

# 3

## Meaning, Memory, and the Interpretation of Metaphors

Valerie F. Reyna  
*University of Arizona*

Recent research on reasoning has indicated that it is necessary to distinguish among alternative representations of presented information. That is, in tasks involving words or numbers, reasoners appear to represent information along a continuum that varies from verbatim precision to vague gist (Ackerman, 1992; Kreindler & Lumsden, 1994; Reyna & Brainerd, 1991, 1993). This distinction between verbatim and gist representations has been useful in explaining surprising dissociations between memory for problem information, which draws on verbatim memories, and reasoning based on gist (e.g., Fisher & Chandler, 1991; Reyna, 1995; Swanson, Cooney, & Brock, 1993).

In this chapter, I apply the verbatim-gist distinction, which is incorporated in fuzzy-trace theory, to the interpretation of metaphors. In particular, I address the question of whether interpretations of metaphors are represented as gist and whether verbatim and gist representations of metaphors display the same properties as analogous representations of other stimuli, such as numbers. I then discuss the theoretical implications of this analysis for such issues as the relationship between literal and metaphorical interpretations (e.g., Glucksberg, 1991); developmental differences in the interpretation of metaphors that describe psychological states (e.g., Reyna, 1985; Winner, Rosenstiel, & Gardner, 1976); and the indeterminacy of metaphorical meaning (e.g., Kittay, 1987).

### BACKGROUND

Before proceeding, it is important to clarify the kind of phenomenon that my discussion is intended to address. Most theorists separate metaphors from other kinds of figurative language, such as irony or sarcasm, and divide them into three types: nominal, predicative, and sentential (Reyna, 1986). The

three types differ depending on which part of speech is used metaphorically. For example, the entire sentence is used metaphorically when "*The troops are on parade*" refers to students proceeding down a hallway. Most of the research I discuss involves nominal metaphors, as in "*Juliet is the sun*," although it should be noted that there are psychological differences between nominal metaphors and other types (Reyna, 1987).

There is also a psychological difference between so-called fresh (or novel) and frozen metaphors. Although the "arm" of a chair may initially have been a novel expression, this meaning is now listed in dictionaries, along with other conventional usages. Once such metaphorical resemblances become conventional, it is unlikely that they are processed in the same way as novel metaphors. For instance, frozen interpretations are more likely to be retrieved than constructed (Reyna, 1986; see also Blasko & Connine, 1993; Martin, 1992).

Of course, metaphors are fresh or frozen by degrees, as in "*She is carved out of ice*" when used to refer to an emotionally unresponsive person. Although the interpretation of this sentence is not given explicitly in dictionaries, little construction of meaning is involved because the interpreter can rely on conventional interpretations of "icy" and "cold." In this chapter, however, I restrict my attention to metaphors at the fresh end of the continuum.

This is because I focus on similarities between reasoning generally and metaphorical interpretation, and these are more likely to be observed for metaphors that require active processing. Thus, interpreting metaphors is compared to reasoning involving literal sentences, stories, or numbers. In both instances, correct responses cannot be generated simply by retrieving stored information.

## CONSTRUCTIVISM, REALISM, AND FUZZY-TRACE THEORY

The first question, then, is whether memory for metaphors behaves in the same way as does memory for the gist of literal sentences (Kintsch, Welsch, Schmalhofer, & Zimny, 1990; Reyna & Kiernan, 1994), of stories (Kreindler & Lumsden, 1994) or of numbers (Reyna & Brainerd, 1993, 1994). In order to answer that question, it is necessary to review findings with conventional materials.

In the 1970s, the now classic experiments by Bransford and colleagues seemed to demonstrate that human memory is constructive (e.g., Bransford, Barclay, & Franks, 1972; Bransford & Franks, 1971). In those experiments, subjects were presented with ordinary sentences, such as "Three turtles sat on a floating log, and a fish swam beneath it." After a delay, a recognition test was

given containing both originally presented sentences and sentences that had not been presented but were consistent with the gist of presented sentences, such as "Three turtles sat on a floating log, and a fish swam beneath them," as well as false sentences. Subjects often could not discriminate between presented sentences and unpresented sentences that preserved the gist of presented sentences. Under some conditions, memory confidence was higher for unpresented sentences than for those that had actually been presented. Thus, researchers concluded that memory was constructed based on subjects' understanding of the meaning of presented material.

Although the roots of constructivism in memory extend back to Piaget (e.g., Piaget & Inhelder, 1973), Bartlett (1932), and beyond, the false recognition experiments of the 1970s seemed to provide an empirical foundation for earlier proposals. Some investigators, however, questioned the interpretation of these experiments (reviewed in Alba & Hasher, 1983; see also Fletcher, 1992). For example, Flagg (1976) demonstrated that misrecognition of true inferences, which had been taken to be evidence for constructive memory, could be predicted by a model involving memory for superficial aspects of presented sentences. In fact, such false recognition effects were demonstrated using nonsense syllables, suggesting that subjects' understanding of the meaning of the material had little to do with these phenomena (Reitman & Bower, 1973; Small & Butterworth, 1981).

