"Less" may never mean more.

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M.I.T.

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New York, Plenum Press.
It is widely accepted that at some point in the child's development, the meaning of "less" is incorrect or incomplete (Donaldson and Balfour, 1968; Donaldson and Wales, 1970; Clark, H., 1970; Clark, E., 1973; Palermo, 1973, 1974). There are two slightly different proposals for the immature lexical entry of "less". In one, "less" is assumed to have the same lexical entry as "more"; that is, to be incorrectly represented as /+quantity/ and /+pole/. In the other, the incomplete entry proposal, "less" is assumed to be marked /+quantity/ but not yet /-pole/. On both accounts, in many different situations, the child should treat "less" as if it meant more, given that more is a better example of quantity than is less. Indeed, since the publication of Donaldson and Balfour's original experiment, several studies have shown this to be so. Typically, asked to make a quantity less, the child increases it, or asked which of two quantities is less, the child indicates the one with more.

The interpretation of these errors as indicating that "less" is represented in the child's lexicon as a synonym for "more" or "some" amounts to a very strong claim. The complete processing of the request "make it so there is less to drink in here", involves looking up the meanings of lexical entries, parsing the sentence, building a representation of the request. It also involves evaluating the non-linguistic situation, and deciding how that request is to be responded to within that context. The incomplete (or incorrect) lexical entry hypothesis locates the child's error in one particular place in this whole processing chain—namely, in the

lexical entry for "less".

There are, of course, other possibilities. For instance, the child may build a very incomplete representation of the sentence, not looking up the word "less" in his lexicon at all, or not using what he finds there at all in his computation of his response. In the extreme, the child's response might be a joint function of the sentence frames "Make it so it's _____", "Put _____ on this one than that" and a response bias to add in the context of apples and trees. Equally possible, as Clark, E., 1974, suggested, the responses might be a joint function of the sentence frame, the response bias to add, and the incomplete lexical entry. The problem I wish to address in this paper is how we could discover whether the lexical entry for "less" (or "more", for that matter) makes any contribution to the responses of very young children at all; that is, to distinguish between the two alternatives just stated.

This question is particularly urgent in the light of the growing acceptance that "comprehension is an interactive process" (Gorman, Campbell, and this volume; Donaldson and Lloyd, 19; Wilcox and Palermo, 1975; Clark, E., 1974.) Given that linguistic contexts interact with the lexical entries of the words of interest, we must develop techniques to tease apart the contributions of each.

The technique explored in this paper could give unequivocal evidence that the lexical entry is playing a role in determining the response. Suppose a nonsense syllable, e.g., "tiv", is used in the place of the word "less" or "more". And suppose the child treats the sentence as if it contained the word "more". Obviously this
response is not due to the incomplete or incorrect lexical entry for "tiv". Such a response would suggest, but not prove, that the lexical entries for "less" and "more" also might play no role in addition responses to sentences containing them. In contrast, suppose the child clearly distinguishes the commands with "tiv" in them from those with "less" in them, e.g., asking "What's that?" or doing nothing to "tiv", while adding to "less". Such a pattern would indicate that the lexical entry for "less" contributed to the response of adding.

In the first experiment to be reported here, the child was asked to make a given quantity of colored water more (or to make it less or to make it "tiv") than it was at present. It seemed plausible that the response of pouring water back into the pitcher might seem very unlikely to the child; that is, the non-linguistic context might influence the child to pour more into the glass no matter what the instruction was. In order to assess the contribution of a response bias to add, half of the subjects were given pretraining trials where they were to adjust the water level in a glass to the level indicated by the experimenter's finger. Sometimes the finger was lower than the present level, making it necessary for the child to pour water out of the glass, back into the pitcher. It was hoped that practice pouring water out of the glass would decrease the response bias to add. By manipulating the response bias in this manner, evidence might be found that lexical entries play more of a role in determining the response than the weaker the response bias.

Experiment I. Method.

Subjects: Subjects were 27 3-year-olds and 38 4-year-olds from the Harvard and MIT nursery schools. They were children of graduate students, faculty members, and employees of the two universities.

Procedure: The experimenter spent several days in the nursery school becoming acquainted with the children before testing. Each child was tested individually in a mobile laboratory driven to the schools. The experimental session was introduced to the child as a tea party game in which a very fussy puppet would never drink his tea until he got just exactly the amount of tea in his glass that he wanted.

Finger indicated adjustments:

In the finger adjustments condition, the child poured some tea (blue water) in the puppet's glass, and the puppet then indicated with its hand a level to which it wanted the water adjusted. After the adjustment, the experimenter put the water to the puppet's mouth and said "drink, drink, drink". If the glass was too full or empty for the next trial, the experimenter unobtrusively adjusted it to about half full and placed it on the floor in front of the puppet who announced it was thirsty again, but that it would not drink because the water wasn't "just right". It then indicated with its hand again the level to which it wanted the water adjusted. After the adjustment, it again was allowed to "drink, drink, drink". The child often took over this pretense of feeding the water to the puppet. For half of the subjects the first adjustment was to a higher level and for the other half the first adjustment was to a lower level. If the child did not see what to do in either case, the experimenter showed him/her, and the pretraining trials were continued until the child had made each type of adjustment correctly.
Verbally indicated adjustments:

The second part of the game was introduced with a new puppet, who was equally fussy, but who was going to tell us what to do rather than point. For the subjects not in the finger adjustments condition, the introduction to this section was the full introduction to the tea party game with a fussy puppet who would never drink until we had got just the right amount of tea in its glass. The children poured some water into a glass; the puppet looked at it and announced that it was not quite right and said "Would you please make it so I have tiv tea in here?" "Tiv" was said distinctly but was not unduly emphasized. If the child made no response, the question was repeated. If s/he asked "How do I do that?", s/he was told to do whatever s/he thought the fussy puppet wanted. If s/he asked "What's 'tiv'?" or "what does that mean?" s/he was told that "tiv" was the puppet's word for "less" or "more" depending upon which of two orders of subsequent requests s/he was to get. Some children received requests in the order "tiv, more, less, tiv" and others in the order "tiv, less, more, tiv". Table 1 shows the distribution of subjects who received the various orders. Unfortunately, twice as many 4-year-olds were in the "more first" than were in the "less first" conditions.

