Why children sometimes say “mice-eater”

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Abstract

Do the production patterns of plural forms in noun-noun compounds reveal the workings of innate constraints that govern morphological processing? Gordon (1985) claims that the fact that children in elicitation tasks produce “rat-eater" but “mice-eater” to describe monsters that eat either rats or mice is evidence for a structural constraint on word formation that prevents regularly inflected forms from entering compounds. This paper re-examines the claim that adults and children ordinarily describe an eater of mice as a "mice-eater". Contrary to the nativist claim that people say "mice-eater" because they lack an innate constraint to prevent them from doing so, it is found that once lexical priming is controlled for, even children describe a monster that eats mice as a "mouse-eater", which is in keeping with the kind of forms that they encounter in the input.

Introduction

Although the communicative abilities of all animals are determined by their genetic endowment, and human communicative skills dwarf those of even our nearest animal neighbors, the exact relationship between language and genetics remains to be determined, and is the subject of spirited debate. Is human language itself genetically specified? Or are our unrivalled communicative powers just one facet of the spectacular, but more general cognitive advantage humans enjoy?

This paper focuses on just one aspect of the search for answers to these questions: the claim that the production patterns of plural forms in noun-noun compounds reveal the workings of innate constraints that govern morphological processing. According to Gordon (1985; see also Pinker, 1999) children’s patterns of inflection in noun compounding, and in particular their tendency to produce *mice-eater* but not *rats-eater* in compounds, strongly supports the notion that a series of built in constraints known as level ordering serve to impose constraints on compounding that prevent regular plurals from entering compounds whilst allowing irregular plurals to do so.

Level-ordering in lexical development

According to level ordering theory, a series of (innate) constraints on word formation affect the production and acceptability of plural forms in compounds (Kiparsky, 1983). Level ordering proposes that lexical processes in English are assigned to one of three levels. Level One is essentially the repository of stored forms (such as idiosyncratic forms and irregulars forms of verbs and nouns, *pluralia tantum* nouns, etc.) and some basic derivational processes such as those that tend to affect the phonology of hosts to which they apply and or forms that are semantically unpredictable, as well as affixes that change the stress patterns or vowel structures of stems. At Level Two processes such as “neutral” derivational processes (those that do not affect phonology and are semantically predictable) and compounding are found. Finally inflection takes place in Level Three.

This theory naturally leads to predictions that can be used to explain a number of phenomena associated with noun compounding. In an elicitation task, Gordon (1985) found that 3 to 5 year-old children produced compounds containing irregular plurals in the non-head (i.e.. left) position of noun-noun compounds (e.g., *mice eater*) but avoided compounds containing regular plurals in the non-head position (e.g., *rats eater*). Level ordering predicts that once a compound is formed at Level Two, its constituents cannot be inflected at Level Three (although the compound itself can be inflected to the right), i.e., it predicts that since *mice*, *mouse*, *rat* and *eater* are stored/formed at Level One, and compounding takes place at Level Two, *before* inflection at Level Three, the constraints assumed by level ordering predict that the word formation system can compound *mice*, *mouse* or *rat* to *eater* (and pluralize these compounds to produce *mice-*, *mouse-*, or *rat- eaters*) but that ordinarily *rats*, since it is inflected at Level Three *after* compounding takes place at Level Two, accordingly cannot enter into a compound. Gordon (1985) argues that the patterns of inflection obtained in his study, which are consistent with these predictions, is evidence that children are innately sensitive to the difference between irregular and regular plurals in compounds, and to different constraints applying to them.

Level ordering in adults

In order to examine whether the principles described by level ordering were learnable or not, Experiment 1 examined the performance of adults on Gordon’s

(1985) "cookie monster' task. Level ordering, insofar as it embodies a set of innate constraints on lexical processing, predicts that adults should optionally produce compounds containing irregular plurals in a manner that is qualitatively different from compounds involving nouns that pluralize regularly (Gordon, 1985). Experiments 1 sought to repeat Gordon's procedure on adults, in order to illuminate how language develops by isolating *what* develops by examining the constraints applying to noun compound production by adult speakers in tasks that replicated and extended the paradigm used by Gordon (1985).