Two views of memory emerged from this research. There was the constructivist view, which held that actual experience was integrated in memory with an individual's understanding of that experience (Glucksberg & Danks, 1975; Jarvella, 1971; Prawatt & Cancelli, 1976; Schwartz & Reisberg, 1991; Turvey, 1974). As Reyna and Kiernan (1994) discussed, if understanding shapes memory in this way, then memory for semantic content must be positively dependent on memory for presented material. In other words, although memory for presented material does not totally determine recognition of semantically consistent inferences, for example, there ought to be some dependency between them.

Other researchers, however, have suggested that memory errors are inversely related to the quality of memory for presented material—that is, that they are negatively dependent (Reyna & Kiernan, 1994). This idea is captured in, for example, Belli's (1989) notion of misinformation acceptance and Loftus, Levidow, and Duensing's (1992) principle of discrepancy detection, which states that the poorer one's memory for presented material, the more susceptible one is to suggestion (see also Reyna, 1995). Some investigators have argued that discrepancy detection applies to misrecognition of semantically consistent or schema-consistent information (see Ceci & Bruck, 1993). In this view, misrecognition of semantically consistent material, such as true inferences,

depends on the degree to which memory for actual experience has faded. I refer to this as the realist view of memory (e.g., Turvey, 1974).

A third view of memory, fuzzy-trace theory, implies that memory performance will sometimes conform to the expectations of constructivism, of realism, and of neither of these, depending on whether judgments are based on gist or verbatim memories. Consider recognition judgments of presented sentences and true inferences. If subjects were to base recognition of both old and new sentences on their memory for gist, those judgments (i.e., of presented sentences and true inferences) would be positively dependent, as predicted by constructivism. If recognition in both cases were based on verbatim memory for the original material, judgments would be negatively dependent, as realism predicts. That is, subjects would erroneously accept inferences if they did not remember the exact wording of original sentences, but reject inferences if they did remember original wording. However, if judgments of presented sentences and inferences were based on separate memory representations, verbatim in one instance and gist in the other, those judgments would be independent, which is predicted neither by constructivism nor by realism.

Predictions from both the constructivist and realist perspectives were contrasted with those of fuzzy-trace theory in Reyna and Kiernan (1994). As noted, according to fuzzy-trace theory, two kinds of memory representations of actual experience are deposited—verbatim and gist—that are independent of one another. Verbatim memory is generally less robust than gist memory—i.e., verbatim representations are more susceptible to forgetting and are acquired less efficiently by younger children (e.g., Clark & Clark, 1977; Kintsch et al., 1990; Reyna, 1995; Reyna & Kiernan, 1994). Thus, delay and development affect the accessibility of verbatim and gist representations.

Under conditions such as those typically used in sentence recognition experiments, for example, verbatim memory remains accessible and governs recognition of presented sentences. However, systematic misrecognition of new semantically consistent sentences (e.g., true inferences) cannot be based on verbatim memory for the simple reason that these sentences were never presented. Subjects sometimes say “yes” to semantically consistent sentences, however, because they cue memory for the gist of what was presented (e.g., Ackerman, 1992). Thus, according to fuzzy-trace theory, under these conditions, recognition of old sentences and misrecognition of new semantically consistent sentences should be independent.

Reyna and Kiernan’s (1994) results confirmed the prediction that recognition of old sentences and misrecognition of new semantically consistent sentences were independent. (For a review of similar findings of independence in problem solving, see Reyna, 1992.) They also showed that this relation could be manipulated experimentally by varying whether judgments were based on verbatim memory, as opposed to gist. For example, merely instructing

subjects to base all judgments on gist converted the relation between the same presented sentences and true inferences to positive dependency. Delaying the memory test until verbatim memory was no longer accessible had a similar effect. In addition, younger children, who were less likely to acquire an accurate verbatim representation, were also more likely than older children to display positive dependency. Finally, regardless of age, delay, or instructions, certain stimuli seemed to invite gist-based (as opposed to verbatim) memory judgments. Although the nature of the stimulus effect is not clear, it could be speculated that materials that elicit integrative imagery (e.g., sentences describing spatial relationships) would be more likely to elicit gist-based judgments, whereas materials whose impact depends on an exact turn of phrase (e.g., jokes that rely on puns) would be more likely to elicit verbatim-based judgments. If these findings for literal sentences regarding age, delay, and instructions were applied to judgments about stimuli such as metaphors, what might one expect to find?

### MEMORY FOR METAPHORS

As noted, Reyna and Kiernan (1994) compared memory for presented literal sentences to memory for their gist. A similar approach was used by Lim (1993) and by Reyna and Kiernan (1995) to study memory for metaphors and their interpretations. [Lim (1993) studied adults and Reyna and Kiernan (1995) studied six- and nine-year-olds, but their materials and procedures were otherwise essentially identical.] In the metaphor studies, subjects received eight vignettes (see Table 3.1), such as:

The woman was shopping in the grocery store.  
The woman saw the lost boy near the door.  
The woman was an aspirin, kneeling by the lost boy.

Following presentation of each vignette, subjects were given a recognition test. On the recognition test, sentences were tested one at a time (in a different random order for each subject), including the three target sentences as well as various true and false lures. Subjects were given the same recognition test again after a delay (of seven days for the children and twelve days for the adults). As in Reyna and Kiernan (1994), one group of subjects was given verbatim memory tests; they were told to accept only presented sentences. The other group was instructed to accept all sentences that were consistent with the meaning of presented sentences. For both instruction groups, recognition tests contained the same sentences. Judgments of presented metaphors were compared to those of various metaphorical interpretations, and to false sentences.