<table>
<thead>
<tr>
<th>Age 3</th>
<th>Finger Adjustments</th>
<th>No Finger Adjustments</th>
</tr>
</thead>
<tbody>
<tr>
<td>More first</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Less first</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Age 4</td>
<td>More first</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Less first</td>
<td>6</td>
</tr>
</tbody>
</table>

Results:

1. The finger adjustments. Almost all of the subjects (32/35 in the adjustments condition carefully matched the puppet's hand wh the puppet indicated a level higher than that presently in the glass. However, when the hand was lower, only 27% of the 3-year-olds and 60% of the 4-year-olds correctly poured some water out of the glass. There were two types of mistaken responses. First, the child added more water, increasing the quantity rather than decreasing it. Second, s/he did nothing, saying "I can't" or "It's already there". The former response (adding) was typical of the 3-year-olds who made errors (7/11); the latter response was typical of the 4-year-olds who made errors (7/8).

Thus, the finger adjustments alone demonstrate that this conte: induces a response bias towards pouring into the focused glass, or against pouring back into the pitcher.

2. The verbal adjustments. There was a wide range of responses to the first request, "make it so there is tiv tea in here". Some children added more water (n = 24), some poured out (n = 6), and some did something irrelevant to quantity change (n = 7) such as sticking their finger in and stirring, or picking up the glass and pretending to drink from it. All of these responses were without comment. The remaining children indicated clearly that they had noticed the nonsense syllable. They failed to respond, looking at the experimenter blankly (n = 12), or they asked questions (n = 16) such as "What's tiv?", "How can I do that?" or "Does that mean to pour some out?"
A high proportion of both 3-year-olds (63%) and 4-year-olds (53) did something without comment in response to the first tiv request. As seen in Figure 1, having been in the finger adjustments condition made 3-year-olds only slightly more likely to respond to tiv with an action. In contrast, having been in the finger adjustments condition more than doubled the likelihood 4-year-olds would do respond. Thus previous experience adjusting the water levels to finger heights seemed to encourage the 4-year-olds not to listen carefully to the question, leading them to construct a response without noticing the "tiv". Such was the natural propensity of 3-year-olds.

Insert Figure 1 about here

Obviously, the young child can construct a response with no input from the relevant lexical entry. When the request contained "tiv", only the sentence frame and non-linguistic context could possibly contribute to the response. But were the responses to "less" and "more" being determined in this manner? In requests containing "more", the lexical entry clearly contributed to some of the addition responses, since the rate of adding to "more" was over twice that for either "less" or "tiv" (Table 2). But we cannot tell from Table 2 whether the lexical entry contributed to those additions in response to "less", since they were no more frequent than additions to "tiv".

Insert Table 2 about here

To answer this question, we must look at the pattern of responses.
over the four questions. This is a formidable task, as there were almost as many patterns as there were children. The patterns have been grouped into 6 categories (Table 3) according to the differentiation of responses to "tiv" from those to both "less" and "more" and to the further differentiation of responses to "less" from those to "more". The significance of each of the obtained patterns will be briefly discussed. However, a glance at the "less" column in Table 3 will show that the only children who added to "less" are found in Groups I, V, and VI. I will argue that the Group I pattern does not support the hypothesis that the lexical entry for "less" is playing a role in the responses of addition. The pattern in Group V is ambiguous; there too, I will suggest that the lexical entry hypothesis is not supported. Only 1 child of the 65, the child who comprises all of Group VI, produced the pattern which unambiguously supports the hypothesis. That is, only one child added to "less" who did not also add to at least one "tiv".

Insert Table 3 about here

Group I. No differentiation of "tiv", "more", or "less" from each other (n = 19). These children added on all four questions (n = 12), did something irrelevant to quantity change on all four questions (n = 4), poured water out on all four questions (n = 1), or did nothing to the first three requests, finally adding on the last "tiv" request (n = 2).

How are these patterns to be understood? On the face, many patterns of responses are consistent with several interpretations.

<table>
<thead>
<tr>
<th>response</th>
<th>more (n = 65)</th>
<th>less (n = 65)</th>
<th>tiv (n = 130)</th>
</tr>
</thead>
<tbody>
<tr>
<td>add</td>
<td>89%(^1)</td>
<td>34%</td>
<td>44%</td>
</tr>
<tr>
<td>pour out</td>
<td>2%</td>
<td>46%(^1)</td>
<td>8%</td>
</tr>
<tr>
<td>no response, question</td>
<td>3%</td>
<td>6%</td>
<td>35%(^2)</td>
</tr>
<tr>
<td>irrelevant to quantity</td>
<td>6%</td>
<td>14%</td>
<td>12%</td>
</tr>
</tbody>
</table>

