

What's the Meaning of a Nominal Root? Insights from Experiments into Denominals and Similarity.

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1. Aims

Denominal verbs, i.e., verbs which seem to be derived from nouns, have been widely discussed in a variety of theoretical studies (Acquaviva 2009, 2014, Borer 2014, Hale & Keyser 2002, Harley 2005, 2008, Harley & Haugen 2007, Levinson 2007, Marantz 1997). One important point under debate is whether denominal verbs are derived from acategorial roots or nominal roots. In other words, is a verb like *dance* directly derived from an underspecified root (Acquaviva 2009, 2014, Borer 2014) or is it derived from the noun *dance* (Hale & Keyser 2002, Levinson 2007), which, in turn, is derived from an acategorial root? We argue that the latter version more adequately captures denominal verb formation. Another important point under debate has been the issue of what exactly the meaning of a nominal root is, in contrast to the meaning of an acategorial root. Which aspects contribute to the meaning of nominal concepts (Acquaviva 2009, 2014, Pustejovsky 1995)? Do function, shape, material, a.o. matter to the same extent, or are certain aspects of meaning perhaps more salient, more relevant or more helpful in defining certain concepts? We argue that nominal concepts are better understood through an interplay of a variety of aspects.

Previously, we have presented evidence from an acceptability judgment task showing that all denominal verbs are derived from nominal roots, regardless of whether they can combine with PP-objects different from the incorporated root (Bleotu & Bloem 2020). Importantly, the degree of similarity of the PP-objects to the incorporated nominal root seems to account for the acceptability of sentences containing denominals in combination with various PPs. In the present paper, we investigate by means of a forced choice task whether similarity of function, shape and material are similarly significant, and our inquiry seems to lead to the conclusion that nominal roots are defined by a variety of aspects rather than one single (predominant) aspect.¹

In what follows, we first summarize our previous experiment on the acceptability of denominals with different PP-objects in section 2, and then present the forced choice task and the effect of these different types of similarity on acceptability in section 3.

2. True-pseudo denominal experiment: Is there any difference?

2.1. Background

Denominal verbs have been the focus of much investigation in lexical syntax and distributed morphology, serving as an interesting domain for pinning down possible differences between nouns and roots and settling the issue of whether roots are categorial or acategorial. Various proposals about how denominal verbs are derived have been put forth in the literature. According to Hale & Keyser (2002), all denominal verbs are derived from nominal roots. According to Kiparsky (1997), some denominal verbs (true

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¹ We would like to specify that, because of space constraints, we have limited ourselves to presenting only one of the experiments we ran on similarity. We leave the presentation of the other experiments for a more comprehensive paper on the topic in the future.

denominal verbs) are derived from nouns, while others (pseudo denominal verbs) are derived from roots. According to Borer (2014), all denominal verbs are derived from acategorical roots.

In what follows, we focus on Kiparsky's (1997) proposal that there are two types of denominal verbs (true/noun-derived and pseudo/root-derived). True denominals like *tape* cannot combine with a prepositional phrase denoting a different object from the one incorporated in the verb. Being noun-derived, true denominals like *tape* imply the specific use of the incorporated object: one can only tape with tape, not with pushpins (1a). In contrast, pseudo-denominals like *hammer* can combine with a prepositional phrase denoting a different object from the one incorporated in the verb. Being root-derived, they allow for the possibility of multiple prepositional phrases, though they usually imply the most typical instrument used for the activity: one can hammer not just with a hammer, but with a shoe (1b).

- (1) a. ??to tape a picture with pushpins. (true)
- b. to hammer with a shoe (pseudo)

This idea has also been embraced by Arad (2003, 2005) for Hebrew, where there seems to be evidence in favor of two types of denominals, though see Rasin et al. (2021) for a new take on the issue, arguing that the data from Hebrew does not point so clearly to a distinction between true and pseudo denominals. According to Harley & Haugen (2007), the distinction between true and pseudo denominals is not structural. While taping with pushpins is bad, taping with band-aids is much better, given that band-aids are more similar to tape in terms of function than pushpins (their adhesive properties allow them to be used to cover something). In Bleotu & Bloem (2020), we tested experimentally whether Kiparsky's distinction between true and pseudo denominals holds for English native speakers.

