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Comprehending compounds: evidence for metaphoric skill?*

GAIL M. GOTTFRIED
Occidental College

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ABSTRACT

Previous studies of children's comprehension of compound nouns show that three-year-olds can identify the appropriate referent for a compound when shown picture arrays that include salient distractors. The four studies presented here investigate comprehension of one kind of compound, *metaphoric compounds* (i.e. noun–noun compounds in which one noun expresses similarity to another object, as in *catfish*). Forty-four three-year-olds, 45 five-year-olds and 22 adults were shown a series of picture arrays and were asked to identify referents of various types of metaphoric compounds. The arrays included target pictures that had metaphoric resemblances based on shape (e.g. bug shaped like a stick) or on colour/pattern (e.g. shells with black and white stripes, like a zebra). Results showed that three- and five-year-olds can comprehend shape-based metaphoric compounds such as *stick-bug*, even when faced with salient distractors (e.g. a stick, a bug next to a stick). The younger children had some difficulty with colour-based compounds, such as *zebra-shells*. Overall, five-year-olds outperformed three-year-olds but performed significantly less well than adults. However, even at age 3, children did not show a general expectation to interpret the compounds literally.

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INTRODUCTION

Researchers have traditionally believed that metaphoric language is a difficult skill for young children to master. During the 1970s, much research indicated that although preschoolers produced seemingly metaphoric utterances, comprehension of metaphors lagged far behind. Indeed, it was argued that even ten- to twelve-year-old children tend toward literal interpretations of metaphoric sentences, rather than metaphoric ones (see Vosniadou, 1987; Winner, 1988, for thorough reviews).

Nonetheless, it is likely that much of the metaphor comprehension research employed methodologies that are too sophisticated for preschool children, such as requiring the children to paraphrase metaphors or explain the literal or metaphoric meanings for sentences (Winner, Rosenstiel & Gardner, 1976). Research employing less complex methods shows that children may show comprehension of metaphors under certain circumstances (cf. Keil, 1986; Vosniadou, 1987; Winner, 1988; Winner, Levy, Kaplan & Rosenblatt, 1988). For example, Vosniadou, Ortony, Reynolds and Wilson (1984) showed that children can enact stories with metaphoric endings appropriately. Pearson (1990) used a paradigm that required children to repeat literal, metaphoric and anomalous sentences: adopting the theory that imitation indicates comprehension, Pearson showed that three-year-old children can accurately repeat literal and metaphoric sentences, although they cannot repeat anomalous ones. Another study (Broderick, 1991) showed that children can comprehend the similarities underlying metaphor, thus providing a basis for comprehending metaphoric language. Finally, Gentner (1988) suggested that the comprehension difficulties found in previous studies may also be affected by the type of metaphors children are asked to explain. She distinguished between attributional metaphoric comparisons (e.g. 'a football is like an egg') and relational metaphoric comparisons (e.g. 'a roof is like a hat') and argued that children may comprehend simple attributional metaphors, based on 'mere appearance matches', prior to comprehending relational ones.

It appears, then, that under certain circumstances preschoolers understand simple metaphors, especially those of the syntactic form 'X is a Y.' However, metaphor can take on a broader meaning, such as that provided by Winner, McCarthy & Gardner (1980): metaphors are 'cases in which a word (or phrase) is transported from its customary context to a novel domain, and in which such a transfer is deemed appropriate (rather than anomalous) by the community' (p. 343). Thus, a psychological evaluation of metaphor should address *language that is used metaphorically* (a behavioural definition) rather than *utterances that are metaphors* (a linguistic definition).

Indeed, adults use language metaphorically in a variety of formats other than the simple copula ('X is a Y') form. For example, adults produce

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utterances such as 'the dolphin's fin buttered through the wave' (see deCordova, 1992) in which a noun is used metaphorically as a verb. These utterances are known as *metaphoric conversions*. Furthermore, adults frequently produce *metaphoric compounds*, lexical units containing two nouns, one of which is used metaphorically as an adjective (Downing, 1977; see also Elbers, 1988). In a metaphoric compound (e.g. *tiger-tablecloth* for a striped tablecloth, produced by a three-year-old), the second noun typically provides the category identity of the object, and the modifier noun is clearly used in a metaphoric way – it is transported from its conventional context (i.e. as a referent for an animal) to a novel domain (i.e. as a modifier meaning 'with stripes like a tiger').

Although metaphoric compounds are prevalent in adult conversation and adults often interpret novel compounds in this way (Downing, 1977), no prior research has investigated children's comprehension of this linguistic form. Thus, an investigation of the comprehension of metaphoric compounds provides a novel approach to the question of whether children understand language used in a metaphoric way, in a situation in which the metaphor is put 'to some specific use' (Elbers, 1988: 598), as a modifier of another noun.

Why might we expect that children can comprehend metaphoric compounds? First, it is clear that they often hear different types of compounds. Empirical studies have shown that parents regularly use noun–noun compounds to label objects for their children and especially to differentiate among objects with the same label. For example, in a study by Callanan (1985), parents were given a set of pictures accompanied by either subordinate- or superordinate-level labels and were asked to teach those concepts to their two- to four-year-old children. Five of the eight subordinate-level objects were labelled with noun–noun compounds by the experimenter (e.g. monkey wrench, claw hammer) and so were taught as such by the parents. Additionally, several parents spontaneously created innovative compounds for two of the other three items (e.g. three parents coined *pug dog* rather than simply labelling the object *pug*, as the experimenter-provided label indicated). Although the parents may have been simply following the pattern of using compounds in this task, the tendency to use compounds with young children emphasizes their productive value in the language. Moreover, adults were clearly not following an established pattern in studies done by Adams and Bullock (1986) and Kohn and Landau (1990), who provided no labels to the parents. Both sets of researchers asked parents to describe picture sets to their preschoolers. Adams and Bullock found that parents of three-year-olds coined noun–noun compounds to help differentiate the various exemplars (e.g. *alley cat* vs. *Siamese cat*), and Kohn and Landau found that parents use noun–noun compounds, often novel ones, to differentiate between the referents of homonyms (e.g. *skate-fish* and *ice-*

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skate or *skate-shoe*). Metaphoric compounds were not singled out, but it is clear that children often encounter the compound form.

