

**The *dax* is *daxing* the cheese:
When do children acquire class extension rules for denominal verbs?**

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1. Introduction

An important aspect of humans' use of language is our ability to understand and produce words and sentences we have never heard before. For instance, people often use proper nouns (e.g., *Google*) or common nouns (e.g., *e-mail*) as novel denominal verbs (e.g. can you *Google* the restaurant? Can you *e-mail* me the picture?), and listeners do not seem to have difficulty understanding them. Even young children seem to understand that nouns can be used as denominal verbs, as there are abundant reports of innovative denominal verbs in the spontaneous speech of young children (Bowerman, 1982; Clark, 1982; Clark, 1993; Kuczaj, 1978; Oshima-Takane, Barner, Elsabbagh, & Guerriero, 2001). For example, Kuczaj (1978) reported children's innovative use of nouns as verbs such as "You're *gunning* him." Clark (1982) also reported various examples of innovative denominal verbs in the spontaneous speech of English-, French- and German-speaking children as young as 2 to 3 years of age. But how can listeners determine the meaning of these novel denominal verbs? Clark and Clark (1979) propose a convention that speakers and listeners need to follow in order to create and interpret novel denominal verbs:

"In using such a verb, the speaker means to denote the kind of state, event, or process that, he has good reason to believe, the listener can readily and uniquely compute on this occasion, on the basis of their mutual knowledge, in such a way that the parent noun denotes one role in the state, event, or process, and the remaining surface arguments of the denominal verb denote others of its roles" (p. 768).

While young children are not likely to know the convention proposed by Clark and Clark (1979), they must at least have acquired a simple class extension rule in order to correctly produce and interpret denominal verbs. That is, they must understand that a word belonging to one form class (i.e., noun) can be used as an instance of another form class (i.e., verb), and that denominal verbs have meanings related to their parent nouns (Lippeveld & Oshima-Takane, 2010; Oshima-Takane, et al., 2001). Clark (1982) suggested that 2-to-3-year old children who produced innovative denominal verbs must have formed a simple class extension rule that "any noun denoting a concrete entity can be used as a verb for talking about a state, process, or activity associated with that entity" (Clark, 1982, p. 417).

However, findings from experimental studies suggest that children do not acquire class extensions rules until 4 or 5 years of age, much older than those reported in case studies of spontaneous speech (e.g., Bushnell & Maratsos, 1984; Clark & Berman, 1984; Clark & Hecht, 1982). For example, Clark and Hecht (1982) tried to elicit novel deverbal nouns from English-speaking children between 3 and 6 years of age, by asking them to derive new nouns from familiar verbs in their vocabularies (e.g., "what could we call something that burns things?"). Their results indicated that while 3-year-old children were only able to coin novel denominal verbs 42% of the time, by 4 years of age they were able to do so about 70% of the time. In

addition, Bushnell and Maratsos (1984) found that while 5- and 7-year-old English-speaking children were able to correctly act out test sentences containing novel denominal verbs (e.g. “can you *truck* a *basket*?”) the majority of the time (75% and 82%, respectively), 2-year-old children only did so about 50% of the time. Bushnell and Maratsos (1984) argued that the 2-year-olds’ difficulty interpreting the novel test sentences stemmed from their use of immature sentence comprehension strategies. Rather than using word-order to interpret the sentences, 2-year-olds were simply piecing together the most probable interpretation of the sentences from the meanings of the individual words. Bushnell and Maratsos (1984) further suggested that 2- and 3-year-old children’s spontaneous use of nouns as denominal verbs may also stem from related immature sentence production strategies, and may be examples of erroneous word usage as opposed to genuine class extensions.