2.2. Materials and Methodology

The experiment (N=100) was based on the idea that the unacceptability of (some of) Kiparsky's sentences could be explained by the lack of similarity between PPs and the incorporated *n* object. We therefore created an acceptability judgment task testing to what extent the similarity of the PP to the incorporated object affects acceptability for native speakers of English. Participants had to rate sentence acceptability on a Likert scale from 1 to 5. There were 56 sentences (28 test sentences and 28 fillers). The test employed 12 instrument denominals, 8 location denominals and 8 locatum denominals.

Based on the sentences by Kiparsky (1997), the Bleotu & Bloem (2020) experiment used four types of test sentences: sentences with true denominals that were deemed unacceptable by Kiparsky, sentences with pseudo-nominals that were deemed acceptable by Kiparsky, modified sentences with true denominals and modified sentences with pseudo-denominals. Instead of the instrument/location/locatum verb used by the author, the modified sentences employed instrument/ location/ locatum PPs that were more or less similar to the incorporated root object. For the class labelled by Kiparsky (1997) as 'true denominals', the PPs were made more semantically similar (2a), while, for the class of 'pseudo-denominals', the PPs were made less similar (not an object type *n*) (2b):

- (2) a. He crowned her ??with a hat/with a rose garland. (true)
- b. Tom paddled the canoe with a board/??with a spoon. (pseudo)

The test sentences therefore vary in terms of PP-similarity (similar/nonsimilar, according to the authors' judgments) and label (true/pseudo).

2.3. Results

Overall, a difference between ratings for denominal verbs with semantically similar PP-objects and ratings for denominal verbs with non-similar ones was found. In the case of pseudo denominals, sentences with similar PPs were rated on average 4.10, while sentences with non-similar PPs were rated 3.23. In the case of true denominals, items with similar PP-objects were rated on average 3.61 and non-similar ones 2.87. The analysis controlled for verb type (instrument/location/locatum) as a fixed effect, and *participant* and *verb* were used as random effects with random slopes for the within-subjects factor *similarity*. Further details on this experiment can be found in Bleotu & Bloem (2020).

		Sentence	-sim object	Mean	+sim object	Mean
T	IM	She taped the picture to the wall with	pushpins	2.48	bandaids	4.44
T	LN	Anne boxed the present in	a brown paper bag	1.80	a tin can	2.88
T	LM	He crowned her with	a hat	3.94	roses	4.65
P	IM	I paddled the canoe with	a board	4.04	a spoon	3.64
P	LN	He shelved the books on	the window sill	4.24	the table	2.68
P	LM	Lisa buttered a piece of toast with	margarine	4.12	honey	2.49

Table 1: Mean judgments for +/- similar objects for some of the test items, from Bleotu & Bloem (2020). T = True, P = Pseudo, IN = Instrumental, LN = Location, LM = Locatum.

The results suggested that there is no difference between true and pseudo denominal verbs, but rather the behavior they exhibit is a function of the similarity of the PP these verbs combine with and the incorporated *n* object. Consequently, we argue that all denominal verbs are derived in the same way.

2.4. Discussion

These results are compatible with several accounts: a referential account or a meaning-based account. On the one hand, it could be argued that denominals are derived from OBJECT TYPE *n*, a function which returns all the objects similar to *n* (including *n* itself). Since OBJECT TYPE *n* refers to *n*-like objects, compatibility with various PPs could be explained through the number of *n*-like objects denoted by OBJECT TYPE *n*. Nevertheless, the OBJECT TYPE *n*/referential account is uneconomical, as it relies on an additional silent noun projection, which is not desirable for economy reasons (Borer 2014).

On the other hand, it could be argued that denominals are derived from roots which are or become nominal. Acquaviva (2009) and Borer (2014) propose that denominals are derived directly from acategorial roots instead of from nominal roots which are derived in turn from acategorial roots. Acquaviva's (2009) argues that lexical relatedness can be expressed without the need to state that the verb includes the noun (or vice versa). Moreover, it is preferable to opt for a simpler structure over a more complex one. Borer's (2014) claims that there are no verbs derived from complex nouns (such as **to destruction*, for instance), which would be unexpected under the view that denominal verbs are derived from nouns. However, under critical scrutiny, these arguments are not so strong. Firstly, embracing the idea that denominals are directly derived from acategorial roots does not do justice to the fact that, often, denominal verbs refer to some action involving the actual object expressed by *n*. Secondly, it does not seem to be the case that there are no verbs derived from complex nouns, if one considers cases such as *to disillusion*, *to proposition*, *to champion*, a.o.