Not only do children hear compounds frequently, but they also seem able to interpret non-metaphoric ones correctly from a very early age. Clark, Gelman and Lane (1985) showed children arrays of four pictures of objects and asked them to select the one labelled by the target compound. For example, children were shown a hat on a fish, a hat on a mouse, a hat, and a mouse and were asked to point to the *mouse-hat*. By three years of age (and as early as two for some children), the children were able to select the appropriate picture (see also Berman & Clark, 1989). However, Clark and colleagues did not test comprehension of metaphoric compounds. The target pictures in those studies showed the referents of both nouns in the compound: for the *mouse-hat*, the picture showed both the mouse and the hat. Certainly, many compounds are used in situations like this one: saying handkerchief-book while pointing to a book with a handkerchief in the pages (Elbers, 1988). Yet adults, and perhaps children, also often use compounds in a more metaphoric way, as when a preschooler called the striped tablecloth the *tiger-tablecloth* because the stripes on the tablecloth reminded her of the stripes of a tiger, or another called an apple an *autumn-apple* because it was coloured like autumn leaves (Elbers, 1988). Thus, we might expect that they would comprehend this type of compound as well.

Metaphoric compounds may be easier to comprehend than other types of metaphoric statements because they convey both identity (i.e. the head noun conveys category membership) and resemblance (i.e. the metaphoric modifier noun) information within only one linguistic unit. When isolated metaphors are used, as in 'Juliet is the sun', children are confronted with the seemingly difficult task of determining whether or not the metaphor is a mistaken label intended literally or perhaps a label that the child has not yet learned (cf. Winner, 1988). Metaphoric compounds, in contrast, label an object in two ways at once, literally and metaphorically. Because the literal information is included, children may find it easy to detect the metaphoric resemblances implicit in the compounds.

In summary, the main purpose of the series of studies reported here is to investigate the development of the ability to comprehend metaphoric compounds. In each of the studies, participants were shown picture arrays, each of which included a target item (e.g. a bug that looked like a stick) and various distractors. It was predicted that both adults and preschoolers would be able to find an appropriate referent for each of the compounds.

STUDY 1

Study 1 is an adult study designed for two purposes. One purpose was to identify a set of stimuli to be used with children in Studies 2–4. Adults were asked to identify the category membership and metaphoric resemblance of a

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large set of target items with various types of metaphoric and non-metaphoric similarities. Items for which both the category membership and the resemblance are easily recognisable should provide good instances of objects that can be labelled with metaphoric compounds. Accordingly, a second purpose of the study was to determine adults' comprehension of metaphoric compounds. In the experimental condition, adults were given a metaphoric compound and were asked to select the appropriate referent from an array of pictures.

METHOD

Subjects

Participants included 22 undergraduate students. Students either volunteered or participated in partial fulfilment of an introductory course requirement.

Design

The design of the study was 2 (conditions: Compound, Control) × 3 (question: Target, Category, Metaphor) × 4 (item type: Shape, Colour, Representational, Simple). Condition was a between-subjects variable, and item type and question were within-subjects variables.

Materials

Stimuli included 116 coloured pictures, depicting objects from the animal, plant, and artifact domains. These domains were selected because Downing (1977) found that adults used comparison-based compounds frequently in these domains. The pictures were divided into sets of four, each of which included a target item that could be labelled with a compound or adjective + noun phrase, an appearance match (i.e. shares label with the modifier of the compound), a category match (i.e. shares the same basic-level category membership), and a distractor item (i.e. shares no recognizable similarity). For example, one set included a picture of a bug that looked like a stick (target), a stick (appearance match), a beetle (category match), and a lawn mower (distractor). The four pictures from each set were attached to 4 × 6 white cards; the cards were then attached to open file-folders in a 2 × 2 array, so that all four pictures were visible to the participants. The location of the pictures in the file folders was counterbalanced.

Nineteen target pictures were selected to represent two different grounds for metaphoric compounds (shape and canonical colour), as described below. Two additional picture sets served as comparisons: four additional target pictures had no apparent metaphoric resemblance but could be labelled with

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adjective + noun phrases (known as Simple objects), and six pictures were hybrid objects (known as Representational objects). Appendix A shows the complete stimulus set.

Shape stimuli. These pictures were of objects that clearly belong to one category but have the same shape as objects in another category. For example, shape objects include a bug that is shaped somewhat like a stick and shells that are shaped somewhat like fans. This resemblance is unintentional, or at the very least, the object is not designed to represent something.

Colour stimuli. These items included pictures of objects that have the canonical colour or colour pattern of another object. For example, seashells that have black and white zigzag stripes have the canonical colour pattern of zebras, and an orange crayon shares the canonical colour of a carrot. Metaphorically, these items can be labelled *zebra-shells* or *carrot-crayon*.

Representational stimuli. These pictures were of objects intentionally designed to look like other objects. For example, representational objects included a plate with the shape and etched features of a fish (e.g. fins, face, etc.) and a green teapot in the shape of a Christmas tree, with a star on top and painted-on ornaments and candy canes). In contrast to the shape items, these items contain a high level of colour and texture detail that makes the resemblance extremely obvious.

In an elicited production task (Gottfried, under review), adults and children showed notable differences in their labels for the Representational objects as compared to the Shape and Colour objects. First, preschoolers and adults frequently labelled the objects with just the modifier noun (e.g. called the fish-plate *fish*). This finding suggests that the category of 'things labelled fish' may include not only the animals but also artifacts or pictures that are designed to represent fish.[1] Furthermore, when adults were asked to label these pictures, they often spontaneously provided the complete compounds, whereas they provided only the category label for the Shape and Colour objects. Thus, these items appear to be qualitatively different from the metaphoric Shape and Colour items and are intended to provide a control set that should be easy for children to identify. To reflect these differences, the labels for the representational items are called hybrid compounds.