\(^1\)correct response
Table 3
Patterns of Responses

<table>
<thead>
<tr>
<th>TIV</th>
<th>MORE</th>
<th>LESS</th>
<th>TIV²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>add</td>
<td>add</td>
<td>add</td>
</tr>
<tr>
<td></td>
<td>irr</td>
<td>irr</td>
<td>irr</td>
</tr>
<tr>
<td></td>
<td>p.o.</td>
<td>p.o.</td>
<td>p.o.</td>
</tr>
<tr>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>add</td>
</tr>
<tr>
<td>Group II</td>
<td>NR,Q</td>
<td>add</td>
<td>p.o.</td>
</tr>
<tr>
<td></td>
<td>add,p.o.</td>
<td>add</td>
<td>p.o.</td>
</tr>
<tr>
<td>Group III</td>
<td>irr</td>
<td>add</td>
<td>irr</td>
</tr>
<tr>
<td></td>
<td>add</td>
<td>add</td>
<td>irr</td>
</tr>
<tr>
<td></td>
<td>add</td>
<td>NR</td>
<td>add</td>
</tr>
<tr>
<td>Group IV</td>
<td>add</td>
<td>add</td>
<td>p.o.</td>
</tr>
<tr>
<td></td>
<td>add</td>
<td>add</td>
<td>p.o.</td>
</tr>
<tr>
<td></td>
<td>p.o.</td>
<td>add</td>
<td>p.o.</td>
</tr>
<tr>
<td>Group V</td>
<td>Q,NR</td>
<td>add</td>
<td>add</td>
</tr>
<tr>
<td>Group VI</td>
<td>Q,NR</td>
<td>add</td>
<td>add</td>
</tr>
</tbody>
</table>

1. add is response of adding; p.o., pouring out; irr, irrelevant response; NR, no response; Q, question; -, second tiv not meaningful

2. Table 3 included patterns of responses from children who received order of presentation tiv, less, more, tiv as well as tiv, more, less, tiv.

Take, within the Group I patterns, that of adding on all four requests. The child could be determining his response by a combination of the sentence frame "make it so..." and the non-linguistic context in all four requests. That is, the lexical entry for "more" might not even be playing a role in the computation. Alternatively, he might be using the meaning of "more" in the sentence containing it, while failing to use any of the lexical entries for "tiv" (obviously) or "less". Finally, it is possible that the child looks up both "more" and "less", finding a meaning in both cases that contributes to his responses and that the responses to the "tiv" request alone are determined from the sentence frame combined with the non-linguistic context.

It is impossible to decide conclusively among these three interpretations. However, two considerations favor the view that neither the lexical entry for "more" nor for "less" contributes to the child's responses. First, since all four responses (including the two "tivs") are not differentiated from each other, the simplest hypothesis is that all are being determined in the same way. Second, while 12 children added to all four requests, 7 did something else to all four (Table 3). Clearly, the lexical entries for "less" and "more" were not contributing to responses irrelevant to quantity. Also, it seemed that in these cases (as well as the cases when the child added to all four), the child was often ready to respond before the request was even completed. S/he seemed not even listening to the question.

Table 4a shows that 3-year-olds were twice as likely to fall in Group I as were 4-year-olds (41% of 3-year-olds were in Group I,
while 21% of 4-year-olds were. Finger adjustments and order of presentation of more and less did not influence the likelihood a child would produce a Group I pattern. That age was the only relevant variable is not surprising, as these were the most undifferentiated patterns.

Group II. Adult pattern: differentiation of "tiv" from both "more" and "less" and differentiation of "less" from "more" (n = 19). The children in this group responded correctly to both "more" and "less" and treated "tiv" as a nonsense syllable on at least one of its presentations. There is no ambiguity in the interpretation of these patterns. The lexical entries for both "more" and "less" were clearly used in the child's generation of his/her responses and all children registered somehow their failure to find "tiv" in their lexicon, although some did not do so until they heard it for the second time.

Among all 65 children, only 7 asked explicitly "What's tiv?" when first hearing it, thereafter being told that it meant either "more" or "less". These children's responses to the second "tiv" give no information, as it was no longer a nonsense syllable. Of the 7, 6 were in Group II. The remaining questions raised, by children in Group II and in other groups as well, did not explicitly question the meaning of "tiv". For these children no meaning was provided. The doll's request was merely repeated and if no response was made, the experimenter announced that she would move on to the

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Table 4a
Breakdown of Groups

<table>
<thead>
<tr>
<th>Age</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>41</td>
<td>11</td>
<td>15</td>
<td>14</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>42</td>
<td>8</td>
<td>16</td>
<td>13</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4b
% children

<table>
<thead>
<tr>
<th>Finger Adjustments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustments</td>
<td>29</td>
<td>29</td>
<td>6</td>
<td>25</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>No. Adj.</td>
<td>30</td>
<td>30</td>
<td>17</td>
<td>3</td>
<td>20</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4c
% children

<table>
<thead>
<tr>
<th>Order</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>More first</td>
<td>26</td>
<td>28</td>
<td>15</td>
<td>11</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>Less first</td>
<td>35</td>
<td>31</td>
<td>8</td>
<td>23</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>
next question. Two children of the 19 in Group II apparently adopted some meaning for "tiv" anyway, one pouring out and one adding in response to the second instruction containing it.

Table 4 shows that of the variables, age, adjustments condition, and order of presentation of "more" and "less", only age influenced membership in Group II. Four-year-olds were 4 times as likely to exhibit this pattern as were 3-year-olds, as would be expected, since these are adult responses.

Groups I and II together account for 58% of the children in Experiment I.