Table 3.1  
Presented Metaphors and Alternative Interpretations

<i>Presented Metaphors</i>
The woman was an aspirin, kneeling by the lost boy.
Tom was a vacuum cleaner, listening to the story.
Kathy was a camera, watching the children in the show.
Mr. Jones was a bulldozer, meeting with the workers.
The coach was a volcano, talking to the team.
John was a pingpong ball, chatting with the guests.
The mother was a thunderstorm, speaking to the girl.
The babysitter was a cup of cocoa, staying with the kids.
<i>Alternative Interpretations</i>
Literal—Perceptual—Psychological [Gist]
was medicine—was round—made him feel better [eased discomfort]
was a machine that sucked things up—was noisy—paid attention [took in]
took pictures—was small—remembered everything [recorded]
was a dirtmover—had big muscles—was bossy [pushed]
was a fiery mountain—was hot and sweaty—was mad [was intense]
was a bouncing ball—moved around—was friendly [was in motion/made contact]
was a big rainshower—was yelling—was angry [let loose on]
was hot chocolate—was warm—was nice [comforted]

*Note.* Interpretations are abbreviated here; subjects were tested using full sentences that were similar in form to presented metaphors. The first four psychological interpretations were classified as "Literal" (i.e., linked to literal functions) and the second four were classified as "Perceptual" (i.e., linked to perceptual features).

The main purpose of the verbatim memory test was to assess the degree to which subjects could discriminate between presented metaphors and various potential gists, namely different metaphorical interpretations. These included sentences incorporating literal synonyms, perceptual interpretations, and psychological interpretations of presented metaphors (e.g., Winner et al., 1976; see Table 3.1). For example, in the previous vignette, the woman kneeling by the lost boy is described metaphorically as "*an aspirin*." The literal synonym described the woman as "medicine"; the perceptual interpretation referred to her as "round"; and the psychological interpretation indicated that she made the boy feel better. Corresponding false stimuli were related either to the metaphorical term (e.g., "*cough syrup*"), or to the literal

synonym (e.g., "nurse"), or they were erroneous perceptual features (e.g., "red cheeks"), or psychological interpretations of the same positive or negative valence as the appropriate psychological interpretation, though they were false (e.g., "proud"), respectively.

According to most accounts, only the true psychological interpretation represents an apt interpretation of the metaphor. All of the true interpretations, however, are semantically related to the metaphor. Therefore, the interesting empirical question regarding verbatim memory tests is whether subjects misrecognize any of these interpretations—literal or metaphorical—as having been presented, as they do for true inferences and other kinds of gist.

In particular, as discussed, theories of memory predict either positive dependency among all sentences that are consistent with gist (i.e., true sentences) or negative dependency between presented sentences and lures. It might be argued, however, that theories of metaphor predict specific relations among subsets of lures. For example, if children initially interpret psychological metaphors perceptually, but ultimately reject such interpretations in favor of psychological ones, one might expect a negative dependency between acceptance of true perceptual interpretations and acceptance of true psychological interpretations (see Reyna & Kiernan, 1995; Winner, 1988).

It might also be argued that metaphors have a special verbatim advantage over other kinds of verbal material. Exact wording or surface form may be especially vivid or it may play a special role in conveying the meaning of figurative expressions. For example, "*Juliet is a yellow star at the center of our solar system*" is metaphorical, and the reference to our sun is the same as in the well-known metaphor. The rhetorical effect of the yellow-star wording, however, is not the same as that of the original wording. For this reason, one might expect that there should be better verbatim memory for metaphors, as opposed to literal language.

In addition to examining the level of verbatim memory for metaphors, I consider how judgments of the various recognition stimuli are related to one another, and whether age, delay, and instructions affect results for these stimuli much like they affected results for other kinds of verbal materials (e.g., Reyna & Kiernan, 1994). I discuss results for children, followed by those for adults.

Level of verbatim memory can be assessed by comparing acceptance rates for presented sentences to those for semantically consistent, but unrepresented, sentences. Such differences (or lack thereof) in acceptance rates between presented and true unrepresented sentences led earlier investigators to argue that verbatim memory became inaccessible soon after presentation. More recently, investigators have found that clarifying instructions, for example, by including examples of the kinds of true sentences that should be rejected, produced much higher rates of verbatim discrimination for literal sentences (Reyna & Kiernan, 1994).

In order to assess verbatim discrimination for metaphorical sentences, Reyna and Kiernan (1995) compared children's acceptance rates for presented metaphors to acceptance rates for true interpretations. They found that children's verbatim memory for metaphors was excellent on the immediate test, although there was some elevation in recognition errors for literal synonyms. Note that literal synonyms cannot be rejected by a general rule that eliminates any nonfigurative sentence. Over the delay, however, misrecognition of true psychological interpretations increased significantly, as did misrecognition of true perceptual interpretations, although the increase was larger for the psychological interpretations. Although the level of discrimination between presented sentences and gist sentences was higher in this experiment with metaphors than in earlier experiments with literal sentences, there was, nevertheless, a tendency to misrecognize sentences that were semantically related to presented sentences (gist), especially after a delay.

