). These modifiers could be with or without the linking element *en* in Dutch, which is similar to the plural suffix *-en* in Dutch. The English translation equivalents for the Dutch compounds were next presented to native English speakers and native Dutch speakers. The plurality ratings by the three groups of participants were then compared.

The native Dutch speakers rated the modifiers as more plural when the compounds contained a linking *en* than when they did not. No such differences were found for the native English speakers in the English version of the experiment. Given that there was no reason for the native English speakers to consider the English translation equivalents as plural, since they always lacked a linking element as plural, this pattern is what we expected to find. Crucially, the native Dutch speakers who participated in the English version of the experiment did also not consider the English modifiers as plural. Their response pattern differed from that of the native Dutch speakers in the Dutch version of the experiment but was almost the same as the response pattern of the native English speakers in the English version of the experiment.

These findings suggest that native Dutch speakers treat the linking *en* as a sign of plural meaning, which corresponds to earlier findings (e.g., Schreuder et al. 1998; Hanssen et al. submitted; Neijt et al. 2004). It even holds for the modifiers with singular concepts. For the English translation equivalents rated by native Dutch speakers, no differences were found for those modifiers which would occur with or without a linking *en* in Dutch. This indicates that native Dutch speakers rely on the form of the linking *en*, which is homographic with the plural Dutch suffix *-en*, when attributing meaning in Dutch but not in English. Although the form of the Dutch linking element appears to originate from either the old Dutch case system (Booij 1996; Van Loey 1969; Van Tiel et al. 2011) or words ending in schwa, the element is related to the plural suffix *-en* for speakers of modern Dutch and therefore used to express plural meaning (e.g., Banga et al. 2012; Neijt et al. 2002) and interpreted as a plural suffix (e.g., present study; Schreuder et al. 1998; Hanssen et al. submitted; Neijt et al. 2004).

The native Dutch speakers participating in the English version of the experiment, which did not contain any linking elements, were found to bring along the semantics of Dutch linking *en* when interpreting conceptually plural modifiers in English but not in the same manner as native Dutch speakers in the Dutch experiment. This indicates that the language people use at a particular moment in time influences their interpretation of compounds.

The question arises whether the results described above really reflect compound interpretation, or are an experimental artefact. We argue for the first option. If the participants had ignored the heads and based their rating only on the modifiers of the compounds, then we would not find the present response pattern. For the compounds containing a linking *en*, we found a difference between the conceptually singular modifiers (e.g., *bananenschil* ‘banana peel’) and the conceptually plural modifiers (e.g., *aardbeienjam* ‘strawberry jam’). For the compounds without linking *en*, we found a difference between the conceptually singular modifiers (e.g., *adreslabel* ‘address label’) and the conceptually plural modifiers (e.g., *appeltaart* ‘apple pie’). These differences suggest that it is not only the modifier that makes the modifier conceptually singular or plural for the native Dutch speakers; it is the combination of modifier and head that results in a conceptually singular or plural concept of the modifier. If the participants had ignored the head, we would not have found this pattern. In this case, the plurality ratings for *bananenschil* and *aardbeienjam* would have been the same, and also the plurality ratings for *adreslabel* and *appeltaart*. In addition, we had similar results in earlier experiments (e.g., Banga et al. 2012; Neijt et al. 2004). Furthermore, there would be no super singular effect in the present study: The conceptually singular Dutch items without linking *en* would have been rated the same as the conceptually singular English items. Instead, in our results, these English items were rated the same as the conceptually singular Dutch items with linking *en*. Given the effects and interactions found in our experiments, we argue that the interpretational effects that are measured can be relevant for everyday reading processes.

In other research, both Kousta et al. (2008) and Boroditsky (2001) investigated linguistic relativity in terms of the influence of a first language on a second language. Kousta et al. (2008) investigated the effects of grammatical gender, which is absent in English but present in Italian. They found Italian-English bilinguals to show the same pattern as English monolinguals when the task was in English and the same pattern as Italian monolinguals when the task was in Italian. Kousta et al. (2008) interpret these results as showing the intraspeaker relativity of semantic representations. Our results are in line with these findings as the Dutch native speakers behaved like the English monolinguals when the task was in English. Unfortunately, we could not compare Dutch bilinguals with Dutch

monolinguals because the general adult population is more or less bilingual, and certainly the students are highly proficient. At Dutch universities, almost all study books are in English.