Simple stimuli. These were pictures of objects that do not have an obvious, distinct resemblance to any other objects. For example, a blue chair and a round clock were two items in this set. These items are not metaphoric but are instead designed to serve as a baseline for subjects' abilities to modify nouns.

[1] It is important to note that we often label objects in this way but do not necessarily consider all objects with the same label to be importantly alike in other ways. For example, we may include toy cars in our category of 'things labelled car' but do not expect them to have a working engine; we may include stuffed bears in our category of 'things labelled bear' but do not expect them to roar or have babies (cf. Carey, 1985).

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Procedure

Adults were tested either individually or in groups in a pencil-and-paper task. Subjects were divided randomly into one of two conditions: Control or Compound.

In both conditions, subjects were shown each file-folder in turn and were asked three questions in random order. In the Category question, they were asked to identify the category members: 'Where is/are the bug/bugs?'[2] In the Metaphor question, they were asked to identify the objects labelled with the metaphoric label: 'Where is/are the stick/sticks?' This question tested whether adults included the target items within the category of things labelled by the modifier. The third question, the Target question, varied with the condition. In the control condition, subjects were asked, 'Where is/are the bug(s) that looks kinda like a stick?' This condition tested whether the adults share the experimenter's perceptions about what the objects resemble. In the compound condition, subjects were asked, 'Where is/are the stick-bug(s)?' This condition tested whether adults comprehended the metaphoric compounds and found them to be adequate labels for the objects.

RESULTS AND DISCUSSION

Item analysis

Because a main purpose of Study 1 was to ensure that adults recognise both the category membership and the metaphoric resemblance of the target items, an item analysis was conducted prior to any other analyses. Only results from subjects in the control condition were considered because the wording used in this condition yields the most unambiguous evidence.

For each of the metaphoric (Shape and Colour) items, the number of subjects who selected the target item in response to each of the questions was calculated. Acceptance of a stimulus depended on four criteria. First, 75% of subjects had to accept the target item (e.g. stick-bug) in response to the category question ('Where are the bugs?'). Next, for the metaphoric items, no more than 25% of subjects could select the target item in response to the Metaphor question ('Where are the sticks?'). Finally, 75% of subjects needed to select the target item only[3] in response to the Target ('looks like') question. Four stimuli were eliminated from further analyses on this basis: the grass-button, fork-shovel, leaf-bug and umbrella-lamp.

[2] Is/are was written on the page to encourage students to select one or more objects.

[3] For the umbrella-lamp, five subjects selected both lamps in response to this question, suggesting that the resemblance between the target lamp and an umbrella was not particularly strong.

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Main analyses

Each subject was given a score indicating the number of times he or she selected the target item in response to the Target question for each item type. Because the number of items differed for each item type, these scores were then converted to proportions for further analysis. Table 1 shows the mean proportion of correct responses for each item type for subjects in each condition.

TABLE 1. *Proportion of correct responses* (*selection of target item in response to target question*) *in Study 1. Standard deviations are in parentheses*

	Item type			
Condition	Shape	Colour	Representational	Simple
Control ($N = 12$)	0·98 (0·06)	0·89 (0·23)	1·00 (0·0)	0·94 (0·11)
Compound ($N = 10$)	0·90 (0·13)	0·83 (0·24)	1·00 (0·0)	0·98 (0·08)

To investigate adults' understanding of metaphoric compounds, a 3 (condition) × 4 (item type: Shape, Colour, Representational, Simple) analysis of variance was conducted on these scores. Results indicated a main effect of item, $F(3, 60) = 4{\cdot}07$, $p < 0{\cdot}02$. *Post hoc* Tukey tests ($\alpha = 0{\cdot}05$) show that this effect is due to the relatively lower number of correct responses to the Colour items as compared to each of the other types of items, which did not differ from one another. No significant condition differences were found: adults were able to identify the referent of appropriately formed metaphoric and hybrid compounds as labels for these items as often as when they heard a literal comparative description of the form 'looks kinda like'. Thus, the high rate of correct responding in Study 1 confirms that adult subjects perceived the metaphoric similarity of the Shape and Colour items and comprehended the metaphoric compounds as easily as the hybrid compounds.

STUDY 2

Study 2 is a control study designed to establish whether preschoolers could identify the category membership as well as the metaphoric resemblance of the target pictures. Children were shown the picture arrays from Study 1 and were asked to select first the two pictures from the same category and then the target picture. The metaphoric resemblance was expressed in a literal sentence, rather than a metaphoric compound (i.e. 'find the [category

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member] that looks kinda like an X'), to provide the most unambiguous evidence.

METHOD

Subjects

Participants included ten three-year-olds (range 2;11 to 3;10, M = 3;4) and 10 five-year-olds (range 4;5 to 5;4, M = 4;10). Children were attending a university preschool at the time of testing.

Materials

Materials included 16 metaphoric picture sets from Study 1: 10 Shape items and six Colour items. The leaf-bug was inadvertently included in testing; however, the data from this item were not analysed. The four Simple objects were also included to provide a baseline level of performance for each child and to keep the children on-task. The Representational items were not included because pilot-testing indicated a potential carry-over effect for the other items when the Representational items were included in the randomly ordered set.

Procedure

Subjects were tested individually in a quiet room. Each child saw the file folders presented in a different random order.

Children were first asked to point to the two pictures from the target category (e.g. 'Where's the two pictures of bugs?'). Children were then asked to find the target picture (e.g. 'Which one's the bug that looks kinda like a stick?'). To maintain consistency in wording for the Simple objects, children were asked to find, for example, 'the telephone that looks kinda like it's red', even though this wording was awkward and perhaps confusing (i.e. the phone *WAS* red).

RESULTS AND DISCUSSION

Children were given one score indicating the number of times they picked both category members in response to the first question. Children were then given a score for the number of times they picked the target item in response to the second question.