These counterarguments suggest that an account where denominal verbs are derived from nominal roots rather than acategorial roots would be more adequate. Moreover, as argued by Levinson (2007), the presence of nominal roots within denominal verbs is further supported by the existence of pseudoresultatives such as (*thin* in *He sliced the bread thin*). We thus embrace the view that all denominal verbs are derived from nominal roots, and that sentence acceptability is driven by the degree of similarity between the PP-objects verbs combine with and nominal roots. However, given that the notion of similarity is difficult to tackle, we decided to further explore it experimentally, trying to see participants' own decisions upon how similar PP-objects are to roots and what aspect of similarity seems to matter more for acceptability (shape, material, use).

3. Nominal root and similarity experiment: What aspects of the nominal root matter for similarity?

3.1. Background

Handling similarity is challenging. In the Bleotu & Bloem (2020) experiment, we were the ones who decided whether a PP-object is similar to the nominal root or not, thus introducing our own subjective biases

in the equation. Moreover, similarity was treated as a binary phenomenon: PP-objects were considered either similar to the nominal root or not similar. However, both these methodological decisions are problematic. First, it is important to avoid biases regarding similarity, and, therefore, it is preferable to obtain empirical similarity data from the participants themselves. Second, similarity between PP-objects and nominal roots may operate at various levels (similarity in terms of function, shape, size, color, a.o.-see Goodman 1972), so one interesting question is what similarity aspects drive acceptability.

In relation to the meaning of a nominal root, many perspectives have been proposed, but they all generally agree upon the fact that nominal roots are different from nouns. Acquaviva (2009), for instance, has argued that, while nouns have reference, nominal roots have only meaning. In other words, while nouns can pick referents, roots only express concepts. This is why, in order to better understand nominal roots and what aspects of meaning might matter more in defining concepts, it is important to articulate an explanatory theory of concepts. Pustejovsky (1995) proposes such a theory, arguing that nominal roots express nominal concepts, which are to be understood as a Qualia Structure, i.e., a system of semantic relations (such as container, space, function, a.o.). Drawing on Aristotle's theory of explanation, ideas from Moravcsik (1975), Hayes (1979), Hobbs et al. (1987) and Croft (1991), Pustejovsky (1995) puts forth the idea that Qualia Structure consists of four basic roles: a) the constitutive role, understood as the relation between an object and its constituents (material, weight, parts and component elements), b) the formal role, understood as that which distinguishes the object within a larger domain (orientation, magnitude, shape, dimensionality, color, position), c) the telic role, understood as purpose and function of the object (purpose that an agent has in performing an act, built-in function or aim that specifies certain activities), d) the agentive role, understood as factors involved in the origin or "bringing about" of an object (Creator, Artifact, Natural Kind, Causal Chain). Pustejovsky (1995) argues that compositionality in language results from combining Qualia Structure with argument structure.

Interestingly, among the roles which define Qualia Structure, function (telos) seems to have a more special status. This is because, while the concrete properties characterizing objects cannot be modified, function can: objects can sometimes be used with a different function than the intended one. For instance, a shoe can be used as a hammer if need be. As discussed previously, drawing on the difference between using objects with their intended function and using them with a different function, Kiparsky (1997) argues in favor of a class of pseudo denominal verbs, which can combine with PP-objects distinct from the nominal root incorporated in denominal verbs. While Bleotu & Bloem's (2020) experimental results suggest that the distinction between true and pseudo denominals does not seem to hold ground, it is nevertheless important to understand the special role function seems to have in Kiparsky (1997)'s classification. In a sense, true denominals are simply those denominals incorporating objects that are harder to use with a different function than their intended one, while pseudo denominals are those denominals incorporating objects that can be used with a different function more easily. The distinction is pragmatic, not structural. Dowd (2010) has a very interesting view upon the matter, arguing for a hierarchy in the relevance of these aspects for the understanding of nominal concepts. In some cases, based on world knowledge, nominal concepts seem to be defined by function (e.g. *hammer*), whereas in others, form or mode of composition are more relevant (e.g. *tape*). While many aspects of the meaning of nominal roots matter for interpretation, a good starting point in getting to the root of the matter seems to be examining the impact of roles such as the formal role (shape, material) and telos (function) on similarity.