Experiment 1

In Gordon's (1985) elicitation task, 3 to 5 year-old children first named the singular form of a stimulus item, and then the name of plural stimulus items, and then they were shown a Monster who might eat the items. They were then asked "What do you think you would call someone who eats X", where X was the plural form of the stimulus item, and "????-eater" the expected compound. Gordon found that when children knew correct irregular plurals they overwhelmingly included them in compounds (e.g., saying *mice eater*). However children avoided regular plurals in compounds (e.g., they did not say *rats eater*). As described above, since level ordering predicts that once a compound is formed at Level Two, its constituents cannot be inflected at Level Three (although the compound itself can be inflected to the right). Gordon (1985) argues that the patterns of inflection obtained in his study, which are consistent with these predictions, is evidence that children are innately sensitive to the difference between irregular and regular plurals in compounds, and to different constraints applying to them. Further, Alegre & Gordon (1996, p 67) argue that adult competence embodies the same constraints that are innately present in children. If this is the case, then it follows that, qualitatively, adult performance in Gordon's elicitation task ought not to differ the performance of children (Gordon, 1985).

In order to test this, a replication of Gordon's (1985) elicitation task was conducted in which noun-agentive compounds (e.g., *rat*-eater) were elicited from fully competent adult Native English speakers. As in Gordon's study, in the main replication, "the context was biased to predispose [participants] to use plural forms inside the compound. This was done both by having a plural referent for the non-head (left) noun, and by having participants produce the plural form (*rats*) prior to the compound form (*rat(s)-eater*)," Gordon, 1985, p 78) Additionally, since the focus of interest here is on what kinds of noun-noun compounds competent adult Native English speakers ordinarily produce (as opposed to the kind of speech-errors that can be induced from them), two other variations on Gordon's original task were examined to control for the possibility that, since participants performing Gordon's task voice a plural immediately prior to compound production, this might result in priming effects that are not necessarily reflective of ordinary, spontaneous noun-compound production.

Participants

45 Native-English speaking students at the University of Edinburgh voluntarily took part in this experiment.

Materials

Following Gordon (1985), participants were trained in the compounding task using non-pluralizable mass nouns. The stimuli were pictures of mud, sand, bread, fruit and corn. The main test items were pluralizable count nouns. Gordon (1985) elicited the singular form for items before eliciting the plural in order to check that the children had lexical knowledge of the items (where possible -- for some items the majority of children had to be supplied with the singular form). Since we were confident that this was not a problem, in the replication (and its variant) participants were supplied the name of the item with a picture of it in singular form, and then the plural was elicited using an unlabelled picture of multiple examples of the item. The items tested were: <u>regular</u> – *ear, hammer, shirt, knife, hand, ring, cow, doll, duck, rat;* <u>irregular</u> – *goose, snowman, mouse, tooth, child, foot*; <u>pluralia tantum nouns</u> – *trousers, pliers, scissors, glasses*. (Note that as in Gordon's original study, each irregular or *pluralia tantum* noun had a regular semantic complement.)

Procedure

Trials were videotaped and later transcribed. Participants were tested individually, and told that they were assisting in piloting a task that was subsequently to be conducted on children. They were told that the task might seem trivial, but that their answers were important, and that they should give the answers that seemed most natural to them.

As in Gordon's original study, the 14 participants in the main replication condition introduced to a "Biscuit Monster" ("biscuit" being British-English for "cookie") and told: "Do you know who this is? … It's the Biscuit Monster. Do you know what he likes to eat? (Answer: Biscuits.) Yes. But this is a particularly greedy Monster – he eats all sorts of things …" Participants were then shown a picture of one of the training items, and asked, "What is this? (Answer: X) – What would you call someone who eats X?" (Answer: An X-eater). Replicating Gordon (1985), this procedure was used to elicit compounds of the form *corn-eater, fruit-eater*, etc. (see also Graves & Koziol, 1971).

For the main items, the singular, plural and compound forms were elicited. To elicit the singular form, participants were shown a labeled picture of a single item and asked, "What is this?" For the plural, an unlabelled picture of a group of the items was presented, and participants were asked, "And what are these?" The Monster was then made to eye the picture

greedily, and the participant was asked, "And what would you call a Monster that eats X?" where X was the form of the noun produced by the participants in response to the plural elicitation.