Group III. "More" is differentiated from both "tiv" and "less", but the latter two are treated alike (n = 7). The criteria for membership in this group are that the child must have treated "tiv" and "less" the same as each other for at least one of the "tivs", and the response common to them must have been different from that to "more".

The children in this group were clearly treating "less" like a nonsense syllable, while they correctly responded to "more". That is, the lexical entry for "more" was playing a role in their responses to the questions containing it; such was not the case for "less".

There were too few children in Group III to speculate about its breakdown as regards age, adjustments condition, or order of presentation of more and less.

Group IV. "More" is differentiated from "less", "tiv" is not treated as a nonsense syllable (n = 10). These patterns are like the adult pattern in that "more" and "less" are responded to correctly. But unlike the adult pattern, "tiv" is not questioned; it is responded to without comment. There are two variants in Group IV. First, 5 children added to both "tivs". It is possible that for these children, the lexical entry for "less" contributes to the response, but that for "more" does not, since "more" is treated like "tiv". However, since it has never been suggested that "less" is learned before "more", the more likely interpretation of this pattern is that the lexical entries for both "more" and "less" are contributing to the responses, while those responses to "tiv" are a function of nonlinguistic context and sentence frame alone. In the second variant, 5 children responded correctly to "more" and "less", while adding for one "tiv" and pouring out for the other. As in the first variant, I would argue that the lexical entries for both words were contributing to the responses, while the responses to "tiv" were determined by response bias, perseveration, or tendency to alternate.

Children who had adjusted the water level to finger height were 8 times more likely to be in Group IV than were those who had not (Table 4). Thirty-five of the total 65 children had been in the finger adjustments condition (Table 1). Therefore, the probability that 9 of the 10 children in Group IV would have been in this condition is less than .02. It is likely that the practice adding and pouring from the glass made these children confident that they knew what kind of thing the doll wanted, and thus less likely to balk at the nonsense syllable. The finger adjustments might also have increased the likelihood of the child's alternating pouring in and taking out responses.
It is clear from the discussions of Groups I - IV (comprising 85.4% of the total sample) that the interpretation of the patterns of responses is far from clear cut. Nonetheless, among the patterns discussed so far, only in Group I were there children who added to "less", and in this group, those children added to everything (Table 3). Thus, in spite of the vagaries of interpretation, only those 12 children from Group I could possibly be construed as supporting the incomplete lexical entry hypothesis. And in their case, since "less" was completely undifferentiated from "tiv", it is likely that the lexical entry of "less" was not contributing at all to the responses.

There remain 10 children who might have differentiated "tiv" from "less" while treating "less" as if it meant "more" or "some". Group V. "Less" is not differentiated from "more", and the differentiation of "less" and "tiv" is ambiguous (n = 9). All nine children in this group made no response to, or questioned, the first "tiv". While indicating that they could not construct a response with no input from the relevant lexical item, none of these children formulated the problem clearly enough to ask "What's tiv?" Therefore, none was told that "tiv" meant either "less" or "more". All of the children went on to add on "less". In this pattern, then the lexical entry for "less" seems to be playing a role in the addition response, since the response to "less" was differentiated from that to "tiv", and the response to "less" was adding.

Unfortunately, the story is not so simple. Only the response to the first "tiv" was differentiated from that to "less"; the response to the second was not. Rather, all of the children in Group V added to the second "tiv". Immediately before the second question containing "tiv", the child had added twice (to "more" and "less"). The child might have perseverated this response, perhaps not even noticing the second "tiv". But perseveration might also account for addition in the case of "less". As can be seen in Table 4, all those children in Group V had received the instructions in the order "tiv, more, less, tiv", rather than in the less-first order (p < .01). Thus, immediately before the question with "less" in it, the child had just added. The lexical entry for "less" might have had no more role in the generation of the addition response than the lexical entry for "tiv" did in the immediately following response.

Thus, the Group V pattern is ambiguous. The lexical entry for "less" may be playing a role in some (or all) of the 9 children's responses, or perseverance may account for some (or all) of the additions to "less". I feel it is likely that perseveration accounts for all of the additions. These children did not know what to do in response to the first question containing "tiv". They looked uncomfortably at the experimenter, saying, if anything, "What?" or "How do I do that?" They did not respond when the instruction containing "tiv" was repeated. When the experimenter moved on to the next question, containing "more", the relief these children felt at adding was almost palpable. They now knew what to do. And they did it for "less" and for the second "tiv", this time without the slightest evidence of discomfort. I realize that such impressionistic
description does not constitute proof; for stronger evidence I offer
only the fact that all 9 children in Group V were in the more-first
condition, whereas only 39/65 of the total sample received this
order.

Group VI. The single child in Group VI merits the honor of a group
to himself because his pattern of responses was the only one which
unambiguously supported the lexical entry hypothesis. He asked
"What's tiv?" Being in the less-first condition, he was told that
"tiv" was the doll's word for "less". He then added to the doll's
glass. He also added on the next question, containing "more", and
on the last question with "tiv". Of course, this last response is
uninformative, as the child had been told that "tiv" meant "less",
and had previously added to "less".

Conclusions

The lexical entry for "more" plays a role in the generation
of responses before the lexical entry for "less" does. This was
shown in Table 2, and also in the patterns of responses. The 7
children in Group III clearly differentiated "more" from "tiv",
while failing to differentiate "less" from "tiv". Also, the 9 chil-
dren in Group V clearly differentiated "more" from "tiv", while
their differentiation of "less" from "tiv" was ambiguous, at best.
Thus, Experiment I corroborates others in finding that "more" is
understood in its comparative sense before "less" is. This question
of order of acquisition is separate from the focus of this paper--
namely, what the lexical entry for "less" is prior to full mastery.

