

Children's use of phonological cues in lexical categorisation

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1. Introduction

Several studies discuss the role of phonological cues in the lexical categorisation of new words, which could be important for understanding how children learn syntactic categories. Phonological cues could, for example, influence or even determine the learning of words or syntactic categories. A study of Fitneva et al., for example, points out that phonological knowledge affects lexical categorisation of verbs in English, which could be crucial for understanding language acquisition in general. The study of Fitneva et al. (2009) for English can be compared to ter Schure's (2010) findings for Dutch. Fitneva et al. conducted two experiments that were carried out with seven-year-old children with English as their native language. The first experiment was carried out with a group of L1 children, and the second experiment with children who were learning a second language (French). The second group was tested because these children had no general knowledge of the L2, which means that they have limited knowledge of phonological cues. Therefore, their sensitivity to phonological cues in a second language could be tested.

In experiment one forty-five monolingual children, aged 6-8, were tested by learning a 'new language', which consisted of pseudo-words that were created by assessing the phonological typicality of these pseudo-words according to the measure of Farmer et al. (2006). Eight noun-like and eight verb-like pseudo-words were selected for the experiment, and the pseudo-words conformed to the phonotactic constraints of English, for example, in syllable length and vowel type. Sixteen pictures of existing objects and actions were thus shown and at the same time the participants were presented with non-existing words like 'skik' or 'posp' (Fitneva et al., 1973). At each picture the participants were asked "to repeat [the word] and pick the picture they thought [it] was referring to." (Fitneva et al., 1977) In this

experiment the children were divided into three groups, where the words were either consistent, inconsistent or independent to the English condition. The major finding from this experiment is that children's initial assumptions about new words are affected by phonological knowledge. Noteworthy, however, is that this was only found when children had to guess whether a new word was a verb or a noun, but not in a learning phase, in which they were taught the 'correct' category of the word or had to reproduce the pseudoword. Hence, Fitneva et al. concluded that phonology only affects the early stages of word learning.

Another important result is that phonological typicality only influenced children's response to verb-like stimuli, as opposed to noun-like stimuli. The children used their phonological knowledge (i.e. chose a monosyllabic item) only when choosing an action picture. This result also appeared in the second experiment, where twenty-eight English speaking children, aged 6-8, "enrolled in a French immersion program" on the same schools as in experiment one (Fitneva et al., 1982). The children were tested in the same manner as in experiment one, but they were further divided into an English-test group and a French-test group. Even though the children of the second experiment had limited knowledge of the second language, phonological cues nevertheless appear to affect their initial inferences about new words, but only when they were in a French language environment. It seems, thus, that within two years of academic exposure to a language, "children can develop sensitivity to the relationship between phonology and grammatical category in that language." (Fitneva et al., 1988) Moreover, the French immersion children did not differ from the monolingual English speaking children, when tested in English; the results of word learning and categorisation were similar. In conclusion, both groups of experiment one and two were more accurate on verb-like than noun-like words when tested in English, which

means that phonological cues affect lexical categorisation, but only with action pictures (verb-like stimuli).

The main goal of the research of Fitneva et al. was to examine whether and how phonological knowledge affects children's grammatical inferences about new words. Both experiments showed that phonological knowledge affects children's inferences, but only in early stages of word learning and only for verb-like stimuli. The question is, however, whether the results of Fitneva et al. are specific to the English language. Therefore, cross-linguistic research could be crucial for an accurate view on word learning and lexical categorisation. Ter Schure (2010) investigated whether Dutch children use phonological cues in category formation. Note that English phonological cues differ from Dutch phonological cues, for example, in stress and vowel type. In both languages, however, word length is a phonological cue, although, at first sight, children seemed to use this cue differently. While English children seem to use word length as a phonological cue for verb-like stimuli, Dutch children, on the other hand, seem to use it for noun-like stimuli. Due to the lack of a wider research area in the Dutch language on this subject, I will discuss whether Dutch children use phonological cues in lexical categorisation in more detail in my thesis with the aim to increase ter Schure's previous findings.