Because the number of items varied for each type, individual scores were converted to percentages (see Table 2), and a 2 (age) × 2 (question) × 3 (item type) repeated-measures analysis of variance was conducted. Results indicated main effects of age, $F(1, 18) = 17{\cdot}93$, $p < 0{\cdot}001$, and question, $F(1, 18) = 40{\cdot}01$, $p < 0{\cdot}001$. Five-year-olds were more likely to select the appropriate pictures than were the three-year-olds, and children were more likely to select the two category members in response to the first question

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TABLE 2. *Percentage of target items selected in Study 2. Standard deviations are in parentheses*

	Both literals (%)	Target (%)
Age 5		
Shape	96·00 (5·16)*	90·00 (9·43)
Colour	93·20 (8·78)	86·60 (13·07)
Simple	97·50 (7·91)	87·50 (13·18)
Age 3		
Shape	88·00 (9·19)	64·00 (24·59)
Colour	81·70 (14·43)	56·80 (19·58)
Simple	100·0 (0·0)	77·50 (18·45)

* All values were greater than chance, $p < 0{\cdot}001$.

than they were to select the target item in response to the second question. Furthermore, an age × question interaction was found ($F(1, 18) = 10{\cdot}78$, $p = 0{\cdot}004$), showing that the three-year-olds had particular difficulty with the second (target) question.

In addition, results indicated a main effect of item, $F(2, 36) = 7{\cdot}53$, $p = 0{\cdot}002$, and an interaction of age and item, $F(2, 36) = 4{\cdot}86$, $p = 0{\cdot}014$. Simple effects analysis of the interaction indicates that, as predicted, children of both ages did quite well identifying the Simple objects, but the three-year-olds were less likely than the five-year-olds to identify the target Shape items ($F(1, 36) = 8{\cdot}88$, $p < 0{\cdot}025$) and target Colour items ($F(1, 36) = 13{\cdot}09$, $p < 0{\cdot}025$).

Although children of both ages responded above chance for all item types (probability of selecting the target = 1/4 on each trial), the younger children's difficulty with the target question was surprising, given the straightforwardness of the question. There are several possible explanations for this finding. First, some children simply may not have recognised the metaphoric resemblance; thus, when asked for the caterpillar that looks like a tiger, for example, children may have been reluctant to pick either caterpillar. In this situation, children may have believed that no picture fulfilled both parts of the question (i.e. *is* a caterpillar, *looks like* a tiger) and engaged in a strategy of picking a picture that fulfilled one or the other requirement. Analysis of children's error patterns shows that when children failed to select the target item they were as likely to pick the category match (other caterpillar) as they were to pick the appearance match (tiger, $p > 0{\cdot}30$). Although they had already restricted the possible selections for 'caterpillar' to only two items, they may have found the second requirement, 'looks like a tiger', to be a salient part of the direction. It is also possible that children had a tendency to select a picture on the second trial that they had not selected on the first trial. This explanation seems quite likely, as children often selected both category members in response to the first question but then selected the

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appearance match in response to the second question. For example, children would select both pictures of shells when asked for the shells but then would select the zebras as the 'shells that look kinda like zebras'. Fifty-one percent of three-year-olds' errors on the second question were of this type.

To provide an additional, more clear test of whether the younger children recognized the metaphoric resemblance of the target pictures, an additional sample of three-year-olds was tested in a simpler task. Nine children (range 2;7 to 4;4; mean age 3;8) were shown each target Shape and Colour picture paired with its category match (e.g. the two balls). Children were asked, 'See my two pictures of Y? Which one's the Y that looks kinda like an X?' It was predicted that when the appearance-match objects were removed from view, children would be able to identify each target item's metaphoric resemblance.

Children were given two scores, indicating the percentage of target items selected for the Shape and Colour items. These scores (Shape: $M = 86{\cdot}56$, Colour: $M = 75{\cdot}11$) were comparable to the five-year-olds' performance on the original task. Single-mean t-tests comparing these scores to chance performance (50%) indicated that children significantly chose the target items for both item types, $p < 0{\cdot}005$.

To summarize, Study 2 shows that both the three- and five-year-olds recognized both the category membership and the metaphoric nature of the target items.

STUDY 3

Study 3 is a test of preschoolers' ability to comprehend innovative metaphoric compounds produced by an adult. The experimental design was similar to that in the studies done by Clark and colleagues (Clark *et al.* 1985; Clark & Berman, 1987; Berman & Clark, 1989). Children were shown each of the arrays of pictures selected in Study 1 (including the Representational objects) and were asked to identify the objects labelled with the target compounds.

METHOD

Subjects

Participants included nine three-year-olds (range 3;2 to 4;2, M = 3;6) and ten five-year-olds (range 4;7 to 5;10, M = 5;3). Children were enrolled in preschool or kindergarten at the time of testing and had not participated in Study 2. An additional five-year-old did not complete the task, and a three-year-old was replaced for showing a bias to select the picture in the same location of each folder.

Design

The design of the study was 2 (age: 3, 5) × 4 (item type: Shape, Colour, Representational, Simple). Age was a between-subjects variable, and item type was a within-subject variable.

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Materials

Materials included the 25 stimulus sets selected on the basis of Study 1.

Procedure

Subjects were tested individually in a quiet corner of the classroom or in a separate quiet room. Children saw the file-folders one at a time. The Shape, Colour and Simple objects were presented first in a block, randomly ordered for each child. The Representational objects were then presented in a block, randomly ordered for each child. Children were asked to locate one of the objects on the page; requests included appropriate metaphoric or hybrid compounds for the Shape, Colour, and Representational objects (e.g. 'Where's the stick-bug?') and adjective + noun phrases (e.g. 'Where's the blue chair?') for the Simple objects.

RESULTS

Each child received four scores, indicating the proportion of target items selected for each item type. Mean scores for each age and item type can be seen in Table 3.