For the 11 participants in the first priming control condition, the procedure was identical to that in the main condition, except that in the compound task, participants were asked "And what would you call a Monster that eats them?" This was to see whether the experimenter's voicing of the plural immediately prior to the compound production, in addition to the participants' having just done so, had any effect in priming the production of plurals in compounds.

In the second priming control condition, which was designed to control for the fact that simply voicing the plural form of a noun immediately prior to compounding might prime plurals in compounds, 16 participants first took part in a naming task, where singular forms of the items were elicited, after which they were shown two training items that were labeled (*sand* and *mud*), after which for two other raining items (*bread* and *fruit*), participants were simply shown pictures and asked to say what kind of monster they thought it was (e.g. Answer: bread-monster, etc.). Participants were then shown pictures of large green Monsters that were depicted with their preferred dietary items. In all of these main test items, the Monster's dietary preferences were presented as multiple items (i.e. participants saw a monster and a bunch of rats). Participants were first asked to name the monster. They were then presented with a picture showing only its diet and asked to state what it was that he ate. Thus this condition tested the learning prediction tested in Gordon's original experiment that:

> [if someone] "were presented with a context in which there were a number of rats being referred to, one might expect him or her to denote an eater of such animals as a **rats-eater* rather than a *rat-eater*. However, if we assume that level ordering constrains pluralization in this case, then such errors should never be found… if [one] has to learn that reduction of regular plurals is required in compounds, there is little reason to assume that this rule would apply only to regular plurals. This is especially true considering the fact that… the input data tends not to include compounds containing irregular plurals… a natural induction from such evidence would be that irregular plurals are also subject to reduction inside compounds." (Gordon, 1985, pp 77-78).

Participants produced a compound to describe a monster that was depicted eying several examples of each test item hungrily *prior* to naming the plural form to control for any interference that voicing the plural might have on the compounding task.

Manipulation Check

The pictures of monsters that eat multiple items in the second priming control condition were intended to semantically suggest a monster that ate items in the plural (i.e., a monster that is eating *mice/rats*). To test this, 3 participants were shown single items and then asked to go through the 'monster items' (e.g., Figure 1) and state what it was that the monster was eating. 100% of these answers were in the plural form (i.e., "That is a monster that is eating *teeth.*").

Results

All participants completed the test items without much difficulty. As Gordon (1985) notes, occasionally participants changed their responses as if to correct themselves. Gordon's (1985) practice of scoring the second 'corrected' response was adopted.

All of the participants successfully produced the singular form of each noun, and 100% of participants successfully produced the correct irregular plural. One participant produced the overregularized *knifes* as the plural for *knife*, but otherwise all other regular plurals were successfully pluralized.

Irregular and regular plurals

The predictions made by the level ordering hypothesis are simply stated: first, participants should consistently reduce regular plurals to singular forms inside compounds (e.g., *rat-eater*); second, participants should optionally allow irregular plurals in compounds (e.g., *mice-eater*). Further, as Gordon notes, the degree to which participants allow irregular plurals in compounds may well be subject to context; the fact that the semantics of the situation suggest a plural, and that a participant's previous utterance will contain *mice* (and this had just been repeated by the experimenter) ought to lead to many *mice-eater* responses.

These predictions are not supported in the adult data. For the regularly pluralized nouns, participants overwhelmingly showed the predicted pattern of reducing plural to singular forms in compounds (e.g., *rat-eater*), with 86/90 such patterns (Gordon's figure with children was 161/164). As per Gordon (1985), participants were categorized as supporting the pattern predicted by level ordering if all regular plurals were reduced inside compounds, and chi-square analysis showed that the tendency to reduce regular plurals was significant ($\chi^2(1, N=15) = 5.40$ $\underline{p}<.025$).

However, the adult participants in this study also tended to reduce *irregular* plurals in compounds as well (if to a slightly lesser extent). 73/90 responses in this category were of the form *mouse-eater*, as compared to only 4/40 in Gordon's study. As in Gordon (1985), since level ordering predicts that the inclusion of irregular plurals in compounds should be at chance (notwithstanding the particular demands inherent in the elicitation task that should tend to prime irregular plural *inclusion*), chi-square values were calculated for participants showing less than 50% of the inclusion of the irregular plural inside the compound, and again the results were significant ($\chi^2(1, N=15) = 5.40$ $\underline{p}<.025$). (Gordon's children produced the exact opposite effect, showing a significant tendency to include >50% of irregular plurals in compounds.) However, the effect of

participants putting no irregular plurals in compounds was not significant ($\chi^2(1, N=15)=0.67$ $\underline{p}>.75$).