My thesis is based on ter Schure's (2010) findings, whose hypothesis was that children will use the phonological make-up of words to establish which category (noun or verb) is the most appropriate. Ter Schure tested the sensitivity of children to phonological cues for noun or verb category formation with 36 monolingual Dutch children aged six to eight. They were asked to categorise a pseudo-word as noun-like or verb-like when shown pictures of unfamiliar objects and actions. They were familiarised with a training block of four pictures of existing objects and actions, and on the basis of these pictures they were

instructed that the experiment would be the same, but with non-existing words. At first, the child was asked to decide, in the guessing-block, which pseudo-word was the 'right' word (verb or noun) out of two. Secondly, the child heard what the 'correct' auditory stimulus was, according to the Dutch condition, and had to choose the correct word out of three in the identification block. Thirdly, the child was asked to produce the stimulus in the production block (any phoneme the child remembered was taken into account). In advance, the children were divided into three groups: consistent, inconsistent, and independent. In the consistent group, phonological cues and word class were consistently matched, i.e. nouns were always bisyllabic and verbs were always monosyllabic. In the inconsistent group, the opposite pattern held, i.e. nouns were always monosyllabic and verbs were bisyllabic. In the independent group, there was no match between phonological cue and word class, i.e. half of the noun and verb stimuli were monosyllabic and half were bisyllabic.

In the Dutch language word length is thus a lexical cue and, therefore, the result was that children seemed to rely on phonological cues of stimuli only for object pictures, because nouns (related to the object pictures) are often bisyllabic or trisyllabic words and the children seemed to use their phonological knowledge of nouns. The phonological typicality of verbs, on the other hand, is that verbs are often monosyllabic. Ter Schure's findings, thus, differ from the findings of Fitneva et al. with English children, where phonological cues affected the verb-like (action) words, as opposed to the results of Ter Schure where phonological cues affected the noun-like (object) words. Moreover, only in the first 'guessing' block participants tended to choose according to phonology (only for objects, not for actions). In the second block, the consistent group performed better than the inconsistent group in learning the pseudo-words; however, the independent group scored the highest of all, which was not expected because the assumption was that children would

use their phonological knowledge, and in the independent group only half of the pseudo-words were formed according to phonological typicality. When looking only at object, however, ter Schure also found a significant result in the identification block, but this effect was only apparent with noun-like stimuli. In the third block the results were as expected: the consistent group scored best and the independent group scored between the consistent and the inconsistent. None of these results were, however significant at $p < 0.05$. Ter Schure's overall conclusion was that Dutch children do seem to rely on phonological characteristics of words, but only when guessing and identifying the correct labels of objects. The effect of her findings were, however, not strong enough, because she only found a result in the first guessing block and partly in the identification block. Therefore, I will test twelve more children to try and strengthen ter Schure's hypothesis.

In my thesis I will, thus, conduct further research on the influence of phonological characteristics of words in the categorisation of new words by testing a larger group of typically developing children, aged 6-8, to increase the power of the previous findings. My hypothesis is that a stronger pattern will arise by testing more children, which may confirm that phonological cues affect word learning and lexical categorisation. The results presented in this thesis thus include the existing findings of Ter Schure and the new findings.

Henceforth, I will simply speak of the old and new results. In my thesis I will also compare the old results to the new results and discuss the possible changes that take place. In conclusion, the aim for the experiment is to increase the number of children in the experiment and to determine whether the previous findings of Ter Schure will be strengthened.

2. Method

Participants

Twelve Dutch-speaking children, aged 6-8, of a primary school in the east of the Netherlands participated in the experiment. The participants consisted of two girls and ten boys. Each participant was subjected to standardised reading and vocabulary tests to check if there was any atypical language development. Reading tests were the EMT (Brus & Voeten, 1980) and Klepel (van de Bos et al., 1994), in which participants are asked to read aloud a list of words and non-words. The Peabody Picture Vocabulary Test (Dunn & Dunn, 1997) was used to assess vocabulary knowledge.