The experimental studies cited above used elicitation or acting-out tasks to test children’s production or comprehension of denominal verbs and deverbal nouns (e.g., Bushnell & Maratsos, 1984; Clark & Berman, 1984; Clark & Hecht, 1982). However, it has been reported that young children often confuse the agent and the object in test sentences in acting out tasks (de Villiers & de Villiers, 1978). Thus, it is possible that young children’s difficulty may stem from the cognitive demands of the experimental procedures used in these studies. It is also possible that the 2-year-old children in Bushnell and Maratsos’ (1984) study did not understand the meanings of some of the novel denominal verbs used in the acting-out task, because their meanings were not related to those of the familiar parent nouns in an obvious way. For instance, children were asked to “circle the yellow”, where the noun “circle” was used as a denominal verb to refer to the act of placing a paper ring around an object. This may have confused the 2-year-old children, because the more conventional meaning of the verb “to circle” is to draw a circle around something. Therefore, a study using a task which is not too cognitively demanding for young children, and which uses denominal verbs that can be understood *readily* and *uniquely* from the meanings of their parent nouns, is necessary to determine whether 2- to 3-year old children possess class extension rules for denominal verbs.

The purpose of the present study was to investigate whether 2- and 3-year-old French-speaking children have acquired class extension rules for denominal verbs using a task more appropriate for testing young children’s comprehension of novel denominal verbs. We examined this question by testing 2- and 3-year-old French-speaking children’s ability to comprehend novel denominal verbs referring to instruments and their functions using an Intermodal Preferential Looking Paradigm (IPLP; Hirsh-Pasek & Golinkoff, 1996). This paradigm is ideal for studying younger children’s comprehension, as it does not require them to respond explicitly by acting out sentences, or by pointing to or touching the target objects. Rather, it relies on their eye gaze behavior in response to test questions. By using this paradigm, we ensured that our results would reflect young children’s ability to comprehend denominal verbs more accurately than those used in previous studies.

To avoid confusing participants with unconventional or novel uses of familiar words, we used novel parent nouns instead of familiar nouns in the present study. Using novel parent nouns also allowed us to control for children’s prior knowledge of the parent nouns, which could lead to individual differences in their performance in interpreting denominal verbs derived from these parent nouns. We hypothesized that if children have acquired class extension rules by 2 to 3 years of age, then they should be able to comprehend the novel denominal verbs based on the meaning of the novel parent nouns.

2. Method

2.1. Participants

Eighteen 2-year-old (mean: 32.83 months, range: 30-35 months) and eighteen 3-year-old (mean: 39.61 months, range: 36-41 months) French monolingual children participated in the present study. The children had a minimum of 70 percent of their weekly language input in French according to parental reports. Participants were recruited from the university's infant research group database containing the names of parents who had agreed to participate in developmental studies with their children. Nine additional 2-year-olds and six 3-year-olds were excluded from the final sample for one of the following reasons: (1) having less than 10% attentiveness during one of the four 6-second test clips, (2) not looking at the attention getter between one of the four control and test clips, (3) not looking at all during the control clip, (4) not completing the testing.

2.2. Materials

The objects used in the present experiment included three sets of kitchen utensils (bottle openers, cheese graters, and pastry cutters) that would most likely be unfamiliar to 2- and 3-year-olds. The set of bottle openers was used as a practice object set, while the sets of cheese graters and pastry cutters were used as test object sets. Each object set consisted of five target objects and three non-target objects. The target objects were different exemplars of the same utensil (e.g. five bottle openers), chosen to be distinct from each other in terms of color, size and shape. The target function for each set was the intended function of the target objects. The non-target objects were chosen so that they would be distinct from the target objects, while retaining a certain degree of similarity in appearance. The non-target function was an action that could be performed by all three non-target objects, and was chosen to be distinct from the target function (see Table 1).

Object	Name	Target Function	Non-Target Function
Bottle Opener	<i>vop</i>	Opening a bottle	Knocking down a bottle
Cheese Grater	<i>dax</i>	Grating a piece of cheese	Scooping up a piece of cheese
Pastry Cutter	<i>ploun</i>	Cutting a ball of playdough into two	Flattening a ball of playdough

Table 1: Object sets and their respective target and non-target functions used in Experiments 1 and 2.