The were no differences in the rates between the main replication condition and the first priming control in which the experimenter did not repeat the plural: the rate of regular reduction in compounds in the first priming control was 94% (62/66) as compared to 96% (86/90) in the replication condition. The figures for irregular reduction were 82% (54/66) in the first priming control and 81% (73/90) in the replication. Thus it did not appear that the experimenter's repeating the plural form uttered by the participants had any significant effect on whether they included an irregular plural in a compound or not.

The results of second priming control condition, in which participants saw a picture of a Monster eating multiple items (thereby creating semantic conditions that suggest a plural compound such as *teeth-eater* might be appropriate) further underlined the extent to which the behavior of the participants in this experiment diverged from the predictions of the level ordering hypothesis. Although they saw pictures of monsters eating *mice, geese, teeth* etc., the rate at which participants produced singular forms of the irregular non-head nouns in compounds (e.g., *tooth-eater*) was 99% (95/96). Singular forms of the regular non-head nouns in the compounds were produced 98% (94/96) of the time.

Considering the twin predictions of level ordering: first, as predicted, the effect of participants producing singular forms for regular plurals in compounds 100% of the time was significant ($\chi^2(1, N=16) = 9.0$ $\underline{p}<.005$). However, the second prediction, that the inclusion of irregular plurals ought to be at chance (or, given the semantics of the task, that participants should prefer irregular plurals in compounds), was not confirmed. The effects of participants producing plural forms of the irregular plural nouns in compounds less than 50% of the time was highly significant ($\chi^2(1, N=16) = 16$ $\underline{p}<.0001$). Moreover, a highly significant majority of these participants produced *no* irregular plurals in compounds ($\chi^2(1, N=16) = 12.2$, $\underline{p}<.0001$).

Discussion

The results of this experiment are surprisingly clear-cut in the case of both regular and irregular nouns. Contrary to the predictions of level ordering, competent adult speakers of English overwhelmingly produce compounds containing singular (or 'reduced') forms of *both* regular and irregular nouns, even in conditions that are specifically designed to elicit 'erroneous' plural forms in compounds (Gordon, 1985). In Experiment 1 adult speakers of English applied exactly the same pattern of constraints irrespective of whether a noun was regular or irregular.

Further, the results of Experiment 1 suggest that other factors have been confounded in interpreting previous studies of compounding behavior, and in expositions of level ordering. It is important to untangle these factors: First, although the majority of irregular compounds produced in all of the conditions were singular, there were significant differences in the number of participants who produced any irregular plurals in compounds when comparing the two conditions that replicated Gordon's method of having participants voice the plural form prior to compounding to the condition which simply tested Gordon's prediction that presenting someone with a context in which there were a number of mice being referred to, one might expect him or her to denote an eater of such animals as a *mice-eater* rather than a *mouse-eater*. In the conditions where a plural was voiced first, 11/26 (42.3%) participants produced at least one irregular plural compound (8/15 in the straight replication) as compared to only 1/16 (6.3%) in the second control condition ($\chi^2(1, N=42) = 4.667$, $\underline{p}<.05$; comparing the straight replication only, $\chi^2(1, N=31) = 4.663$, $\underline{p}<.05$). The overall rates at which irregular plural compound were produced were 19% in the replication, 18% in the first control condition and just 1% in the second control condition. On the other hand, the overall rate at which regular plurals were produced in compounds remained relatively constant (at 2 to 4%) across all three conditions for regular plurals.

This suggests two things: first, that in situations where the semantics of a situation suggest that multiple items need to be referred to in a noun-compound (say describing a monster eating mice), ordinarily, exactly the same constraints apply to both irregular and regular compound production (i.e., that all other things being equal, the non-head noun should be in singular form, as in *mouse-eater*); and second, that (at least some) compounds involving irregular nouns might be more susceptible to induced performance errors (i.e. priming) in tasks that involve participants voicing the plural form immediately prior to plural production.