Boroditsky (2001) investigated how native English speakers and native Mandarin speakers with English as a second language think about time because time is represented horizontally in English and vertically in Mandarin. Mandarin speakers tended to think about time vertically even when thinking in English, which is in contrast with the findings of the present study. It may thus be the case that the influence of language on thought differs depending on the category. More comparative study is thus a direction for future research.

In conclusion, the results of the present study provide support for the claim that interpretation may be influenced by the morphological form available in a language. When native Dutch speakers interpret modifiers in Dutch compounds, the interpretation of plurality is influenced by the presence or absence of a linking *en* which is homographic with the Dutch plural suffix *-en*. When native English speakers interpret modifiers in the English translation equivalents of the Dutch compounds, no such variability is found because, in English, linking elements are generally not present between the two parts of a compound. English native speakers rely on their knowledge of the world to interpret the modifiers in a compound. When native Dutch speakers performed the English version of the experiment and thus did not see linking elements, moreover, they did not bring all their Dutch semantics to the interpretation of the English modifiers. When processing English, native Dutch speakers followed more or less the pattern of native English speakers, which shows the language being used to influence semantic interpretations.

## Appendix A: Items

*Compound words with linking en and conceptually singular modifier*

<u>Dutch</u>	<u>CELEX</u>	<u>Google</u>	<u>English</u>	<u>CELEX</u>	<u>Google</u>
bananenschil	0	33100	banana skin	–	125000
bandenpech	0	12000	tyre trouble	–	74300
beddensprei	0	39400	bedspread	2	736000
eendenei	0	5180	duck egg	–	1810000
flessenwarmer	0	281000	bottle-warmer	–	226000
ganzenbout	0	2140	goose leg	–	4610
hoedenlint	0	1430	hatband	0	23100

hondenpoep	1	427000	dog dirt	–	39900
notendop	1	1080000	nut shell	1	3320000
ruitensproeier	0	240000	screen washer	0	807000
schapenvacht	1	466000	sheepskin	1	5540000
slangenbeet	0	12900	snakebite	0	179000
speldenknop	0	42300	pin-head	1	100000
spinnenweb	1	204000	spider web	–	209000

*Compound words with linking en and conceptually plural modifier*

Dutch	CELEX	Google	English	CELEX	Google
aardbeienjam	1	116000	strawberry jam	–	256000
ballenjongen	1	71700	ball boy	–	190000
beeldengalerij	0	20000	statue gallery	–	15800
bessenstruik	0	15200	currant bush	–	11500
boekenplank	1	690000	bookshelf	–	4680000
dierendag	0	463000	animal day	–	48700
duiventil	1	131000	dovecote	0	715000
erwtensoepe	1	783000	pea soup	–	210000
gebarentaal	1	283000	sign language	0	6720000
hakkenbar	0	788000	heel bar	–	151000
hertenkamp	0	222000	deer park	–	114000
juwelenkistje	0	18300	jewel case	–	2520000
kersenboom	0	130000	cherry tree	–	2880000
kleurenfoto	1	243000	colour photograph	–	781000
konijnenhok	0	793000	rabbit hutch	0	2600000
leeuwentemmer	0	47900	lion tamer	–	74500
rollenspel	1	2050000	role play	–	14700000
rupsenplaag	0	21700	caterpillar plague	–	1200
schoendoos	1	226000	shoebox	–	696000
sperziebonenrecept	–	5290	green bean recipe	–	28700
sterrenstelsel	1	8770	star system	–	211000
studentendecaan	0	172000	student counsellor	–	33800
tandenstoker	0	182000	toothpick	1	398000
tijdschriftenwinkel	–	24300	magazine shop	–	71200
tomatensaus	1	1440000	tomato sauce	–	1200000