We created still clips of the objects alone, as well as dynamic clips of the experimenter manipulating the objects. These were filmed so that only the objects and the experimenter's hands were visible. The linguistic stimuli were recorded by a native female Quebecois-French speaker using child-directed speech. The movie clips and linguistic stimuli for each of the three object sets were presented to the children in the form of a QuickTime movie (see Appendix 1 for a sample of the movie script), which was created using the Apple iMovie Software and the

Splitscreen Preferential Looking Paradigm for QuickTime Pro (Hollich, 2003). We used 3s animated movie clips of animal puppets as attention getters in order to center the children's eye-gaze between experimental movie clips

The presentation of each of the three object sets began with a noun teaching trial, where the children were taught a novel noun referring to two novel target objects, presented one after the other. This was followed by a noun contrast trial, where they were taught that the novel noun could not be extended to objects that could not perform the target function. Then in the noun control trial, the children were introduced to two novel objects (one target object and one non-target object) and their functions. The children's gaze behavior during this control trial was later used in the analysis as a measure of children's visual or side preference. Finally in the noun test trial, we tested children's interpretation of the novel parent nouns by showing them still frames of the two objects from the noun control trial, and asking them to identify the object that could be labeled with the novel noun (noun test questions 1 and 2). In noun test question 1, we asked them to "Find the *vop*." In noun test question 2 we asked them to "Look at the *vop*."

The noun test trial was followed by the verb control trial, during which the children were shown two additional novel objects (on target object and one non-target object) performing their respective functions side by side. We then tested children's interpretation of the denominal verbs in the verb test trial. In this trial, children were shown clips of the two test objects from the control trial performing their respective functions, and asked to identify the object performing the function labeled with the novel verb (verb test questions 1 and 2). In verb test question 1, the children were asked to "Find the one that is *voping*." In verb test question 2 they were asked to "Look at the one that is *voping*." The side of the target object during the noun and verb control and test trials, as well as the order of the presentation of the two test object sets was counterbalanced across children.

2.3. Procedure

The children sat on their parent's lap in a beach chair, which was placed 112 cm away from a 60 cm x 45 cm screen. The lights in the room were dimmed so that only the screen was salient. Parents were asked to avoid talking, pointing, and/or giving any form of approval or disapproval in response to their child's behavior during the presentation of the movie. The movie was then played, and the children's eye gaze was video-recorded while they watched the movie. At the end of the movie, the parents filled out a demographic questionnaire, and the children received a small gift bag to thank them for their participation.

2.4. Analysis

The children's interpretation of the novel words was determined using an Intermodal Preferential Looking Paradigm (Hirsh-Pasek & Golinkoff, 1996). This paradigm is based on the findings that when children are presented with two visual scenes side by side, they tend to look longer at the scene that is consistent with an audio-taped utterance (Hirsh-Pasek & Golinkoff, 1996). If the children do not understand the utterance, they tend to look randomly at both scenes.

The direction of the children's eye gaze (i.e. left, right, center or away) during the noun and verb control and test trials was coded frame-by-frame (30 frames per second) using SuperCoder software (Hollich, 2003). For each child, we calculated proportion scores for each control and test clip by dividing the number of frames during which the child was looking at the matching

screen (the one containing the target object/action) by the number of frames during which the child was looking at either the matching or the non-matching screen (the one containing the non-target object/action). These proportion scores were calculated based on the children's gaze behavior during the entire 180 frames (6 seconds at 30 frames per second) of each clip.

3. Results

Figure 1 shows the mean proportion scores and standard errors for the control and test clips of the two test object sets combined (*dax* and *ploun*). The graph is separated in terms of the different noun and verb test clips (control, test question 1 and test question 2), with the different bar color representing a different age group (2- and 3-year olds).