The interpretation of the pattern of the 9 children in Group V
is crucial to the overall conclusions we draw from Experiment I as
to the lexical entry for "less". If we decide that the lexical
entry for "less" was contributing to the response of addition, then
we would have 10 children (Groups V and VI) whose patterns supported
the incomplete (or incorrect) lexical entry hypothesis. While 10/65
might seem a small proportion, it is certainly a substantial pro-
portion. Nobody would expect all 3- and 4-year-olds to have an
incomplete or incorrect lexical entry for "less". Some already have
the adult lexical entry (Groups II and IV). Some apparently have
no lexical entry for "less" (Group III), and the rest are immature
enough that they construct responses in this situation with no input
from any of the lexical entries for "more", "less" or "tiv" (Group
I). Thus, 10/65 would be good evidence that some (perhaps all)
children go through a period of an incomplete or incorrect lexical
entry for "less".

However, if the addition to "less" in Group V is interpreted as
an effect of perseveration, Experiment I does not provide support
for the incomplete (or incorrect) lexical entry hypothesis. The
overall pattern of results would then be that the only children who
added to "less" did not differentiate this response from that to
"tiv" (both "tivs" in Group I; the second "tiv" in Group V). The
one lone exception, the child in Group VI, may be a single anomal-
ous case of a child with an incomplete or incorrect lexical entry for
"less" but contrary to the accepted view expressed in the litera-
ture on semantic development; this is not a common state of affairs.

Experiment II is designed to clear up the ambiguity of the pat-
ttern in Group V.
Two factors seemed to be producing additions to "less" in Experiment I. The first was the non-linguistic context. Evidence that the non-linguistic context strongly favored addition is that over half of the children in the finger adjustments condition had to be shown how to take water out to lower the level. Also, 44% of the responses to the instructions containing "tiv" were additions, as compared to 8% taking outs, and 12% irrelevant responses. The second was a perseveration effect, evident in Groups I and perhaps Group V. As far as I know, attention had not previously been called to such perseveration effects. Part of the explanation of the perseveration phenomenon involved the child ceasing to listen as carefully once s/he had decided what was expected of her/him. This was particularly evident in the cases where children responded before the question was even completed. This phenomenon is clearly related to a response bias; the bias is set up in the course of the series of instructions.

The value of Experiment I is mainly in showing that the child can generate a response with no input at all from a crucial lexical item. By choosing a situation with a strong response bias, I hoped to make this demonstrational point. The finger adjustments condition was designed to mitigate the response bias, but it failed to have the desired effect. The paradoxical effects of this condition on relatively mature children, making them twice as likely to respond to "tiv" without comment, may be due to a version of the perseveration phenomenon. Having just poured water into and out of the glass, the children were confident that they know what was
 required of them, and thus were willing to construct a response to the instruction containing "tiv" (or perhaps did not listen carefully, and so failed to notice the "tiv").

Four aspects of the design of Experiment I might have minimized evidence for a partial (or incorrect) lexical entry for "less". These are corrected in Experiment II, designed to maximize the differentiation of "tiv" from "less" by 3- to 4-year-olds.

1) In Experiment II, an attempt was made to minimize the response bias. The asymmetry between adding from a pitcher (normal) and pouring back into a pitcher (abnormal) was eliminated. An apparatus was made such that colored water in a tube could be increased by squeezing the stop-cock above the tube and decreased by squeezing the stop-cock below the tube (Figure 2).

2) In Experiment I, the comparison between "tiv" and "less" was always within a child. Furthermore, the two items always appeared in different positions in the sequence of questions. "Tiv" was always first and last; "less" always sandwiched in between. The optimal comparison would be between two matched groups of children, so that "tiv" and "less" could occupy exactly the same position in the sequence. Therefore, in Experiment II, one group received a series of instructions containing "more" and "less"; the other group received a series containing "more" and "tiv".

3) Because there were only two instructions containing "tiv" and one each containing "more" and "less", the patterns in Experiment were particularly difficult to interpret. In Experiment II, each child received eight questions in the order "more, less, less, more, less, more, less, more" or "less, more, more, less, more, less, more, less". In the group receiving instruction containing "more" and "tiv", the same two orders were used, "tiv" replacing "less".

4) To encourage responses to "tiv" in Experiment I, only those children who directly asked what "tiv" meant were told either "less" or "more". In experiment II, the opportunity for adding to "less" after treating "tiv" as a nonsense syllable was maximized by telling any child who failed to respond or asked any question at all (e.g., "How do I do that?") that "tiv" was the word we used for "less". Since all children who treated "tiv" as a nonsense syllable were immediately told it meant "less", there was no chance for the ambiguous pattern of Group V in Experiment I. This maximized the chance of the Group VI pattern.

Thus, two different kinds of evidence for the partial (or incorrect) lexical entry hypothesis might emerge from Experiment II. First, there is the within child comparison in the more/tiv condition. As in Experiment I, evidence that the lexical entry for "less" contributes to the response of adding would be addition to "less" after treating "tiv" as a nonsense syllable. In addition, Experiment II allows a between groups comparison. Support for the hypothesis that the lexical entry for "less" plays a role in adding responses would be (a) "tiv" being treated differently from the comparable "lesses" and (b) there being more additions to "less" in the more/less condition (especially more children who add to all eight instructions) than to "tiv" in the more/tiv condition. Even if the
effects of sentence frame, non-linguistic context, and the perseveration phenomenon still yield substantial addition to "tiv", if the lexical entry for "less" contributes to the addition response, the children in the more/less group, as a whole, should add to "less" more often than the children in the more/tiv condition add to "tiv".