Materials

After the standardised tests, the children were tested with the same phonological cue experiment that ter Schure used in her research. In this experiment, eight pictures (4 containing a novel action and 4 containing a novel object, see table 1 and Appendix A) were presented to the children on a laptop.

Item type	Test items 1	Test items 2	Fillers
verb-like	ruip	voek	wijg
	ries	goop	weep
	hook	hig	gol
	zil	vijs	guik
noun-like	gater	wamer	pineer
	banijn	mapier	safel
	wegel	tinger	fato
	bodee	nado	gappel

Table 1: Items Experiment.

For each picture the children were asked to choose between two pseudo-words, which were pronounced clearly by a pre-recorded female voice. One of the pseudo-words was

monosyllabic (i.e. 'noun-like') and the other one was bisyllabic (i.e. 'verb-like'). Pseudo-words were always preceded by *ik* 'I' for action pictures and *een* 'a' for objects. Furthermore, the items were created by looking at whether the words resembled highly frequent verbs and nouns in a corpus, and it was found that the nouns were more 'typical' than verbs. e.g. 'mapier' is like 'papier', but 'voek' can be both 'boek' or 'zoek'. Appendix B provides the words that were used and the three conditions used. Beforehand, the twelve children were divided into three groups: a consistent, inconsistent, and neutral group, as explained above.

Design & Procedure

Children were tested individually in a quiet room of their primary school and at first were familiarised with the test by a training block that consisted of four pictures of existing words that they were familiar with. The child was told that he or she was going to learn new non-existing words and that they should try and remember the words. At each picture the children were asked to respond and make a guess of which word they thought corresponded best to the picture. They, for example, heard 'ik wamer' and 'ik ruij' and had to choose which of those two words corresponded to the action picture that was presented to them. After they had made a guess, they heard the 'correct' response. The pictures were then shown again and the children were now asked to choose the correct response out of three words (of which one was a filler). They could, for example, choose the 'right' word out of the following three: 'gater' (noun-like), 'voek' (verb-like), and 'wigg' (a distracter). Lastly, the child was asked to produce the 'correct' word if they remembered it. In addition, the child was also asked to produce any phoneme it remembered, which will also be taken into account in the results. The experiment is thus the same as ter Schure's experiment and therefore I hypothesise that the results will be similar with respect to the use of phonology

in the first guess trials. Furthermore, the results may be strengthened if children also turn out to use phonological cues in the learning phase of the experiment.

3. Results

For the data analysis, the data of the children who participated in the first study ($n=36$) were added to the data of the current group of children, resulting in a total of 48 children. First of all, the results on the guessing block changed. The mean percentage of choosing according to phonological cues (i.e. choosing a bisyllabic word for a novel object or a monosyllabic word for a novel action) was 49.7% (SD 17.4), which does not differ from chance (50%) on a one sample two-tailed t-test ($p>.1$). On objects, the score was 55.7% (SD 25.4) of correct choice according to phonology. Even though Ter Schure found a result significantly different from chance for objects (61.1%), the current data show a non-significant result ($p=0.125$). Children chose the monosyllabic pseudoword 'correctly' when the picture contained an action in 43.7% (SD 27.5) of all pictures and the results remained non-significant at $p=0.122$. This means that participants did not tend to choose according to phonology in the first guessing-block as the results were not significant for verbs or objects. This thus differs from the old findings of Ter Schure's experiment.

In the second and third blocks learning was measured through identification (i.e. choosing the novel word out of three) and production (i.e. producing the novel word). The data were analysed using A one-way ANOVA with group (consistent, inconsistent, independent) as a between-subject factor and percentage correct identification, percentage correct production and percentage phonemes correct as dependent variables. The new scores of the three groups are reported in table 2.

	Identification	Production (word)	Production (ppc)
Consistent	75.8 (22.1)	7.8 (6.2)	16.0 (14.0)
Inconsistent	70.3 (17.6)	7.8 (12.8)	18.0 (21.4)
Independent	78.7 (18.0)	5.5 (0.9)	14.0 (11.4)

Table 2: Mean percentages correct identification and correct production with standard deviations in brackets per group.