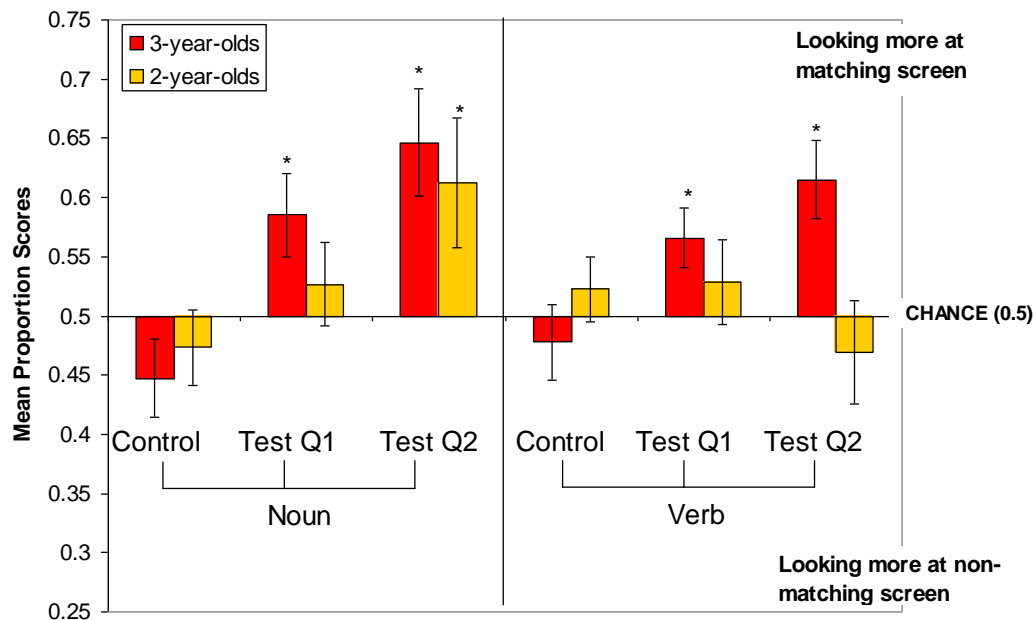


Figure 1. Mean proportion scores for the control and test clips of the combined test object sets. The graph is separated in terms of age group and clip type. Proportion scores above 0.5 indicate a preference for the matching screen whereas proportion scores below 0.5 indicate a preference for the non-matching screen. A score close to 0.5 indicates no preference towards any of the screens. Error bars represent standard error. * $p < .05$

3.1. Parent noun results

Single sample t-tests indicated that the 2-year-old's mean proportion scores were significantly higher than chance (0.5) in noun test question 2 ($t(17) = 2.043$, $p = .028$, one-tailed) only. For the 3-year-olds, the mean proportion scores were significantly higher than chance in noun test questions 1 and 2 ($t(17) = 2.438$, $p = .013$; $t(17) = 3.208$, $p = .003$; one-tailed, respectively). We then compared children's proportions scores in the test clips to their proportion scores in the control clip to examine whether the significance found in the single sample t-tests was a result of a side or visual preference. Paired-sample t-tests indicated that the mean proportion scores of the 2-year-olds were significantly different from the control in noun test

question 2 only ($t(17) = -2.597, p = .010$, one-tailed). The mean proportion scores of the 3-year-olds were significantly different from the control in both noun test questions 1 and 2 ($t(17) = -2.838, p = .006$; $t(17) = -4.981, p < .001$; one-tailed, respectively). These results provide evidence that both 2- and 3-year-old children were able to extend the novel parent nouns to a new instance of the target object set.

3.2. Denominal verb results

Single sample t-tests indicated that the mean proportion scores of the 2-year-olds were not significantly higher than chance for either test question ($ps > .05$). The mean proportion scores for the 3-year-olds were significantly higher than chance in verb questions 1 and 2 ($t(17) = 2.601, p = .010$; $t(17) = 3.458, p = .002$; one-tailed, respectively). Paired-sample t-tests further indicated that the 2-year-olds' proportion scores in both test questions 1 and 2 did not differ significantly from their proportion scores in the control ($ps > .05$). The 3-year-olds' proportion scores in verb test questions 1 and 2 were significantly higher than their proportion scores in the control ($t(17) = -3.063, p = .004$; $t(17) = -3.295, p = .002$; one-tailed, respectively). This indicates that only the 3-year-olds were able to comprehend the denominal verbs correctly.

4. Discussion

The results from the present study indicate that both the 2- and 3-year-olds were able to extend the newly learned parent nouns to new instances of the same kind, suggesting that both age groups learned the novel parent nouns. However, only the 3-year-old children were able to interpret the novel denominal verbs correctly. These results indicate that by 3 years of age, French-speaking children have acquired class extension rules for denominal verbs.

The present findings are inconsistent with those from previous experimental studies which report that children have difficulty producing or comprehending novel denominal verbs until 4- or 5- years of age (Bushnell & Maratsos, 1984; Clark & Berman, 1984; Clark & Hecht, 1982). This discrepancy may be explained by differences between the experimental procedure used in the present study, and those used in previous studies. In the present study we used a procedure based on looking time measures to determine children's interpretation of the novel denominal verbs, which is considered to be less cognitively demanding than the elicitation or acting out procedures used in the previous studies. Furthermore, we used novel parent nouns instead of familiar nouns to avoid confusion stemming from the use of familiar words in an unconventional way. Thus, the present findings suggest that when the task is not too cognitively demanding, children can demonstrate their knowledge of class extension rules for denominal verbs by 3 years of age.