Experiment II. Method

Subjects: Subjects were 57 3- and 4-year-olds from the same population as in Experiment I. The two groups (n = 29 in the more/less condition; n = 28 in the more/tiv condition) were matched for age and for metalinguistic skills. The latter was done on the basis of prescreening on an opposites task and a lexical decision task.1

Procedure: After the experimenter had got to know the children, each child was shown a smaller version of the apparatus in Figure 2 and taught to make the water "go up" by squeezing one stop-cock and "go down" by squeezing the other. The apparatus was called a chemistry set, the experimental version having 8 different chemicals (called blue water, orange water, etc.). In the experiment proper, the experimenter assumed the role of the chemist who needed his chemical to be "just right" and the child the role of the helper, adjusting water levels on the instruction, "Make it so there is more blue water in this one". (Or "less", or "tiv", in the orders described above.) All the children enjoyed this game, and helped set up the apparatus for the next child in order to prolong playing with

1This experiment, to be reported in full in Carey and Sam Vargas, forthcoming, was designed to address several questions in addition to that of whether the lexical entry for "less" contributes to the response of adding. Here I will report only those aspects of the procedure and data relevant to this question.

the chemistry set.

Results

A) Within more/tiv condition. Eleven of the 28 children (39%) treated "tiv" as a nonsense syllable, and were therefore told that "tiv" meant the same as "less." This is comparable to the 29/65 (45%) who treated "tiv" as a nonsense syllable in Experiment I. Table 5 (more/tiv condition) presents the patterns of responses. As in Experiment I, only one of these children produced the pattern supporting the incomplete (or incorrect) lexical entry hypothesis. After being told "tiv" meant "less," he added. He also added to "more" (Group VI). All other children who treated "tiv" as a nonsense syllable failed to add to "less" (Groups I and V) or to "more" (Group VI). Insert Table 5 about here

Group I, the adult pattern, accounted for most of these children. The child in Group V, after being told that "tiv" meant "less," asked what "less" meant. And the child in Group VI became completely confused, adding to "less" and taking out to "more." This pattern, shown by no other child of all 112 in both experiments, seems uninterpretable.

All remaining children, since they did not treat "tiv" as a nonsense syllable, cannot possibly support the incomplete (or incorrect) lexical entry hypothesis. The bulk of them either added or took out to all eight questions (Group III) or responded randomly (Group IV). The only remaining pattern of interest (Group I') consisted of adding to "more" and taking out to "tiv" without asking
what "tiv" meant. It is likely that this pseudo adult pattern reflected these children's noting that the word "tiv" was different from the word "more", and that it therefore called for a different response. In this highly constrained situation, the most obvious other response was to decrease the amount of water by pushing the lower stop-cock. It is impossible to tell how many of the adult patterns in the more/less condition reflected this contrast strategy.

In summary, the increased opportunity in Experiment II for questioning "tiv" and adding to "less" did not yield a substantial number of children with such a pattern of responses. In Experiment I 1/65 (2%) unambiguously did so; in Experiment II 1/28 (4%) did so. Thus, the results of Experiment II confirm the perseveration interpretation of Group V in Experiment I. Addition to "less" after treating "tiv" as a nonsense syllable was all but eliminated by the removal of the interpolated "more" between "tiv" and "less".

B) Comparison between the more/less and more/tiv conditions.
There was a large difference between the two groups of children in their treatments of "less" and "tiv". Eleven children treated "tiv" as a nonsense syllable, while only one child in the more/less condition treated "less" as a nonsense syllable (Group V). However, this large differentiation between "less" and "tiv" across groups means nothing out of the context of the pattern analyses.

Table 5 shows, on the whole, a remarkable similarity in the distribution of patterns of responses in the two conditions. Around 30% of the children in each group showed the adult pattern of responses (in the more/less condition this corresponds to responding

<table>
<thead>
<tr>
<th>Group I</th>
<th>(adult)</th>
<th>9 (31%)</th>
<th>8a (28.5%)</th>
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</thead>
<tbody>
<tr>
<td>Group I</td>
<td>(pseudo-adult)</td>
<td>--</td>
<td>3 (10.5%)</td>
</tr>
<tr>
<td>Group II</td>
<td>(starts right, perseverates)</td>
<td>3 (10.5%)</td>
<td>1 (3.5%)</td>
</tr>
<tr>
<td>Group II'</td>
<td>(all add, 1 right on less)</td>
<td>1 (3.5%)</td>
<td>--</td>
</tr>
<tr>
<td>Group III</td>
<td>(all responses addition)</td>
<td>10 (34.5%)</td>
<td>6 (21.5%)</td>
</tr>
<tr>
<td>Group III'</td>
<td>(all responses taking out)</td>
<td>1 (3.5%)</td>
<td>3 (10.5%)</td>
</tr>
<tr>
<td>Group IV</td>
<td>(random)</td>
<td>4 (14%)</td>
<td>4 (14.5%)</td>
</tr>
<tr>
<td>Group V</td>
<td>(questions &quot;less&quot;)</td>
<td>1 (3.5%)</td>
<td>1a (3.5%)</td>
</tr>
<tr>
<td>Group VI</td>
<td>(&quot;less&quot; is more)</td>
<td>--</td>
<td>1a (3.5%)</td>
</tr>
<tr>
<td>Group VI'</td>
<td>(&quot;more&quot; is less)</td>
<td>--</td>
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*aChild treated "tiv" as a nonsense syllable, so was told "tiv" meant less.