Also consistent with earlier findings, recognition judgments for presented sentences were independent of judgments of semantically related sentences. As in Reyna and Kiernan (1994), however, judgments of sentences that expressed the gist of presented sentences were sometimes dependent on each other. For example, judgments of psychological interpretations were positively related to judgments of literal interpretations and to judgments of perceptual interpretations. Overall, positive dependencies were more likely to be observed among younger children than among older ones.

Results from the instruction condition that stressed meaning bolstered the conclusion that children's misrecognitions in the verbatim task were based on their representations of the gist of the metaphors. When asked to judge meaning, children affirmed true psychological interpretations more often than any other type, including true perceptual interpretations. Although the relative popularity of these two types of interpretations was the same for older and younger children, there was a smaller difference between true and false perceptual and psychological interpretations for the younger children. In other words, both age groups favored psychological and, to a lesser degree, perceptual interpretations, but younger children seemed less able to discriminate true from false interpretations.

Lim (1993) found that adults also have excellent memory for the surface form of metaphors. Indeed, verbatim discrimination was better among adults than among children, consistent with developmental differences for literal sentences (Reyna & Kiernan, 1994). On the immediate recognition test, adults were able to differentiate metaphors from all other sentences, true or false. After a delay, misrecognition of sentences with literal synonyms rose, and true sentences generally were affirmed more often than false ones (once the effects of acquisition were partialled out). These differences were quite small, however. Recognition performance for adults remained at a high level even

after 12 days, resembling recognition performance for children tested immediately.

The pattern of dependencies with presented sentences differed from those found with children. Judgments of true interpretations tended to be negatively dependent on judgments of the presented metaphor (whereas these had been independent for children). On the other hand, the relationships among judgments of unpresented true sentences were similar to those found for children. Judgments of different true interpretations were generally positively dependent on one another (for details, see Lim, 1993).

As in the experiments with children, adults in the meaning condition favored the true psychological interpretations over other types. True perceptual interpretations, however, were affirmed at a relatively high rate, 40%, roughly comparable to the rate for children, 47%. (False perceptual interpretations were accepted only 8% of the time). Consistent with previous results with children and previous results with literal sentences, dependencies among true sentences (including presented metaphors) were generally positive in the meaning condition.

In summary, responses to metaphors and their interpretations generally resembled responses to literal sentences and their semantically related sentences, with some interesting exceptions. Under verbatim recognition conditions, the "gist" of metaphors—their true interpretations—were misrecognized more often than false interpretations. However, adults were less prone than children to misrecognize metaphorical gist, and such gist was less subject to misrecognition by all age groups, compared to the gist of literal sentences. Also under verbatim conditions, children independently recognized presented metaphors and their interpretations, but this relationship tended to be negative for adults. As in the case of literal gist, judgments of unpresented true interpretations were usually positively dependent.

Under meaning instructions, all judgments tended to be positively dependent. Children and adults favored the psychological interpretations of metaphors, but the ability to discriminate true from false interpretations steadily increased with age. Although perceptual interpretations were not the most widely accepted interpretations for any age group, they were affirmed at a surprisingly high rate, even among adults.

### INTERPRETING MEMORY DATA FOR LITERAL VERSUS METAPHORICAL SENTENCES

The explanation offered by Reyna and Kiernan (1994) for their independence findings (i.e., that judgments of old sentences and new semantically consistent

sentences were independent) can be applied straightforwardly to children's verbatim memory for metaphors. That is, metaphors themselves cue verbatim memory, but their interpretations cue memory for gist. This explanation is further supported by the finding that the independence relationship could be manipulated by varying instructions to base judgments on gist, as opposed to verbatim memory. Instructing children to base all judgments on gist converted independence to positive dependency for the same presented sentences and true interpretations. For adults, negative dependency was converted to positive dependency. The result that judgments of different true interpretations were positively dependent, regardless of instructions, is also consistent with the claim that these interpretations cue memory for gist.

Delaying the recognition test until verbatim memory was no longer accessible increased misrecognition of true interpretations. Such misrecognition also varied with age. Younger children were less likely than older children, and older children were less likely than adults, to discriminate between verbatim metaphors and true interpretations. This developmental trend supports the conclusion from earlier research that younger children are less able to acquire accurate verbatim representations. Although younger children were slightly more likely than older children to display positive dependency, and delay was slightly more likely to elicit positive dependency, these effects were smaller than previously observed with literal sentences (Reyna & Kiernan, 1994).

As suggested by previous research, certain stimuli seem to influence whether memory judgments are based on verbatim or gist representations. In particular, metaphors appear to encourage verbatim verification, although this factor is modulated by age, delay, and instructions (verbatim or gist). As some commentators have speculated, the exact wording of metaphors remained accessible for longer periods of time, compared to literal sentences. Adults, and even children, were easily able to discriminate presented metaphors from equally metaphorical sentences containing literal synonyms, as in "*The woman was medicine, kneeling by the lost boy,*" or the false metaphorical sentence "*The woman was cough syrup, kneeling by the lost boy.*" Discrimination in these cases may have been aided by subtle nuances of meaning, as well as by differences in surface form. The literal so-called synonym, "medicine," does not, in fact, encompass exactly the same subtleties of meaning as the metaphor, "*The woman was an aspirin, kneeling by the lost boy.*"

This effect of materials also explains the main deviation from previous research, namely the finding of negative dependencies between presented sentences and true interpretations for adults (under verbatim instructions). Such negative dependencies would be expected if verbatim memory were so accessible that it would be retrieved even with gist as a cue. Thus, the idea is that true interpretations were rejected at such a high level because those

rejections were based on accessing verbatim memory, resulting in a "mismatch" judgment. If true interpretations were rejected based on verbatim memories, but the presented metaphors were accepted based on those same verbatim memories, this would lead to the observed relationship of negative dependency.