One question that remains unanswered is why the 2-year-olds in the present study failed to show their knowledge of class extension rules for denominal verbs, despite the fact that previous case studies have reported numerous examples of innovative denominal verbs in the spontaneous speech of 2-year-olds (Bowerman, 1982; Clark, 1982; Clark, 1993; Oshima-Takane, et al., 2001; Oshima-Takane, Miyata, & Naka, 2000). It is possible that 2-year-old children's spontaneous use of nouns as verbs as reported in observational studies may reflect immature sentence production strategies as suggested by Bushnell and Maratsos (1984). However, it is also possible that the children reported in previous case studies might not be representative of 2-year-olds in general; they might have produced innovative denominal verbs because their language development was

more advanced than most 2-year-olds. That is, individual differences in the age of acquisition of class extension rules may have led the 2-year-olds in the present study as a group to fall short of comprehending the denominal verbs. An analysis of individual data from the 2-year-olds in the present study supports this interpretation: four out of sixteen 2-year-olds performed similarly to the 3-year-olds in the present study. Further work is needed to directly compare children's ability to understand denominal verbs in an experimental task to their use of nouns as denominal verbs in their spontaneous speech. This will allow us to determine whether children's flexible use of nouns as verbs in their spontaneous speech reflects their knowledge of class extension rules. We are presently examining this question by investigating whether 2-year-old children who spontaneously use denominal verbs and their parent nouns (e.g. *give me the brush* and *brush my hair*) flexibly in an observational task also understand novel denominal verbs better in our experimental task.

In sum, the present study demonstrated that when a cognitively undemanding task is used to test children's comprehension of novel denominal verbs, children as young as 3 years of age are able to interpret novel denominal verbs correctly when they know the meaning of their novel parent nouns.

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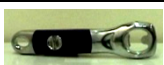









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Appendix 1:

Crucial sequence of visual and linguistic stimuli. 3-s attention-getter clips were presented between clips

TRIAL	LINGUISTIC STIMULI (English Translation)	VISUAL STIMULI	
		Left Screen	Right Screen
Noun Teaching	C'est un <i>vop</i> ! Regarde ce que le <i>vop</i> peut faire à la bouteille! (This is a vop! Look at what the vop can do to the bottle!)	 target action	
	C'est un autre <i>vop</i> ! Regarde ce que le <i>vop</i> peut faire à la bouteille! (This is another vop! Look at what the vop can do to the bottle!)		 target action
Noun Contrast	Ceci n'est pas un <i>vop</i> ! Il ne peut pas faire la même chose à la bouteille! (This is not a vop! It can't do the same thing to the bottle!)	 non- target action	
	C'est un <i>vop</i> ! Regarde ce que le <i>vop</i> fait à la bouteille! (This is a vop! Look at what the vop can do to the bottle!)		 target action
Noun Control	Regarde ce qu'elle fait avec celui-la! (Look at what she is doing with this one)	 target action	
	Regarde ce qu'elle fait avec celui-la! (Look at what she is doing with this one)		 non- target action
	Maintenant ils sont differents. Comme ils sont amusants! (Now they are different, aren't they fun?)	 target action	 non- target action
Noun Test	Trouve le <i>vop</i> ! Regarde le <i>vop</i> ! (Find the vop! Look at the vop!)	 target action	 non- target action
Denominal Verb Control	Regarde ce qu'elle fait avec celui-la! (Look at what she is doing with this one)		 target action
	Regarde ce qu'elle fait avec celui-la! (Look at what she is doing with this one)	 non-target action	
	Maintenant ils sont differents. Comme ils sont amusants! (Now they are different, aren't they fun?)	 non-target action	 target action
Denominal Verb Test	Q1: Trouve lequel vop! Q2: Regarde celui qui vop! (Q1: Look at the one that is voping! Q2: Find the one that is voping!)	 non-target action	 target action