Goals Our present experiment sets out to elicit empirical similarity data from the participants themselves, seeing what PP-objects they consider similar or dissimilar to the nominal root. The goal is to then use this information in order to see whether our contextual acceptability ratings from the test can be derived from non-contextual semantic intuitions. In addition, the current experiment delves into the question of what aspect of similarity (function, shape, material) drives acceptability, trying to shed light on the semantics of nominal roots, as opposed to nouns.

3.2. *Materials and Methodology*

Drawing on Pustejovsky's (1995) idea, we designed a similarity experiment (N=60) in order to see (i) what PP-objects are considered by English native speakers to be similar/non-similar to the incorporated nominal root, and (ii) in what respect (shape, material or function).

Factor	Category	t	P-value	Est. difference	95% conf. int.
Classification	-Pseudo	4.94	* 1.88 ⁻⁰⁶	1.05	0.63 – 1.48
	+IN, -LN/LM	-0.80	0.433	-0.31	-1.08 – 0.46
Verb type	+LN, -LM	0.30	0.77	0.15	-0.87 – 1.17

Table 2: Fixed effects of variables on the acceptability ratings of denominals with different objects (2800 observations) in a model based on Kiparsky (1997). IM = Instrumental, LN = Location, LM = Locatum, * = significant at the $\alpha = 0.05$ level.

The experiment employed a forced choice task of comparative similarity, where participants were asked to say which of the two items (i.e. the PP-objects from Bleotu & Bloem’s (2020) acceptability task) were more similar to the roots (present in the make-up of the denominal verbs) in terms of three distinct similarity criteria: shape (form), material (composition) and use (function). The exact same test items were used as in the sentences from Bleotu & Bloem (2020). There were three test questions for each of the denominal verbs used (resulting in 28×3 test questions). For each target denominal, participants were asked three distinct questions about the three similarity criteria:

- (3) a. Which is more similar to paddle in terms of shape (form)? i. board ii. spoon
- b. Which is more similar to paddle in terms of material (composition)? i. board ii. spoon
- c. Which is more similar to paddle in terms of use (function)? i. board ii. spoon

They then had to pick between *board* and *spoon*, a forced choice question corresponding to one of the acceptability judgment questions from the previous experiment. Importantly, the forced choice provides a standard of comparison (e.g. *paddle*) against which participants can judge the similarity of the objects at stake. The questions involved roots without an (in)definite article to avoid a DP interpretation.

Next, we preprocess the data by calculating, for each test item (answer option) and for each similarity criterion, the proportion in which it was picked in the experiment. For example, for the denominal *to paddle*, the item *board* was picked over the alternative option *spoon* 43.5% of the time in the shape condition, 51.8% of the time in the material condition, and 77.6% of the time in the function condition. Having these numbers for each test item, we added it to the Bleotu & Bloem (2020) acceptability dataset, which uses the same items, to be able to model the individual acceptability judgments in that dataset on the basis of these numbers.

3.3. Results

Using this data, we created linear models testing the effect of similarity ratings provided according to the three different criteria (shape, material or function) on the acceptability of the test sentences based on Kiparsky’s (1997).

As a baseline, we present a model based on Kiparsky’s (1997) classification in Table 2. It models acceptability of sentences with denominal verbs and PP-objects only on the basis of the Kiparsky classification of the denominal (true/pseudo) while controlling for verb type (instrument/location/locatum) as a fixed effect and participant as a random intercept, with a random slope for the within-subjects factor Kiparsky classification. We also add verb as a random intercept. The participant random effect controls for any potential between-subjects variation in acceptability rating, and the verb random effect controls for any potential variation between denominal verbs, or the test sentences constructed with those verbs. For example, if some test sentences are less acceptable than others for reasons other than the PP-object used, this random effect would capture this variance.