Because the prediction of negative dependency turns on the accessibility of verbatim memory, it makes sense that negative dependency was not observed for children judging metaphors and related sentences, nor for children or adults judging literal sentences. The level of verbatim discrimination of metaphors was lower for children than for adults; for instance, children displayed some tendency to misrecognize true interpretations on immediate tests, whereas adults showed no such increase in misrecognitions on immediate tests. Children's *acceptance* of true interpretations could not be based on verbatim memory, contrary to the conditions stipulated for negative dependency. Similarly, for both children and adults, verbatim discrimination of literal sentences was lower than that for metaphors and related sentences. Again, acceptance of true unrepresented sentences could not be based on verbatim memory, violating conditions for negative dependency.

Apparently, although adults were able to access verbatim memory for metaphors, and therefore could reject interpretations consistent with gist, access to verbatim memory for literal sentences depended on the nature of the cue. When verbatim discrimination was at a lower level, as it was for literal sentences, presented sentences were still able to cue verbatim memories, but unrepresented true sentences cued gist memories. Thus, although negative dependency was associated with high levels of verbatim memory, independence was associated with lower levels of verbatim memory at which judgments depended on cues (Reyna, 1995).

### IMPLICATIONS FOR THE RELATION BETWEEN LITERAL AND METAPHORICAL MEANING

Traditional theories of the interpretation of figurative language suggest that literal meaning is processed first, and then rejected in favor of a figurative interpretation (Clark & Clark, 1977). A number of studies have called this serial model into question (e.g., Glucksberg, 1991; Ortony, Schallert, Reynolds, & Antos, 1978). It seems as though interpreters can simultaneously process both literal and figurative meanings, especially given sufficient supporting context. (For problems regarding the role of context in supplying the meaning of metaphors, however, see Reyna, 1986). However, this leaves open the question of how interpreters construct novel metaphorical meaning, in particular, how elements of literal meaning are incorporated or integrated into

metaphorical interpretations, and how theorists ought to distinguish literal from metaphorical meaning.

Lim's (1993) results suggest that alternative aspects of meaning, including literal, perceptual, and abstract psychological features, do not necessarily operate in opposition to one another, as traditional approaches imply. Forced-choice tasks—that is, pick the “correct” interpretation—assume the mutual exclusivity of alternative interpretations. On the other hand, if subjects are permitted to make separate yes-no judgments for each alternative, they can indicate acceptance of more than one interpretation. Using such yes-no judgments, Lim (1993) found that, although virtually all adults accepted the psychological interpretations of the metaphors, they also sometimes accepted other kinds of interpretations.

Moreover, when subjects were asked to judge meaning, judgments of different interpretations were not negatively dependent on one another. In other words, subjects who accepted a psychological interpretation of a metaphor were not less likely to accept a perceptual interpretation or a literal-synonym sentence. On the contrary, they were more likely to accept such sentences (i.e., they were positively dependent). Not surprisingly, under instructions to process meaning, subjects often interpreted literal-synonym sentences metaphorically. For example, the sentence “*The woman was medicine, kneeling by the lost boy*” could be interpreted as the woman making the boy feel better, that is, the psychological interpretation.

Lim (1993) noted further that for some metaphors, literal-synonym sentences and psychological interpretations seemed to be linked, as in the “*medicine*” example, but for other metaphors, the perceptual and psychological interpretations were linked, as when a man was described as a ping-pong ball at a party, which could be interpreted perceptually as movement and mingling or psychologically as gregariousness. Lim (1993) divided the metaphors into two such categories, based on ratings from an independent group of subjects blind to the hypothesis. (Subjects rated the degree to which perceptual and literal meanings overlapped.) She found that dependencies among interpretations within each category conformed to her expectations about links between either literal and psychological or perceptual and psychological interpretations (see Table 3.1).

Specifically, Lim analyzed dependencies separately for the two categories of metaphors, referred to as Literal and Perceptual (depending on whether the psychological interpretations were linked to literal or perceptual interpretations, respectively). She found that judgments of literal-synonym sentences and perceptual interpretations were independent of each other for both categories of metaphors. Also for both categories, judgments of the metaphor's meaning and of the psychological interpretation were positively dependent. For the Literal category, however, judgments of the metaphor's

meaning were positively associated with judgments of the literal-synonym sentence, but were independent of the perceptual interpretation. (The opposite was true for the Perceptual metaphors.) Also for the Literal type, literal and psychological interpretations were positively dependent, but perceptual and psychological interpretations were independent. This category included the "aspirin" example.