Children, compounding and priming

The results of Experiment 1 indicate that that, contrary to the predictions of Gordon (1985), in situations where the semantics of a situation suggest that multiple items need to be referred to in a noun-compound (say describing a monster eating mice), adults apply exactly the same constraints apply in both irregular and regular compound production. Further, they suggest that compounds involving irregular nouns might be more susceptible to induced performance errors (i.e. priming) in tasks that involve participants voicing the plural form immediately prior to plural production.

Experiment 2

To facilitate a full examination of the possibility that the results of Gordon (1985) stem from artifacts of the experimental procedure rather than from any specific constraint on language production, Gordon's original study was first decomposed into its logical elements. These comprised four basic elements: (1) checking that

children knew the singular form of nouns, (2) checking to see that they knew the plural forms, (3) training them in noun-compound production, and (4) presenting them with a situation which had a semantic construal involving a single eater consuming multiple (plural) examples of items and asking children to produce a compound to describe the eater. Since the singular naming was a manipulation check to see whether children could identify the items independently in Gordon's original study (and as Gordon reports, children in fact required a lot of prompting in this task), in the following experiments, this procedure was separated from the plural naming and production part of the procedure. In both of the experiments described below, children performed the singular naming condition prior to receiving training in compound production (which was as per Gordon 1985, and is described in Experiment 1, above).

This meant that the main body of the experimental procedure comprised two elements: presenting a set of items to elicit a plural, and presenting a monster eating multiple items to elicit a compound (in circumstances where the semantics suggested that the eater was an "items-eater" rather than an "item-eater" as described in relation to Experiment 1, above).

This allowed two versions of Gordon's procedure to be tested. In the first, the plural form was elicited prior to the compound. This was to see whether Gordon's results could be replicated without the experimenter priming the children's responses to the compound task (e.g. to ensure that the result did not rely on the question "And what do you call a monster that eats MICE?"). The second version of the procedure inverted the order of plural elicitation and compound production. Children were asked to produce a compound to describe the eater eating multiple items, and then were presented with just the multiple items alone in order to elicit a plural. This second version was intended to ensure that the results of the compounding task did in fact result from factors inherent in Gordon's original hypothesis, and not from priming resulting from children having just uttered a plural form. Gordon's hypothesis was that "[if someone] "were presented with a context in which there were a number of rats being referred to, one might expect him or her to denote an eater of such animals as a **rats-eater* rather than a *rat-eater*," unless constrained by level ordering. If this was hypothesis was indeed correct, then the order of presentation of the plural elicitation and compounding tasks ought to be irrelevant. On the other hand, any differences resulting from these changes in the presentation order of the tasks would be attributable to interactions between the demands of the various tasks interfering with the child's performance on the tasks, rather than to the responses of the child's language production system to the semantics of the stimulus.

Participants

Participants were 50 children aged between 3 and 8 (average age 5:11) recruited form a school and a kindergarten in Edinburgh, Scotland.

Materials

The same materials as those in Experiment 1 were used.

Procedure

Trials were transcribed contemporaneously, and videotaped to aid with resolving any ambiguities. Participants were tested individually, and told that they were helping to teach a particularly stupid monster to learn the names of his friends.

Participants were then shown a picture of one of the training items, and asked, "What is this? (Answer: X). This was repeated until the child had named all the items. As in Gordon (1985), feedback was given where children could not name items spontaneously.

Participants were then introduced to a monster that had a terrible memory. They were going to be introduced to a number of his friends, and they were asked to assist the monster by telling him the names of his friends.

After training on mass nouns as per Gordon (1985), participants were randomly assigned to one of two versions of the main experimental procedure.

Experiment 2a: in this version of the procedure, plural forms were elicited prior to compounds. Participants in were first shown a picture of multiple items to elicit the plural, being asked, "what are these?"

Having named the plural, children were then shown a monster eating the plural items and simply asked, "So what is this monster? Called?" (these superficial changes to the procedure were made to enable the task to be run without the experimenter having to ask, "What would you call someone who eats X," and thereby priming the child with the plural form of X).

Experiment 2b*:* in Experiment 2b trial procedure was as per Experiment 2a except that the order of compounding and plural production was reversed.