In the identification block, although the consistent group performed better than the inconsistent group (a small difference), the independent group performed best. This differs from the expected behaviour of the groups, because only half of the items for the independent group were consistent with phonology. However, there was no effect of group on any of the learning measures ($p > .1$), which matches Ter Schure's findings. Although the exact percentages differ a little from the old data, the new data thus gives similar results.

Results for the production measures show that the consistent and inconsistent group performed the same with 7.8% (SD 6.2) for the consistent group and 7.8% (SD 12.8) for the inconsistent group. The independent group scored the lowest with 5.5% (SD 9.1). Although the findings thus differ from ter Schure's findings, the final results remain the same as the difference between both groups remains non-significant at $p < 0.05$.

The children were thus tested on their correct production of a pseudoword, but moreover they were encouraged to produce any phoneme they remembered. Therefore, I also looked at the mean score of all groups on the correct number of phonemes as a percentage of the total number of phonemes in the target (see table 2, production (ppc)).

In the previous study, Ter Schure looked at the data for object and action pictures separately, and found a significant difference between the consistent and the inconsistent group in the identification block for nouns, with the consistent group outperforming the inconsistent group. She found that the mean score of the consistent group on identification was 85.4% (SD 19.8), and of the inconsistent group 56.2% (SD 30.4), which was significant on a two-sided t-test with ($t [22] = 2.785, p = 0.011$). Because ter Schure found a significant result here, in this study, the nouns were also considered separately from the verbs, which resulted in the scores shown in table 3 below.

	Nouns	Verbs
Consistent	84.4 (20.2)	67.2 (29.9)
Inconsistent	60.9 (31.6)	79.7 (22.8)
Independent	76.6 (21.3)	79.7 (18.7)

Table 3: Mean percentages correct identification of nouns and verbs considered separately with standard deviations in brackets per group.

Again, a one-way ANOVA with group as independent variable was performed, which resulted in a significant effect of group on the identification for nouns ($F (2.47) = 3.676, p=.033$). A Bonferroni post-hoc test showed that this effect was due to the difference between the consistent and the inconsistent group ($p=.028$). The findings of ter Schure are thus strengthened with the results presented in figure 4.