TABLE 3. *Percentage of target items selected in Study 3. Standard deviations are in parentheses*

	Shape	Colour	Representational	Simple
Age 5	59·90 (21·28)**	66·70 (23·41)***	95·00 (11·20)***	97·50 (7·91)***
Age 3	50·67 (18·80)*	40·78 (23·60)	83·22 (25·08)***	97·22 (8·33)***

*$p < 0{\cdot}05$; **$p < 0{\cdot}01$; ***$p < 0{\cdot}001$; (Chance = 33 %).

To investigate children's comprehension of metaphoric compounds, a two (age) × four (item type) repeated-measures analysis of variance on these scores was then conducted. Results indicated a main effect of item, $F(3, 51) = 48{\cdot}10$, $p < 0{\cdot}001$. *Post hoc* Tukey tests showed that children performed significantly better on the Simple and Representational items (which did not differ) than they did on the Shape and Colour items (which also did not differ), $p < 0{\cdot}01$.

Although there was no significant effect of age, a trend appeared, $F(1, 17) = 3{\cdot}37$, $p < 0{\cdot}09$. Five-year-olds were somewhat more likely than three-year-olds to identify the correct target item. Moreover, a trend toward an interaction of age and item appeared, $F(3, 51) = 2{\cdot}65$, $p < 0{\cdot}06$. Simple effects analysis showed that this trend was due to an age difference on the Colour items, with five-year-olds outperforming three-year-olds.

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Single-mean *t*-tests were then conducted, comparing each mean score to chance performance. Although true chance responding would yield an average of 25 % correct responses, none of the children selected a distractor: as a result, the more conservative estimate of 33 %, indicating chance selection of a meaningful object, was used. Results indicated that children of both ages selected the appropriate Shape, Representational, and Simple objects at above-chance levels (see Table 3), but that the three-year-olds did not systematically select the appropriate target items for the Colour items.

To test whether children had more difficulty understanding the metaphoric compounds than the literal 'looks kinda like' statement from Study 2, a 2 (age) × 2 (study) × 2 (item) analysis of variance was then conducted comparing the data to the data from the target (second) question from Study 2. This analysis excluded the data from the Representational items, as they were not included in Study 2. Consistent with results from both of these studies, the analysis showed a main effect of age, $F(1, 35) = 18{\cdot}59$, $p = 0{\cdot}001$, with the five-year-olds outperforming the three-year-olds. Furthermore, there was a significant effect of study, $F(1, 35) = 14{\cdot}15$, $p = 0{\cdot}001$. Children of both ages were more likely to identify the correct referent (e.g. the zebra-shells) when they were asked to find, for example, 'the shells that looked kinda like zebras', rather than the 'zebra-shells'. For both item types, the metaphoric compound form appeared to be more difficult for children of both ages.

For each child, the total number of errors involving selection of the appearance match and the number involving selection of the category match were computed for the metaphoric items. The data from both item types (Shape and Colour) were combined for greater power in the analysis. Paired *t*-tests conducted on these scores demonstrated that when children erred in selecting a metaphoric target item, they were more likely to select the appearance match ($M = 4{\cdot}32$, S.D. $= 2{\cdot}26$) than to select the category match ($M = 2{\cdot}63$, S.D. $= 1{\cdot}67$), $t(18) = 2{\cdot}84$, $p < 0{\cdot}02$.

DISCUSSION

This study was designed to test whether three- and five-year-old children comprehended, and thus could select the appropriate referent for, novel metaphoric compounds. The results indicated that this skill has begun to develop by age 3, as evidenced by the above-chance responding of the younger group, and is more advanced by age 5. However, a comparison of these data with the adults' near-ceiling performance in Study 1 shows that this skill does continue to develop throughout childhood.

Children of both ages performed well when asked to find the referent for an object labelled with an adjective + noun phrase (i.e. the simple objects: blue chair), suggesting that they understood the task. Children also identified the appropriate Representational objects, which were labelled with hybrid compounds. These results indicate that children did not generally have

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trouble with a modifier + noun construction or with the compound form *per se*. Even by age 3, children were near ceiling in their responses for these stimuli.

It appears that children had difficulty with metaphoric compounds specifically, as they were less likely to select the appropriate referent when asked for the Shape or Colour items than the other items. This difficulty does not appear to be due to an inability to notice the resemblance – children in Study 2 could successfully identify the referent when the objects were requested with a phrase of the form 'X that looks kinda like a Y.' To support this argument, it is necessary to rule out a methodological explanation for the difference in experiments. As discussed previously, in Study 2, the children were first asked to pick the two category members (e.g. 'Where's the two pictures of bugs?'), and they regularly included the target item in their response to this question. Thus, this question may have served to focus the children's attention only on the bugs, and so may have narrowed down the possible choices in response to the second (target) question. The chance of responding correctly, then, could be seen as 1/2 as opposed to 1/4. However, inspection of children's error patterns suggests that this explanation is not valid, or at least is not the primary explanation for the task differences. In Study 2, when children selected an incorrect referent, they often picked the object labelled by the modifier (e.g. the stick when asked for the stick-bug or the bug that looks kinda like a stick) although they had not selected it when asked the category question (e.g. 'Where's the bugs?'). Based on these results, the task difference cannot be attributed to the category question narrowing the number of possible choices in Study 2.

A more likely explanation for the task differences is that children found metaphoric compounds to be more difficult than the straightforward 'looks kinda like' phrasing. Metaphoric compounds may be difficult because they violate the linguistic principle of transparency (Clark, 1981; Clark & Berman, 1984; Clark, Hecht & Mulford, 1986). The principle of transparency is a rule predicting the kinds of words that children will coin – children should construct new words with forms that mark only one meaning. Yet children may also rely on this principle, or a similar one, when interpreting novel words. If a speaker uses a word in a figurative, non-transparent way (e.g. using 'lemon' to mean 'lemon-like'), the children may have particular difficulty if they expect that words should be used literally, or at least transparently.