For the Perceptual category, which included the "ping-pong ball" metaphor, judgments of the metaphor and of the perceptual interpretation were positively dependent, but the metaphor and the literal sentence were independent. Unlike the Literal category, perceptual and psychological interpretations were positively dependent. Partial correlational analyses further confirmed that literal and psychological interpretations were linked for Literal metaphors and perceptual and psychological interpretations were linked for Perceptual metaphors.

Clearly, Lim's (1993) data demonstrated that alternative metaphorical interpretations are not mutually exclusive. These data also indicated that perceptual interpretations are processed by adults, especially for certain metaphors. Developmental theories that posit strict stagelike progress from perceptual to psychological interpretations are not supported by these data. Perceptual interpretations, however, do not constitute the most preferred interpretations in any case. Even for Perceptual metaphors, true psychological interpretations were favored.

Although Lim's data do not suggest that subjects pass through an initial literal stage of interpretation, aspects of literal meaning, both functional and perceptual, appear to afford a bridge to novel metaphorical meaning. For the "aspirin" metaphor, the literal function of an aspirin, to ease physical discomfort, provides a link to the interpretation that the woman eased the boy's psychological discomfort. For the "ping-pong ball" metaphor, the perceptual feature of movement provides a link to social interaction. Although these links can be appreciated intuitively, they raise fundamental questions about the distinction between literal and metaphorical meaning. That is, is the literal feature, for example, "to ease discomfort," transferred to (and perhaps integrated with) the metaphorical topic, in this case, the woman? Or, is the meaning of "to ease discomfort" different for aspirins and women, the first meaning being to quell pain literally and the second to do so only metaphorically?

## THE INDETERMINANCY OF METAPHORICAL MEANING

As discussed in the preceding section, Lim's (1993) analysis of metaphor types pointed out certain connections between functional and perceptual aspects of literal meaning and the interpretation of metaphors. Rather than reject these aspects of literal meaning—for example, to ease discomfort or to move about—subjects often judged them to be consistent with metaphorical interpretations, and the degree to which they were accepted was positively associated with acceptance of metaphorical interpretations. As I suggested, the status of such intermediate functional and perceptual features is unclear.

There are, basically, two answers to the status question. First, these functional and perceptual properties could be classified as literal features. In that case, easing discomfort would be seen as literally alleviating physical pain and moving about would be seen as literally bouncing back and forth. The problem for this approach, however, is to explain the empirical and intuitive connections to the metaphorical interpretations. In short, if the features are indeed literal, then they do not explain the metaphorical interpretation; the woman is not alleviating the boy's physical pain (subjects rejected the literal interpretation that she is a nurse) and the party goer is not really bouncing back and forth. Thus, this approach does not address what Ortony (1979) has called the "attribute inequality" problem, which is that "shared" attributes (e.g., easing discomfort) do not mean the same thing when they are applied literally versus metaphorically.

Another approach to this problem, one that does explain metaphorical interpretation, is to assume that, at some point during interpretation, literal features are processed at a generic level (Reyna, 1981, 1987). The functional and perceptual aspects of literal meaning that are linked to metaphorical meaning are interpreted in a broader or more general sense. Depending on the level of communicative precision that is required, these generic senses are re-instantiated in the metaphorical context to arrive at a specific interpretation. Informally, I am claiming that the literal property of aspirins, to alleviate pain, is interpreted in a broader or more vague way, and then applied to the scenario of a woman kneeling by a lost boy. The ultimate metaphorical interpretation, then, is a product of the generic sense of "to alleviate pain" coupled with a plausible re-interpretation of that generic sense in light of the specific scenario (see also Kittay, 1987).

In particular, I argue that interpreters process the gist of literal meaning in order to arrive at metaphorical interpretations. That gist is then episodically re-instantiated so that it coheres with the context at hand (e.g., Reyna & Brainerd, 1990, 1991). This analysis is similar to that offered by

fuzzy-trace theory for reasoning and problem solving. For example, in transitive inference, reasoners might be presented with rods that vary imperceptibly in length. As each pair of rods is introduced (e.g., "The orange rod is longer than the blue rod"; "The blue rod is longer than the red rod," etc.), reasoners recognize the gist of a linear ordering, that as the rods are placed down in order that they decrease in length from left to right. When reasoners are then asked an inference question, such as whether the orange rod is longer than the red rod, they episodically instantiate the question by searching for the orange and red rods in the array, and identifying which rod is to the left. The answer to the inference question is based on memory for the gist that the rods decrease in length, rather than detailed memory for the absolute positions of different rods.

The experimental evidence that I have reviewed regarding the representation of metaphorical meaning suggests that such constructs as gist and verbatim memory can be interpreted in similar ways across different tasks.

This evidence indicates that gist and verbatim representations are stored in tasks involving metaphors, so that gist is available during processing to act as a bridge between literal and metaphorical meaning. However, this evidence does not confirm the specific account of metaphorical interpretation that I have discussed. The drawing of parallels between ordinary reasoning and metaphorical interpretation also raises additional questions.