Table 5
Patterns of Responses

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correctly to "more" and "less"; in the more/tiv condition this corresponds to questioning "tiv" and then responding correctly to "more" and "tiv", after being told "tiv" means "less"). Thus it is these mature children who account for almost all of the differentiation of responses to "tiv" and "less" across the two conditions. Thus, one prediction of the lexical entry hypothesis, that "tiv" and "less" would be treated very differently in the two groups, was not borne out, except for among mature children who responded as adults would.

Another prediction was that there would be more addition responses to "less" in the more/less condition than to "tiv" in the more/tiv condition. The relevant comparison included the children in Groups II through IV, excluding adult patterns and children who questioned "tiv" and "less". Of those included, a total of 72% of the responses to "less" in the more/less condition (n = 19 children) were additions, and a total of 63% of the responses to "tiv" in the more/tiv condition (n = 14 children) were additions.

A further examination of Table 5 locates two sources of this small, insignificant, difference. First, there are more Group II children in the more/less condition than in the more/tiv condition. These children usually made one or two correct responses to "less" and then added to the other instructions containing "less" as well as to those containing "more" (one child perseverated the response of taking water out). This pattern probably reflects the correct lexical entry for "less", which is masked by the perseveration phenomenon remarked upon in Experiment I. Since there is no lexical entry for "tiv", we would expect none of these patterns in the more/tiv condition. Thus, the higher proportion of Group II children in the more/less condition contributes to a higher proportion of additions to "less", but does not support the incomplete (or incorrect) lexical hypothesis.

The second source of the difference is seen in the breakdown of Group III and III' (all responses addition and all responses taking out, respectively). In the more/less condition, 10/11 of these patterns involved always adding, while in the more/tiv condition only 6/9 of these patterns involved always addition. The distributions of patterns in the two conditions did not approach a significant difference (Fisher exact test).

Conclusions

Neither experiment provided evidence that the lexical entry for "less" contributes to the response of adding. Experiment II (within more/tiv condition) replicated Experiment I, in spite of the increase chance for less/tiv differentiation among children who questioned "tiv". Of 93 children (65 in Experiment I; 28 in Experiment II) only 2 differentiated "tiv" from "less" while adding to less. Given the range and variety of patterns observed, 2% of the total might best be attributed to noise.

While the children in the more/tiv condition were much more likely to question "tiv" than were the children in the more/less condition likely to question "less", this difference was almost entirely accounted for by the adult-like patterns of responses, comprising about 30% in each group. And among the non-adult patterns, the two conditions were also almost perfectly matched. There was only the slightest tendency (completely non-significant) for "less" to lead
to more additions than "tiv". Thus, not only are "tiv" and "less" treated alike within a group of children (Experiment I and Experiment II, more/tiv condition, with the exception of adult responses), so too are they treated alike when "tiv" replaces "less" in the instructions to a different group of children (Experiment II, again with the exception of adult responses).

Discussion

Where have we got to? We have shown that one of the main sources of evidence for the incomplete (or incorrect) lexical entry hypothesis namely the child's treating "less" as if it meant "more" cannot be accepted at face value. At least in the experimental situations reported here, those children who treated "less" as if it meant the same as "more" also treated "tiv" in this fashion. Inpugning one source of evidence, however, does not show the hypothesis wrong. We must examine other evidence that has been offered in its favor.

Other stimulus materials, such as apples and apple trees, have been used in paradigms similar to those used in Experiments I and II. Also other responses, such as indicating which of two quantities is less, have been required. Perhaps with these materials in these responses, the lexical entry for "less" plays a role in determining the child's behavior. If so, responses to "less" should be differentiated from those to a nonsense syllable. D. Palermo (personal communication) and G.R.E. Ouweeneel (personal communication) have explored this possibility, with preliminary results confirming those found in the present studies.

Wales, Garmon, and Griffiths (1976) report experiments using stimulus materials which apparently remove most of the response bias present with water and glasses or apples and trees. The effect of these materials (dishes of marbles) is to greatly decrease additions to "less" compared to the rate found with the more standard materials. Wales et al. also reported that requests containing "tiv" produced great discomfort, obviously due to the child's not knowing what to do. They discontinued this phase of exploration, concluding that the lexical entry for "less" was clearly playing a role in the children's responses. I agree, but in the absence of a full pattern analysis, we cannot know which responses "less" contributed to. Most of the 4-year-olds and many of the 3-year-olds in their study responded correctly to "more" and "less"; clearly the lexical entry contributes to such responses. We would expect these children to treat "tiv" as a nonsense syllable. It would be very interesting to repeat Experiment II (embryoning both within-child and across-children comparisons of "tiv" and "less") with Wales et al.'s stimuli, to see if the lexical entry for "less" plays a role in any responses other than the correct one.

Only further studies will determine the generality of the results found in Experiments I and II. However, there remain additional sources of evidence for the incomplete lexical entry hypothesis which do not depend upon the child's treating "less" as if it meant "more". If two trees are equally laden with apples and the child is asked "which has less?", s/he sometimes answers "they both do". (Donaldson and Balfour, 1968). This is consistent with the hypothesis that "less" is incompletely represented as "some". However, such responses
are also found when the question contains "more", which would indicate that "more" is also represented incompletely as "some". More importantly, if "less" (and "more") were really marked only for quantity, then the response "they both do" should be found sometimes even when the quantities being compared were not equal. This has never been reported. Thus, it seems more likely that the response that both of two equal quantities have "less" (or "more") reflects difficulties in producing "they both have the same number".