Results

Experiment 2a

Regular nouns: In Gordon (1985), participants consistently reduced consistently reduced regular plurals to single forms inside compounds; 161/164 of responses were of this form. This was the case in the present study as well with 135/142 of regular plurals reduced to singles when compounded in Experiment 2a

Correct irregular nouns: In Experiment 2a, 58/86 of the responses giving the correct irregular plural carried this on into the compound word to form, e.g., producing *mice-eater*. Gordon (1986) found that 36/40 of correct irregular responses were of this form;

As in Gordon's study, a chi-square calculated for subjects showing greater than 50% inclusion of the irregular plural within compounds showed this trend to

be significant (χ^2 (1, N = 24) = 8.2, p < 0.005).

Experiment 2b

Reversing the order of compound production and plural elicitation in this task produced two significant alterations in the pattern of data observed in experiment 2a. First, it was found that when participants produced the compound first, they tended to produce the singular form of irregular plurals in their compounds (i.e., saying *mouse-eater,* not *mice-eater*). A chi square test calculated for subjects showing greater than 50% inclusion of the singular form of the irregular noun within compounds showed this trend to be significant (χ^2 (1, N = 26) =3.85, p < 0.05).

Secondly, an increase in overregularization of irregular nouns was noted in Experiment 2b as compared to Experiment 2a. The mean number of plural overregularizations in Experiment 2a was 1.29. this figure rose to 2.35 in Experiment 2b ($t(45)=2.48$, $p<0.05$).

Discussion

The main effects and trends reported in Gordon (1985) were replicated in Experiment 2a. However, the key finding in Gordon's original study–children's inclusion of irregular plurals in compounds–entirely disappeared when compounding occurred before plural elicitation. This was despite the fact that the semantics depicted in the stimuli (which were supposed to be the driving force in Gordon's hypothesis) remained unchanged.

As the results of Experiment 1 suggested, it appears that the main effect in Gordon (1985) – the inclusion of irregular plurals in compounds is a result of priming before production in Gordon's task affecting children's performance, and is not reflective of children's underlying competence when it comes to noun compounding.

This priming explanation gains further support from the increase in overregularization observed in Experiment 2b as compared to Experiment 2a. This finding suggests that the priming effect on children's irregular plural production is bi-directionalpriming "mice" in Experiment 2a caused children to say "mice-eater", despite the fact that all of the evidence collected here (and available to children) points to a rather general prohibition on plurals in compounds. On the other hand, saying "mouse-eater" immediately before producing a plural form caused children to say "mouses", another form that is not warranted by either the input or later production patterns.

General Discussion

According to Alegre & Gordon (1996, p65), "advances in our understanding of phenomena often arise from paradoxes." The claim has been that explaining the "paradox" between people's behavior in forming and interpreting regular and irregular noun plurals in compounds advances our understanding of the innate mechanisms that govern language.

The results of the experiments described here suggest that plurals in compounds present neither a paradox, nor evidence for native constraints. Putting these results together yields a straightforward, non-paradoxical picture of learning: first, we have the input, which is rich in the case of regular nouns, and very sparse in the case of stem-change irregular nouns (Gordon, 1985). Unsurprisingly, the initial quality of the output mirrors the quality of the input: as Gordon (1985) showed, children are initially much poorer at forming irregular plurals than regulars; given the distribution of the input, the irregular constraints children extract from the environment will be correspondingly less strongly learned than the regular constraints and thus will be more susceptible to priming However, in spite of the sparseness of the input data, once the priming in the Gordon task is controlled for it is quite apparent that over time, children readily begin to acquire compounding constraints for both regular and irregular nouns that reflect the patterns in the input.

Finally, adult output comes to match the input presented to the child. The production of adult speakers in the third (un-primed) control condition in Experiment 3 matched the proportions of regular and irregular nouns in plural and singular form in the linguistic environment (Gordon, 1985). This latter fact points to the resolution of the knottiest "paradox" of level ordering: how to explain how a balanced input of regular and irregular plural compounds in the linguistic environment could result from very different constraints on linguistic production. The evidence suggests that (perhaps unsurprisingly) the patterns governing the output ultimately align with those in the input. There is no paradox: people succeed in learning similar constraints for all compounds, and use these in producing the patterns of output that serve as input to succeeding generations.

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