This model’s estimate of the mean acceptability rating is 3.51 points (95% confidence interval 3.10 .. 3.91 points). The estimate of denominals labeled as *pseudo* is significantly higher than the estimate of denominals labeled as *true* ($t[2045] = 4.94$, $p = 1.88^{-06}$). We observed no evidence for an effect of verb type. We conclude that test items with pseudo-labeled denominal verbs are rated higher than those with true-labeled denominal verbs (estimated difference = 1.05 points; 95% confidence interval 0.63 .. 1.48 points). This appears to confirm Kiparsky’s (1997) ideas for these test sentences, though Bleotu & Bloem

Factor	Category	t	P-value	Est. difference	95% conf. int.
Classification	Sim- <i>function</i>	10.71	* < 2 ⁻¹⁶	1.20	0.98 – 1.43
Verb type	+IN, -LN/LM	-1.45	0.16	-0.34	-0.82 – 0.13
	+LN, -LM	1.38	0.18	0.44	-0.20 – 1.07

Table 3: Fixed effects of variables on the acceptability ratings of denominals with different objects (2800 observations) in a model based on *function* similarity judgements from our experiment. IM = Instrumental, LN = Location, LM = Locatum, * = significant at the $\alpha = 0.05$ level.

Factor	Category	t	P-value	Est. difference	95% conf. int.
Classification	Sim- <i>shape</i>	12.86	* < 2 ⁻¹⁶	1.60	1.35 – 1.84
Verb type	+IN, -LN/LM	-1.50	0.15	-0.35	-0.81 – 0.11
	+LN, -LM	1.23	0.23	0.38	-0.24 – 0.99

Table 4: Fixed effects of variables on the acceptability ratings of denominals with different objects (2800 observations) in a model based on *shape* similarity judgements from our experiment. IM = Instrumental, LN = Location, LM = Locatum, * = significant at the $\alpha = 0.05$ level.

(2020) note that this effect is better accounted for by the verb random effect, suggesting differences in acceptability between specific denominal verbs (or their test sentences) rather than two distinct classes of denominals. The question we are now interested in is whether semantic similarity of the PP-object presents a better account than this baseline (explaining more of the variation in acceptability ratings), and which aspects of meaning contribute to it.

To compare the two theories, we present another model based on our nominal root and similarity experiment, and we first focus on *function*, given the special status of this role in Qualia Structure. Here, we model acceptability of sentences with denominal verbs and PP-objects only on the basis of semantic similarity according to the *function* criterion, while controlling for the same variables as before (verb type, participant random intercept+slope, verb random intercept).

Shown in Table 3, this model estimates that sentences containing denominals with PP-objects that are rated to be more similar in terms of function, are considered significantly more acceptable than those that are rated to be less similar in terms of function ($t[2045] = 10.71$, $p < 2^{-16}$). Again, we observed no evidence for an effect of verb type. The estimate of the *function* similarity effect is such that for items that were picked as ‘more similar’ 100% of the time, acceptability goes up by an estimated 1.20 points (95% confidence interval 0.98 .. 1.43 points) as compared to items that were picked as ‘more similar’ 0% of the time. This estimated effect size is larger than that of Kiparsky’s classification in the baseline model.

When we combine both accounts into a single model with the same controls as before, the estimate of the effect of Kiparsky’s classification is 0.43 points ($p = 0.03$) and that of *function* similarity is 1.18 points ($p < 2^{-16}$), indicating that *function* similarity is a better explanation of the acceptability data.

However, we are not just interested in similarity in terms of function, but also in terms of shape and material. For these two criteria, the models estimate acceptability to be between 0.9 and 1.6 points higher when all of the participants consider the object in the sentence more similar, compared to when none of them consider it more similar to the root. Table 4 shows all the fixed effects for the *shape* criterion model, which has the largest effect size — the effect on acceptability is that it goes up by an estimated 1.60 points (95% confidence interval 1.35 .. 1.84 points). Unfortunately, because the different similarity criteria are highly correlated (*function-shape*: $r(2048) = 0.82$, $p < 2^{-16}$, *function-material*: $r(2048) = 0.72$, $p < 2^{-16}$, *shape-material*: $r(2048) = 0.75$, $p < 2^{-16}$), linear mixed models cannot accurately determine how much variance is explained by each criterion (there is too much multicollinearity). Therefore, we instead perform a series of model comparisons, where we only examine and compare the effects of each entire model, including its control factors.