Finally, the opposites children give are often consistent with the incomplete lexical entry hypothesis. For example, "some", "none", "gone", and "full" were all given as opposites for "less" in the metalinguistic screening in Experiment II. However, comparable responses are made to "more--", e.g., "lots", "millions", "nothing" and "you don't have any". Such responses could reflect momentary difficulties in accessing the full meaning, or in constructing a fully opposite response.

If a young child truly has "less" (and possibly "more") represented in their lexicon with only some of the relevant semantic features, then a consistent pattern of responses should emerge over several tasks. For example, the child should agree "less" is a word that should produce a semantically appropriate opposite, and should add when requested to make a quantity "less". Carey and Sam Vargas (forthcoming) report such an analysis for the metalinguistic passer: in Experiment II. No such consistency emerges.

Although all the data are not in, I am suggesting that there is no point during development when "less" is represented in the lexicon as a word with a meaning that is not in opposition to "more".

If this is right, then the situation for "less" parallels that for polar adjectives. It was once suggested that "little, short, thin, shallow", etc., might each be incompletely represented, in each case the incomplete representation lacking negative polarity. The bulk of evidence available now suggests that this proposal, too, is wrong (see below).

That these particular proposals about incomplete lexical entries may be wrong does not mean that there are no partial meanings during development. Quite the contrary, the rate of vocabulary acquisition and the sheer weight of full semantic representations ensures that there must be (Carey, 1976).

In fact, there is good evidence that there are partial meanings for comparative spatial adjectives which persist for several years. It seems that "tall, wide, fat, high, long, thick, etc.", are represented as "big"; their opposites as "little". That is, while polar seems to be represented from the beginning, the particular dimensions referred to is not worked out until much later. Several sources of evidence support this generalization.

First, if young children are asked for the opposites of comparative adjectives they often err, but almost always respect the polar of the correct response—e.g., short-big; short-wide; wide-little; wide-low (Clark, E., 1972; Carey and Considine, 1976). Second, in an array of objects varying in many dimensions, errors respected polarity, not dimension. For example, asked to indicate the skinny one in Figure 3a, the child picks either A or B (Carey and Considine 1976; Brewer and Stone, 1975). Third, in an array such as Figure 3
when asked "is one of the flag poles fatter than the rest, or are they all the same in fatness", 3- and 4-year-old children said that the tallest one is fatter than the rest about 50% of the time.

Insert Figures 3 about here

Pretesting showed that this was not due to failure to understand the locution, "all the same in fatness" (Carey and Considine, 1976).

Why should one contrast (polarity) be systematically represented while the other (specific dimension) systematically dropped? That is, why one type of partial meaning rather than another? Answers may be sought at different levels of explanation. The distinction between positive pole and negative pole is binary, while those distinctions among the dimensions of length, height, width, breadth, depth much more complex. Also, the child learns the words "big" and "little", polarities properly marked at age 2 (Carey, 1976). Thus, as s/he is learning new spatial adjectives, the polarity features are already available as lexical organizers. Finally, the particular partial representation which persists for several years leads to few, if any, communication errors. In comprehension, usually the dimension in question is obvious from context—the stimuli vary along only one dimension; for example, one would not usually use "fat" in discussing the stimuli in Figure 3b. And in production, if the child is not sure of which word applies to a specific dimension, s/he can rely on the more general "big" or "little".

There are other well documented cases of incorrect or partial meanings. Some are understandable in terms of actual adult uses of
the words (e.g., "different" has a usage which means "another one of these identical objects"). Others, like the spatial adjectives, involve the child's difficulty mastering a complex system of distinctions (e.g., "blue" is marked /+ color/ before its particular hue is worked out (Bartlett, this volume).

Other possible cases of incorrect lexical entries are not yet so well documented. For example, the claim that "after" is represented as a synonym of "before" rests on comprehension errors where sentences containing "after" are treated as if they contained "before" (Clark, 1970). An experiment replacing "after" with a nonsense syllable would bear on whether the lexical entry for "after" played any role in such errors. Anecdotally, Weil (personal communication) describes to me a young child acting out sentences of the form "Hitler you drink the Coke, touch your stomach", with no hesitations. Later the child wanted a turn giving the instructions and produced an item containing "bitler". Asked what "bitler" meant, the child disdainfully shrugged her shoulders and said, "you know, hitler".

Finally, Clark (1974) has suggested that "on" and "under" may be represented in the lexicon as synonyms of "in" (incorrect lexical entry) or simply as spatial prepositions (incomplete lexical entry). Her suggestion for how the incorrect lexical entry might come about is ingenious and important. She showed that there is a response bias to put objects inside one another rather than on or under one another. If this response bias contributes to the comprehension of sentences containing "on" and "under", it could yield an incorrect hypothesis of the meaning of these words. The plausibility of this suggestion rests on the frequency that the child might hear "on" or "under" when an "in" interpretation is possible. It also rests on the likelihood that the incorrect interpretation would go undetected and uncorrected by the mother. At any rate, before we try to explain the mistaken meaning, we must rule out the possibility that the lexical entries for "on" or "under" play no role in the responses which constitute the evidence for such an incorrect entry. Again, the nonsense syllable design could provide unequivocal support.

There are well documented cases of partial and mistaken meanings during development. And a theory of language development must have as one goal their description and explanation. But before progress is possible in attaining that goal, we must be sure of our evidence for any putative case of systematic partial or incorrect meanings.
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