For example, if gist acts as a bridge in metaphorical interpretation, how does this differ from its role in literal interpretation? I would suggest that the difference is one of degree. Indeterminacy characterizes both literal and metaphorical meaning (e.g., Lehrer, 1992). The literal interpretation of words, for example, can be narrowed or broadened in context (e.g., Reyna, 1987). Theorists have proposed a number of ways of representing this vagueness of meaning, including fuzzy logic (e.g., Oden, 1984), assigning weights to semantic components (Lehrer, 1970), prototype theories of core meaning, and so on. Generally, a number of theorists now argue that literal meaning is generic, but that pragmatic principles allow the specification of the meaning of a word in a particular context (Lehrer, 1992). For example, the verb "to peel" is specified somewhat differently depending on whether the object to be peeled is an apple or a banana, and the difference is based on knowledge of the properties of apples and bananas (Reyna, 1987).

Of course, this approach to literal meaning resembles the one I have taken to metaphorical interpretation. The difference, however, is that the gist of semantic features must be interpreted more broadly in metaphorical interpretation. Because metaphorical comparisons traverse different categories, in a specific sense, literal attributes are not the same when they are applied metaphorically (Glucksberg, 1991). Because the woman is really not an aspirin, the features of an aspirin must be viewed in a more abstract way in

order to apply them to women. (In contrast, literal usage would exploit more specific aspects of conventional meaning.) Evidence for this view is provided by response-time data, which show that time to interpret novel metaphors increases as the literal and metaphorical categories become more disparate (Reyna, 1981, 1987).

This analysis implies that there is a continuum that varies from literal to metaphorical interpretation, depending on how much the interpreter must stretch the meaning of semantic features. Such an account explains the fact that it is sometimes difficult to judge whether an interpretation is an extended literal sense of a word, or a metaphorical interpretation. It also explains how literal and metaphorical interpretation could proceed in parallel so that their effects converge, rather than disrupt one another (Keysar, 1989). The rationale for this convergence would be that similar pragmatic principles support both literal and metaphorical interpretation.

These pragmatic principles might exploit conventional aspects of denotation, as well as connotation, relationships with related words, and knowledge of the situation and the world. For instance, the metaphor "*Their eyes locked*" could be interpreted positively (e.g., they looked lovingly into each others eyes) or negatively (e.g., they stared each other down). Appropriate interpretation of the metaphor requires pragmatic knowledge about what kind of situations imply each type of interpretation. Similar indeterminacy would apply, however, to the literal sentence "They stared at each other," which could likewise be interpreted as either a positive or negative gesture, depending on the situation. Thus, the meaning of "peel" in a sentence such as "*She peeled off her clothes,*" though metaphorical, is not sharply different from its meaning in "He peeled a banana" (the literal meaning of "peel" being to remove an outer covering), and substantial variation in that core meaning is observed across its literal interpretations (Miller, 1979; Reyna, 1981).

## SUMMARY

Children and adults were administered verbatim and gist recognition tests for metaphors and their interpretations (Lim, 1993; Reyna & Kiernan, 1995). In order to determine whether these special verbal materials exhibited properties like those observed for literal language, recognition performance and dependencies between judgments for different sentences were evaluated. Specifically, subjects judged presented metaphors as well as sentences incorporating literal synonyms, perceptual interpretations, and abstract psychological interpretations. Results indicated that subjects represented verbatim metaphors in memory and their gist, and these representations were independent of one another, contrary to constructive theories of memory. In

this respect, and in many others, memory for metaphors resembled that for literal sentences (Reyna & Kiernan, 1994).

Memory for metaphors did exhibit certain unique properties, however.

Adults were able to recognize the exact wording of metaphors, and to reject highly similar distractors, even after a delay of 12 days. This level of performance distinguishes memory for metaphors from memory for literal sentences. Children's performance was nearly as good. In adults, verbatim memory was sufficiently accessible that it appeared to be used both to accept presented targets and to reject semantically related distractors (i.e., gist), producing negative dependency between judgments of these stimuli. When another group of subjects judged the same sentences for their consistency with meaning, positive dependency was observed. Thus, alternative interpretations—literal, perceptual, and psychological—were not mutually exclusive. Instead, functional and perceptual aspects of literal meaning appeared to serve as a bridge to abstract metaphorical interpretations. An implication of these findings is that interpreters use the gist of literal meaning in order to interpret metaphors, a proposal that addresses the "attribute inequality" problem.

## REFERENCES

- Ackerman, B. P. (1992). The sources of children's source errors in judging causal inferences. *Journal of Experimental Child Psychology*, *54*, 90-119.
- Alba, J., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin*, *93*, 203-231.
- Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge, England: Cambridge University Press.
- Belli, R.F. (1989). Influences of misleading postevent information: Misinformation interference and acceptance. *Journal of Experimental Psychology: General*, *118*, 72-85.
- Blasko, D. G., & Connine, C. M. (1993). Effects of familiarity and aptness on metaphor processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *19*, 295-308.
- Bransford, J. D., Barclay, J. R., & Franks, J. J. (1972). Sentence memory: A constructive versus interpretative approach. *Cognitive Psychology*, *3*, 193-209.
- Bransford, J. D., & Franks, J. J. (1971). The abstraction of linguistic ideas. *Cognitive Psychology*, *2*, 331-380.
- Ceci, S. J., & Bruck, M. (1993). Suggestibility of the child witness: A historical review and synthesis. *Psychological Bulletin*, *113*, 403-439.
- Clark, H. H., & Clark, E. V. (1977). *Psychology and language*. New York: Harcourt Brace Jovanovich.
- Fisher, R. P., & Chandler, C. C. (1991). Independence between recalling interevent relations and specific events. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *17*, 722-733.
- Flagg, P. W. (1976). Semantic integration in sentence memory? *Journal of Verbal Learning and Verbal Behavior*, *15*, 491-504.
- Fletcher, C. R. (1992). Assessing recognition memory for surface forms in discourse: A methodological note. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *18*, 199-203.
- Glucksberg, S. (1991). Beyond literal meanings: The psychology of allusions. *Psychological Science*, *2*, 146-152.