We compare the different models of the three similarity criteria in terms of their information loss when modeling acceptability ratings. Information loss is expressed as an Akaike Information Criterion

Factor	AIC
Kiparsky (1997)	6963.2
Shape criterion	6801.2
Material criterion	6898.7
Function criterion	6869.9
All sim criteria	6804.6

Table 5: Anova comparison of models with different criteria for comparative similarity, showing information loss in terms of AIC.

(AIC) value. A model with lower AIC loses less information compared to the data it models, and thus accounts for more variance. We find that all ratings, regardless of criterion, predict acceptability better than Kiparsky’s classification. The results of all model comparisons are shown in Table 3.3.

Regarding the similarity criteria, we observe that a model of *shape* similarity provides the best fit to the acceptability data, followed by *function* and *material*. Differences between these models are all significant according to ANOVA model comparisons (*function-shape*: $\chi^2 = 68.6$, $p < 2^{-16}$, *function-material*: $\chi^2 = 28.8$, $p < 2^{-16}$, *shape-material*: $\chi^2 = 97.5$, $p < 2^{-16}$). Lastly, we also included a model with all three of the similarity criteria as predictors. Interestingly, this model has a slightly higher estimated information loss than the *shape*-only model (6804.6 vs 6801.2 AIC). However, this difference is not statistically significant ($\chi^2 = 14.6$, $p = 0.10$), so we have no evidence for a difference. Adding Kiparsky’s classification as a control factor to these models does not significantly change the information loss. We can conclude that similarity of the PP-object to the root in terms of shape accounts for more of the variation in acceptability ratings than the other similarity criteria, but similarity in terms of shape, function and material combined accounts for acceptability similarly well.

Lastly, we also observe that models perform better if we add a random slope for the similarity score to the verb random intercept (AIC goes from 6801 to 6605 for the *shape* condition, 6804 to 6606 for the full model). This means that the extent to which PP-object similarity affects denominal sentence acceptability, strongly differs per denominal. This is not just an effect of Kiparsky’s classes, however, as adding those did not significantly improve the model. This observation may suggest that there are some other features of denominal verbs that affect how similar their PP-objects can be. However, a more likely possibility is that this is an effect of other differences in acceptability between the test sentences chosen in Bleotu & Bloem (2020), as there was only one test sentence (with two different PP-objects) for each verb in the acceptability experiment. An expanded acceptability judgement experiment with more different test sentences per denominal would be required to explain this effect.

3.4. Discussion

The results further support the idea that the acceptability of combining denominals with various PP-objects depends on the similarity between PP-objects and the incorporated nominal roots. Moreover, at a more fine-grained level, we find that similarity of shape, material and function are each better predictors of sentence acceptability than the distinction between true and pseudo denominals. Nevertheless, material seems to perform worse than shape or function, possibly because of combining denominals with PP-objects that belong to different materials, thus making it hard for participants to make a choice in terms of which object is more similar to the nominal root. Importantly, shape seems to predict sentence acceptability better than function, which seems to predict sentence acceptability better than material. These findings go against the logic of Kiparsky (1997)’s classification or Dowd (2010)’s proposal that function/use is somewhat more special than other aspects of the nominal root, and some nominal roots can be predominantly defined by it. However, even though shape seems to be the best predictor of acceptability, the three aspects (shape, material, function) all seem to matter, as the effect sizes for each of them individually were estimated to be large, and they were statistically significant. Hence, our research supports Pustejovsky (1995)’s idea that nominal concepts are defined by a variety of aspects. Because some functions can only be performed by objects with certain specific properties, we get the illusion that some concepts are exclusively defined

by form/mode of composition, when, in fact, multiple aspects matter.

4. Conclusion

In conclusion, in the current paper, we have presented two experiments showing evidence (i) that all denominals (be they true or pseudo) are derived from nominal roots, (ii) that similarity of PP-objects to the incorporated nominal roots drives acceptability of sentences where denominals combine with those PP-objects, and (iii) that nominal roots are defined by a multitude of aspects (shape function, material a.o.) rather than just one single aspect.

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