Furthermore, the younger children had more difficulty with the Colour stimuli than with the Shape stimuli. This finding is consistent with the literature on spontaneous metaphor production: Winner (1979) found that, of the metaphors based on perceptual grounds, 65 % were based on contour, whereas only 1 % were based on colour and 2 % were based on a combination of colour and contour. Thus, children may have an expectation that when

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words are metaphorically extended, it is on the basis of shape (cf. Baldwin, 1989; Smith, Jones & Landau, 1992). This expectation may be further enhanced by the prevalence of representational objects in their environment: children frequently encounter objects intentionally made in the shape of other things (e.g. toy animals, dolls, plastic food) and extend basic-level labels to these items with no difficulty (e.g. bear, baby, hamburger).

When children failed to select the target metaphoric item, they commonly selected the appearance match. For example, when asked to find the *stick-bug*, the children who erred most often selected the stick, rather than the other (not stick-like) bug. This finding is in keeping with Clark *et al.*'s (1985) findings: when children erred in the Clark *et al.* study, they tended to select a referent for the modifier noun, that is, the mouse alone when asked for the *mouse-hat*. Children may be influenced by the stress pattern found in compounds, in which the first (modifier) noun carries the greater stress. Because this pattern was found for both metaphoric as well as non-metaphoric compounds, no conclusions regarding children's expectations for metaphoric language can be drawn from the error data.

To summarize, Study 3 demonstrates that the developmental course for comprehension of metaphoric compounds begins before age 3 and continues at least through early childhood. By age 5 children show a fairly impressive grasp of this type of compound but are not yet performing at adult levels. However, even at age 3 children are quite capable of understanding the compound form, as evidenced by their performance on the representational items.

STUDY 4

Study 4 was designed to provide a stronger test of whether children interpret compounds as metaphoric. Downing (1977) suggested that adults may interpret the relation underlying compounds as one of comparison only as a fall-back interpretation, if no other interpretation is available. Thus, it is important to provide the children with a viable alternative that may be labelled with the compound. In this study, children were asked to select the appropriate referent from an array that included both a picture of the target element (e.g. lemon-ball) and a composite picture that included both elements of the compound (e.g. a lemon next to a ball). If children interpret the compound as metaphoric, they should select the lemon-ball. If they interpret the compound as two literal labels, they should select the lemon next to the ball.

Although adults generally do not use compounds to label objects accidentally juxtaposed or contiguously related (Downing, 1977), research suggests that children may produce compounds for objects related in these ways. For example, Clark *et al.* (1985) elicited innovative compounds from

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children and found that three-year-olds used compounds to label pictures that showed 'accidental combinations of objects in momentary juxtaposition' (p. 87) as often as they produced phrases or simple noun labels[4] for those pictures. Thus, compound labels appear to be considered legitimate labels for objects in temporary juxtaposition. As a result, selection of the appropriate target item when asked for the '*lemon-ball*' would provide evidence that children are willing to override a legitimate literal interpretation of the compound label in favour of a metaphoric one.

METHOD

Subjects

Participants included 25 three-year-olds (3;0 to 4;3, mean age 3;9) and 25 five-year-olds (4;10 to 6;1, mean age 5;6). Children were enrolled in preschool or kindergarten at the time of testing, and none had participated in any of the previous studies.

Design

The design of the study was 2 (age: 3, 5) × 2 (condition: Compound, Composite) × 3 (item type: Shape, Colour, Representational). Age and condition were between-subjects variables, and item type was a within-subject variable.

Materials

A new set of picture arrays was created from the Shape, Colour, and Representational stimuli used in Study 3. Each new array included a picture of the original target item (called the *compound picture*) and a composite created by juxtaposing the category match and the appearance match from each Study 3 set (the *composite picture*). The location of the pictures in the composite was counterbalanced, so that the appearance match appeared equally above, below, to the right, and to the left of the category match. The arrays also included two distractor items that shared no recognizable similarity with any of the other pictures. One distractor was a composite of two unrelated pictures, and the other was a complex item, most of which could be labelled with compounds. Appendix B shows the complete stimulus set.

The four pictures from each set were attached to 4 × 6 white cards; the cards were then glued to different-coloured 5 × 7 squares of construction paper, which were attached to open file-folders in a 2 × 2 array, so that all four pictures were visible to the participants. The colour of the squares behind

[4] It is important to point out, however, that children in the Clark *et al*. (1985) study, like the adults in Downing's (1977) study, produced significantly more compounds for objects that shared a more permanent relation than for those in temporary juxtaposition.

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each picture and the location of the pictures in the file folders were counterbalanced.

Procedure

Subjects were randomly assigned to one of two conditions (compound or composite) and were tested individually in a quiet corner of the classroom or in a separate quiet room. The procedure was similar to that of Study 4, with a slight wording change: children were instructed that each folder had four windows, each one a different colour. They were then asked to point to the window where they could see the condition-appropriate item (e.g. 'Which window has the *X*?'). This wording was used to encourage children to see the composite picture as one unit. Although it was possible that children would still see the pictures as separate (i.e. the composite window could contain a lemon-ball and another ball), it was predicted that this wording would lessen this tendency. In the composite condition, children were asked to point to the window where they could see the two items that formed the composite (e.g. 'Which window has the lemon and ball?'). In the compound condition, children were asked to point to the window with the compound object (e.g. 'Which window has the lemon-ball?').

RESULTS AND DISCUSSION

Each child received three scores, indicating the percentage of target items selected for each item type. Mean scores for each age, condition, and item type can be seen in Table 4.

TABLE 4. *Percentage of Compound pictures selected in Study 4. Standard deviations are in parentheses*

	Shape	Colour	Representational
Age 5			
Compound	52·92 (24·19)	57·62 (28·47)	64·08 (32·59)
Composite	10·08 (8·72)***	4·25 (7·69)***	18·17 (14·93)***
Age 3			
Compound	48·67 (19·39)	44·50 (19·37)	69·42 (23·40)*
Composite	27·38 (16·66)***	9·15 (8·82)***	36·38 (14·98)**

*** $p < 0{\cdot}001$; ** $p < 0{\cdot}01$; * $p < 0{\cdot}05$; (Chance = 50%).

A 2 (age) × 2 (condition) × 3 (item type) repeated-measures analysis of variance showed an effect of condition, $F(1, 46) = 82{\cdot}44$, $p < 0{\cdot}001$. Children in the compound condition were more likely to select the compound picture than children in the composite condition. Condition also interacted with age, $F(1, 46) = 4{\cdot}22$, $p < 0{\cdot}05$: the five-year-olds were more likely to select the condition-appropriate picture than were the three-year-olds.