*Compound words without linking en and conceptually singular modifier*

Dutch	CELEX	Google	English	CELEX	Google
adreslabel	–	168000	address label	–	323000
ballonvaart	0	1010000	balloon ride	–	125000
bankdirecteur	1	57500	bank manager	–	575000
beursintroductie	–	13900	market introduction	–	402000
fietsbel	0	13900	bicycle bell	–	43700
huisnummer	1	554000	house number	–	1060000
kastdeur	2	122000	cabinet door	–	2320000
kerkganger	0	172000	churchgoer	0	30500
knierreflex	0	1200	knee reflex	–	928
koolsla	0	18300	coleslaw	1	80000
korsetveter	0	513	corset lace	–	91000
naambordje	–	151000	nameplate	0	747000
oorbel	0	838000	earring	1	5680000
raamventilator	0	20900	window fan	–	364000
schilderijlijst	0	47600	picture frame	–	2550000
schroefkop	0	106000	screw head	–	136000
smaakversterker	–	37500	flavour enhancer	–	123000

*Compound words without linking en and conceptually plural modifier*

Dutch	CELEX	Google	English	CELEX	Google
aardappelmesje	0	22300	potato knife	–	4490
appeltaart	1	1080000	apple pie	0	1680000
boomchirurg	0	43300	tree surgeon	–	863000
citroenlimonade	0	9400	lemon drink	–	124000
dagboek	19	23000000	daybook	0	75400
diamantmijn	0	30800	diamond mine	–	109000
graanhandel	0	59700	grain trade	–	96900
granaatwerper	0	94700	grenade launcher	–	698000
instrumentmaker	0	125000	instrument maker	–	310000
kaashandel	0	107000	cheese shop	–	244000
olijfolie	5	6050000	olive oil	–	5750000
prijslijst	0	4020000	price list	0	8680000
straatbende	0	19400	street gang	–	201000
tonijnvangst	–	10600	tuna catch	–	14000

## Appendix B: Instructions

### B.1 Dutch experiment

Het eerste deel van een samenstelling heeft soms een meervoudsbetekenis, soms een enkelvoudsbetekenis. Bijvoorbeeld: meervoud voor *kleuter* in *kleuterklas*, want het gaat om meerdere kleuters, en enkelvoud voor *mannen* in *mannenstem*, want het gaat om de stem van één man. Dat onderscheid noemen we numerositeit.

Het volgende blaadje bevat een woordenlijst. In deze lijst geeft u aan hoe meervoudig u het eerste deel van de samenstelling vindt. Bijvoorbeeld:

mannenstem	enkelvoud	●	○	○	○	○	○	○	meervoud
kleuterklas	enkelvoud	○	○	○	○	●	○	○	meervoud
mierenhoop	enkelvoud	○	○	○	○	○	○	●	meervoud
sinaasappelschil	enkelvoud	○	○	●	○	○	○	○	meervoud
appelsap	enkelvoud	○	○	○	●	○	○	○	meervoud
lippenstift	enkelvoud	○	●	○	○	○	○	○	meervoud

Wanneer u het eerste deel alleen maar als een enkelvoud kunt interpreteren, dan kleurt u het eerste rondje in. Kan het eerste deel ook een meervoudsbetekenis hebben, dan kiest u een van de rondjes rechts daarvan. Hoe meervoudiger u het eerste deel vindt, hoe meer naar rechts u het rondje inkleurt.

Het gaat om individuele betekenisoordelen. Denk niet te lang na, en laat u vooral leiden door wat het eerst in u opkomt.

Bedankt voor uw medewerking!

### B.2 English experiment

The first part of a compound word may be a semantic plural or singular. For instance: a plural meaning for *bulb* in *bulb farm*, where many bulbs are grown, but a singular meaning for *male* in *male voice*, the voice of a man. This distinction is called numerosity.

The following two pages contain a list of compounds. In this list, please indicate your numerosity estimations the first part of each compound. For instance, one's estimations could be as follows:



male voice	singular	●	○	○	○	○	○	○	○	plural
bulb farm	singular	○	○	○	○	○	○	●	○	plural
ant hill	singular	○	○	○	○	○	○	○	●	plural
orange peel	singular	○	○	●	○	○	○	○	○	plural
apple juice	singular	○	○	○	●	○	○	○	○	plural
lipstick	singular	○	●	○	○	○	○	○	○	plural

If your interpretation is singular, then colour the first circle. If the first part of the compound can also have a plural interpretation, choose one of the circles to the right. The more plural you think the first part is, the more to the right your choice of circle to color.

Note that the task concerns individual meaning judgments. Do not think about things too much, and let your initial intuition guide you.

Thank you for your cooperation!

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