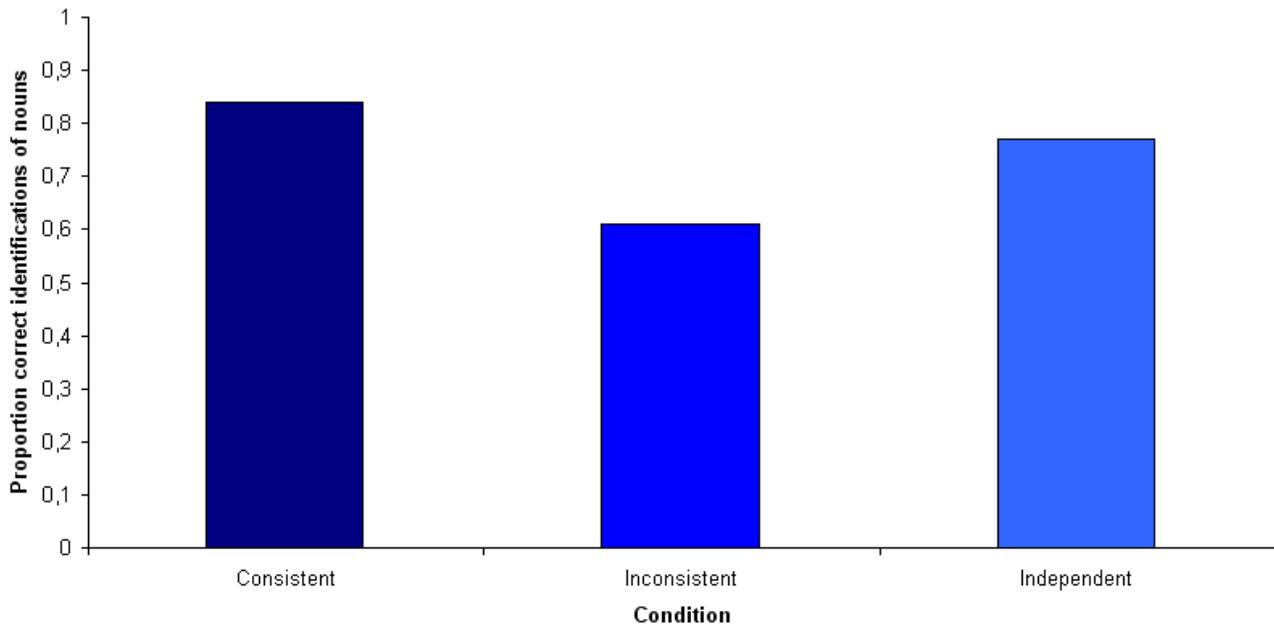


Figure 4: Proportion of correct identification of nouns only.

As in Ter Schure (2010), no effect of group was found on any of the other learning measures, for either nouns or verbs. Hence, the new results match Ter Schure’s findings in that an effect of group was found on the correct identification of nouns. Furthermore, this result was strengthened because the previous effect was only found when the two groups were compared directly, whereas the current result takes into account all three groups.

4. Discussion & Conclusion

The aim of this experiment was to investigate whether previous findings by ter Schure (2010) could be strengthened by testing more children with the same experiment. A significant finding of Ter Schure was that children seemed to rely on phonological cues of stimuli only for object pictures. This influenced their first guesses towards which word was the most likely label for a picture, and the accuracy with which they learned these words. Participants in her study showed a preference for choosing disyllabic items as noun labels over

monosyllabic ones in the first guessing-block of the test. This result, however, disappeared when adding the results of the new participants to the previous findings.

The finding on the identification block, however, was strengthened by the new data and therefore that result is now more accurate. Hence, Dutch children seem to rely on phonological cues when learning novel words, however, this effect is only apparent when children learn nouns by means of identification.

In English, on the other hand, a preference for verb learning over noun learning was found in an earlier study by Fitneva et al. Words more typical for the verb class (i.e. monosyllabic) related more easily to action pictures. The typicality of verbs and nouns, in English, was determined by the frequency of certain phonemes or phoneme clusters in words in English. Fitneva et al. explained that this effect was due to “statistical differences between the reliability of phonological versus distributional cues in the lexical classification of nouns and verbs.” (ter Schure, 2010:23) They thus also considered distributional cues, which could have lead them to interpret the findings differently. The question, however, that remains unanswered is how it can be that there is a significant finding for verbs in English and for nouns in Dutch. What could cause this difference between these two languages and can this difference be explained?

One possible explanation of ter Schure for the different findings between English and Dutch is that Dutch children do not rely on phonological cues for verb-like stimuli due to the surrounding morphemes. Children are able to recognise these morphemes and therefore are able to recognise the word as a verb. In the English language, verbs consist less of these morphemes and therefore children are be able to use other information (phonological cues) to recognise the word as a verb. However, although bisyllabic words often tend be nouns, monosyllabic words are also good nouns. The phonological cue of word length is thus not

invariable, but frequently more subtle. Another possible reason for why children may remember nouns more easily than verbs (in the identification block) is that children are able to recognise an object more clearly in a picture. An action picture, on the other hand, is variable, as one cannot always explicitly point at it.

In my thesis I have attempted to strengthen ter Schure's findings of her experiment on the use of phonological cues in lexical categorization of pseudo-words with Dutch children. Ter Schure hypothesised that if more participants were tested, a significant effect of group might be found on the production block as well. This prediction, however, cannot be supported based on the current data, as no significant finding appeared on the production block with the new data. Although her finding on the guessing block disappeared, the findings on the identification block for nouns were strengthened. This could be due to that children find passive recollection (identification block) easier than active recollection (production block). Furthermore, it is possible that participants perform better on nouns in the identification block, because they remember the word being bisyllabic and are able to recollect one syllable of the word and, then, choose the correct word out of three.