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An effect of item was found, $F(2, 92) = 16{\cdot}72$, $p < 0{\cdot}001$. Across conditions, children were more likely to select the compound Representational picture than the compound Shape or Colour pictures. This is not surprising, as Study 3 demonstrated that the representational pictures were easier to identify than the others in a compound condition and spontaneous labelling data suggests that children readily think of these objects as accurately labelled with both nouns (e.g. the fish-cups are both fish and cups). An age × item interaction and accompanying simple effects analyses suggest that three-year-olds overattribute this expectation to the Shape items as well as the Representational items, $F(2, 92) = 3{\cdot}20$, $p < 0{\cdot}05$.

When children did not select the Compound item, they overwhelmingly chose the composite picture; 99% of all selections included either the compound or composite picture. Thus, children were clearly not selecting randomly but were instead selecting one of the two meaningful possibilities. A series of *t*-tests were then conducted, comparing children's selection of the compound items to 'chance' probability of 1/2 (i.e. random selection of a meaningful choice). Results indicated that children in the composite condition tended to select the composite pictures for all three item types (see Table 4). They recognised that the request for two pictures (e.g. 'lemon AND ball') required them to select the window that included both items. In the compound condition, children were as likely to select the compound picture as they were to select the composite picture, with one exception: three-year-olds selected the compound Representational picture significantly more often than chance would predict. Overall, then, children seem to have realised that the compound referred to one of the meaningful choices, but they did not know which one. In other words, the data show that neither three- nor five-year-old children were sure if a compound such as *lemon-ball* meant 'lemon and ball' or 'ball that looks like a lemon'.

Importantly, however, the differences between the compound and the composite condition demonstrate that children did not universally interpret the compound as a composite. This finding could be interpreted as demonstrating that children had a rather impressive understanding that language can be used non-literally – they were willing to interpret the compound metaphorically, even when an appropriate literal choice was available. On approximately half the trials, children heard a compound composed of two object labels but selected a compound object in which only one of the labelled objects was actually present, and they rejected a picture in which both objects were present. Thus, the children did not seem to have a general expectation that the labels were necessarily used literally or transparently. This finding is particularly important in light of Clark *et al.*'s (1985) finding that children often produce compounds for objects accidentally juxtaposed in this way. Children in the present study may have believed that both the composite and compound pictures could be adequately labelled with compounds (in one

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case metaphoric, and the other literal). If so, they may have selected one or the other of the windows on a case-by-case basis, depending on the degree to which they felt that the compound object actually looked like another object. For example, if they thought the fan-shells did not look very much like fans, they may have selected the composite picture showing the shells and fans. This would have to vary for each individual, however, because no overall item effects occurred.

Moreover, when children selected the window with the composite picture, they may not necessarily have intended that the complete composite picture was the referent of the compound. Instead, children may have selected the composite picture because they believed that one of the two elements in the composite could be labelled with the metaphoric compound. Although the task was designed to encourage children to see the composite as one picture, children frequently pointed to one of the elements in the window. For example, when asked to find the window with the lemon-ball, children often pointed directly at the lemon. This evidence is not unequivocal, as it is not clear that these children were intending to select only the lemon, but it is possible that children did recognise that a compound label referred to, as one child proclaimed, 'the one thing, instead of the two things', even if the one thing was in a window with another thing.

To summarize, both three- and five-year-olds' performance in this study indicates that children still have much to learn about interpreting metaphoric compounds. On the other hand, it is clear that they do not have a general expectation that when two nouns are used in a compound, the window should contain referents for both nouns – they selected the composite picture at better-than-chance levels only when asked for two pictures, such as 'the lemon and ball'. Children's performance in this study may be seen as a willingness to interpret language metaphorically at least some of the time, despite a viable alternative picture that could be labelled by the compound.

GENERAL DISCUSSION

Comprehension of metaphoric compounds is a skill that should be difficult for young children. To comprehend this type of utterance, a child must identify the specific metaphoric resemblance (Study 2), recognize that labels can be used in a non-transparent way (Studies 3 and 4), and know that a compound form labels one object, not two (Study 4). Certainly, this is a wealth of information for a three-year-old to know. It is all the more heartening, then, that three- and five-year-old children in these studies showed an impressive ability to comprehend many of the metaphoric compounds produced by an adult. Children of both ages were generally able to locate the appropriate item in an array that included salient distractors – referents of the elements of the compound.

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However, in these studies, colour-based metaphoric compounds were more difficult for the children to interpret than shape-based metaphoric compounds. This finding is consistent with the research on early metaphor production, as discussed previously, as well as the literature on word extension. For example, the overextension literature reveals that early object words are overextended principally due to shared shape rather than colour (Clark, 1973), although if children overextend based on pattern is not specified. Moreover, much word extension research suggests that children favour shape over colour when extending novel words (Au & Markman, 1987; Landau, Smith & Jones, 1988; Baldwin, 1989; Au, 1990; Au & Laframboise, 1990; Smith, Jones & Landau, 1992). Shape similarities may be particularly salient to children as they are learning word extensions, both conventional and metaphoric ones.

Children did not appear to have a general expectation that compounds are used only if both elements of the compound are actually present. Study 4 provides a strong test of this possibility, yet children in this study did not regularly select the window containing both a stick and a bug when asked to find the *stick-bug*, as they did when asked for the *stick AND bug*. Children as young as three years did not appear to believe that the meaning of the words was necessarily literal (cf. Vosniadou, 1987; Winner, 1988). Indeed, the three-year-olds showed an ability to comprehend metaphoric language, despite the literature suggesting that this is a later-developing skill. When a task that does not rely on explanations of metaphoric sentences is used, preschool children seem able to interpret the metaphoric intent. By age 3, then, children appear to understand simple metaphoric language based on easily accessible perceptual (primarily shape) similarities. Even more significantly, they understand the metaphoric meaning of words combined into larger lexical units. Thus, the children seem to recognize that words that are conventionally object labels can be used metaphorically to modify other nouns.

The next question to answer is what accounts for the developmental change between three and five years of age. One possibility is that children have an early expectation that language should be transparent (Clark, 1981; Clark & Berman, 1984; Clark *et al*. 1986). Metaphoric compounds are not transparent: the modifier noun is used in a way removed from its conventional meaning. Children may have an implicit assumption that speakers follow the Gricean conversational principles of Quality ('Do not say what you believe to be false') and Manner ('Avoid obscurity of expression', 'Avoid ambiguity') (Grice, 1975). In other words, they may expect a speaker to use the label *stick* only if the picture really included a stick. This assumption would be a useful strategy for word-learning, as it would help to narrow down the range of possible word meanings. Thus, *stick* should not mean 'stick-like'. Such an assumption may work in tandem with a whole-object constraint

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(Markman & Wachtel, 1988; Markman, 1989). The whole-object constraint posits that children expect novel words to refer to whole objects, rather than parts of objects. Yet this assumption may carry over to known words as well: children may expect that when an object word is used, it refers to the object conventionally labelled with that word. Again, *stick* does not usually mean 'stick-like'. This expectation may be stronger in three-year-olds than in five-year-olds and may decline as children become more familiar with figurative language. Indeed, the ability to use a label in a non-transparent way, for something not physically present, is an important sign of metaphoric competence.

Another possible explanation for the age differences found in these studies is that three-year-olds are still struggling with the distinction between appearance and reality. Much research has shown that children of this age often find it difficult to think of an object as being one thing but looking like another (Flavell, Flavell & Green, 1983; Flavell, Green & Flavell, 1987). If children have difficulty maintaining simultaneous representations of what an object is and what it looks like, then metaphoric compounds will be particularly difficult to comprehend, as the form requires the child to recognize both appearance and identity. However, a difficulty distinguishing appearance from reality does not appear to be present with the Representational objects. In each study, children were better able to locate the referent for hybrid compounds than for the metaphoric compounds. This finding is consistent with their labelling practices (Gottfried, under review): Representational objects, unlike the Shape and Colour objects, were often spontaneously labelled with compounds. The high level of detail and obvious resemblance in these objects likely accounts for this difference. This finding suggests that children in some circumstances can understand some compounds in which one noun refers to appearance and the other refers to category identity, especially when the resemblance marked by the modifier noun is very blatant.

To conclude, young children showed rather impressive abilities to understand conventional object words used in metaphoric ways. However, metaphoric compounds are only one linguistic form that contains a metaphoric comparison. Preschool children of these ages may have much more difficulty comprehending metaphoric conversions or copula metaphors of the form 'X is a Y.' Yet even so, understanding simple attributional metaphoric relations, contained within the compound form, is a significant step toward more sophisticated figurative language.

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APPENDIX A
Stimulus set for Study 1

Target items	Appearance match	Category match	Distractor
Shape items			
fan shells	fans	shells	TV
stick bug	stick	bug	lawn mower
leaf bug	leaf	bug	car
fork shovel	fork	shovel	hat
umbrella lamp	umbrella	lamp	camera
flower candles	flowers	candles	sunglasses
star shell	star	shell	purse
bird fish	bird	fish	shoe
star flower	star	flower	rooster
hand plant	hand	plant	comb
leaf frog	leaf	frog	jump rope
mitten leaf	mitten	leaf	pitcher
Colour items			
lemon ball*	lemon	ball	jar
carrot crayon*	carrot	crayon	truck
zebra shells	zebras	shells	owl
tiger caterpillar	tiger	caterpillar	bike
ladybug flower	ladybug	flower	ice cream cone
rainbow rock	rainbow	rock	book
grass button	grass	button	fire engine
Representational objects			
dog table	dog	table	glasses
fish cups	fish	cups	iron
melon candles	watermelon	candles	scooter
tree teapot	tree	teapot	vacuum
fish plate	fish	plate	scissors
butterfly mask	butterfly	mask	mailbox
Simple objects			
round clock	round ball	clock	pants
red telephone	red garbage can	phone	star
blue chair	blue shoe	chair	guitar
fuzzy toy	fuzzy rug	smooth toy	peanut butter

* Also share shape.

APPENDIX B
Stimuli used in Study 4

Compound items	Composites	Single distractor	Double distractor
Shape			
flower candles	flowers & candles	ice cream cone	scissors & jar
stick bug	stick & bug	rooster	teddy & lamp
fan shells	fans & shells	Garfield soldier	carriage & clock
mitten leaf	mitten & leaf	star ornament	elephants & hats
bird fish	bird & fish	gumball machine	shoe & iron

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star shell	star & shell	snowmen	pens & skates
hand plant	hand & plant	toy box	keys & cereal
leaf frog	leaf & frog	mailbox	plane & grapes
star flower	star & flower	dinosaur rocker	TV & umbrella
Colour			
zebra shells	zebras & shells	peanut butter	spade & juice
tiger caterpillar	tiger & caterpillar	sun mirror	lipstick & car
carrot crayon	carrot & crayon	giraffe scooter	pillow & bulb
rainbow rock	rainbow & rock	carousel horse	bike & tree
ladybug flower	ladybug & flower	lawn mower	socks & purse
lemon ball	lemon & ball	stuffed animal	chair & pants
Representational			
dog table	dog & table	fire truck	cherries & banana
butterfly mask	butterfly & mask	red ball	phone & guitar
watermelon candles	watermelon & candles	pitcher	glasses & truck
fish cups	fish & cups	train clock	shoe & trash can
tree teapot	tree & teapot	jump rope	owl & book
fish plate	fish & plate	vacuum cleaner	shoes & glasses

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