To sum up, I have found no evidence that Dutch children use phonological cues in lexical categorization for verbs and this may be due to the dominance of other more explicit information available to children (i.e. morphemes), which could also be the reason for why the findings in Dutch differ from those in English. In Dutch, the only effect of phonology can be found in the identification block, where children seem to use word length (bi- or trisyllabic) as a phonological cue for recognising new words as nouns. This could be because children find passive recollection easier than active recollection, or simply more easily recognise object pictures than action pictures.

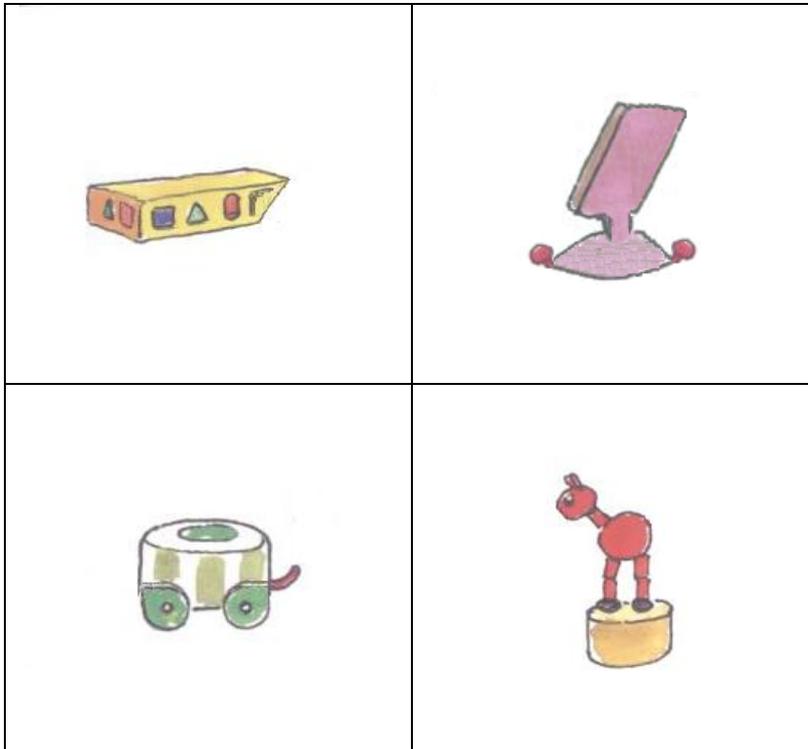
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APPENDIX A

Stimulus pictures used in the phonological cue experiment.

Object-like pictures:



Action-like pictures:



APPENDIX B

Pseudo-word stimuli used in Experiment

Table 8 presents the pseudo-words in the experiment per group and the matching to pictures according to condition: consistent (C), inconsistent (I) or independent, neutral (N). In the independent condition, each word was matched once to an object, and once to an action picture, so that each stimulus word would be tested consistently and inconsistently an equal number of times. Naturally, each child only learned one word per picture.

		Items	C	I	N
1 Items	Verb-like	ruip	5	3	6/3
		ries	7	4	7/3
		hook	6	1	5/1
		zil	8	2	8/1
	Noun-like	gater	4	6	3/6
		banijn	3	5	3/7
		wegel	2	8	1/5
		bodee	1	7	1/8
Means					
2 Items	Verb-like	voek	6	4	4/5
		goop	8	3	4/8
		hig	5	2	2/6
		vijs	7	1	2/7
	Noun-like	wamer	3	5	5/4
		mapier	4	7	8/4
		tinger	1	6	6/2
		nado	2	8	7/2
Means					
3 Fillers	Verb-like	wijg	5/3	5/3	5/4/6/3
		weep	7/8	3/5	3/7/7/2
		gol	6/7	1/2	7/3/2/7
		guik	8/2	8/7	2/6/1/5
	Noun-like	pineer	4/6	4/6	4/5/3/6
		safel	3/4	7/4	8/1/4/8
		fato	2/1	2/8	6/2/5/1
		gappel	1/5	6/1	1/8/8/4
Means					

Table 5: Pseudo-words per group and picture match.