- Glucksberg, S., & Danks, J. (1975). *Experimental psycholinguistics: An introduction*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Jarvella, R. J. (1971). Syntactic processing of connected speech. *Journal of Verbal Learning and Verbal Behavior*, 10, 409-416.
- Keysar, B. (1989). On the functional equivalence of literal and metaphorical interpretations in discourse. *Journal of Memory and Language*, 28, 375-385.
- Kintsch, W., Welsch, D., Schmalhofer, F., & Zimny, S. (1990). Sentence memory: A theoretical analysis. *Journal of Memory and Language*, 29, 133-159.
- Kittay, E. F. (1987). *Metaphor: Its cognitive force and linguistic structure*. Oxford, England: Clarendon Press.
- Kreindler, D., & Lumsden, C. (1994). Extracting a narrative's causal gist: A modeling study based on fuzzy-trace theory. *Journal of Experimental Child Psychology*, 58, 227-251.
- Lehrer, A. (1970). Indeterminacy in semantic description. *Glossa*, 4, 87-110.
- Lehrer, A. (1992). A theory of vocabulary structure: Retrospectives and prospectives. In M. Putz (Ed.), *Thirty years of linguistic evolution* (pp. 243-256). Philadelphia: John Benjamins Publishing.
- Lim, P. (1993). *Meaning versus verbatim memory in language processing: Deriving inferential, morphological, and metaphorical gist*. Unpublished doctoral dissertation, University of Arizona.
- Loftus, E. F., Levidow, B., Duensing, S. (1992). Who remembers best? Individual differences in memory for events that occurred in a science museum. *Applied Cognitive Psychology*, 6, 93-107.
- Martin, J. H. (1992). Computer understanding of conventional metaphorical language. *Cognitive Science*, 16, 233-270.
- Miller, G. A. (1979). *Language and speech*. San Francisco: Freeman.
- Oden, G. C. (1984). Integration of fuzzy linguistic information in language comprehension. *Fuzzy Sets and Systems*, 14, 29-41.
- Ortony, A. (1979). Beyond literal similarity. *Psychological Review*, 86, 161-180.
- Ortony, A., Schallert, D. L., Reynolds, R. E., & Antos, S. J. (1978). Interpreting metaphors and idioms: Some effects of context on comprehension. *Journal of Verbal Learning and Verbal Behavior*, 17, 465-477.
- Piaget, J., & Inhelder, B. (1973). *Memory and intelligence*. New York: Basic Books.
- Prawatt, R. S., & Cancelli, A. (1976). Constructive memory in conserving and nonconserving first graders. *Developmental Psychology*, 12, 47-50.
- Reitman, J. S., & Bower, G. H. (1973). Storage and later recognition of exemplars of concepts. *Cognitive Psychology*, 4, 194-206.
- Reyna, V. F. (1981). The animated word: Modification of meaning by context. *Dissertation Abstracts International*, 42, 3852B [Ann Arbor, MI: 82-03153].
- Reyna, V. F. (1985). Figure and fantasy in children's language. In M. Pressley & C. Brainerd (Eds.), *Cognitive learning and memory in children: Progress in cognitive development research* (pp. 143-179). New York: Springer-Verlag.
- Reyna, V. F. (1986). Metaphor and associated phenomena: Specifying the boundaries of psychological inquiry. *Metaphor and Symbolic Activity*, 4, 271-290.
- Reyna, V. F. (1987). Understanding verbs: Easy extension, hard comprehension. In A. Ellis (Ed.), *Progress in the psychology of language* (Vol. 3, pp. 301-315). London: Lawrence Erlbaum Associates, Ltd.
- Reyna, V. F. (1992). Reasoning, remembering, and their relationship: Social, cognitive, and developmental issues. In M. L. Howe, C. J. Brainerd, & V. F. Reyna (Eds.), *Development of long-term retention* (pp. 103-127). New York: Springer-Verlag.
- Reyna, V. F. (1995). Interference effects in memory and reasoning: A fuzzy-trace theory analysis. In F. N. Dempster & C. J. Brainerd (Eds.), *Interference and inhibition in cognition* (pp. 29-59). San Diego, CA: Academic Press.
- Reyna, V. F., & Brainerd, C. J. (1990). Fuzzy processing in transitivity development. *Annals of Operations Research*, 23, 37-63.

- Reyna, V. F., & Brainerd, C. J. (1991). Fuzzy-trace theory and children's acquisition of mathematical and scientific concepts. *Learning and Individual Differences, 3*, 27-59.
- Reyna, V. F., & Brainerd, C. J. (1993). Fuzzy memory and mathematics in the classroom. In R. Logie & G. Davies (Eds.), *Everyday memory* (pp. 91-119). Amsterdam: North Holland.
- Reyna, V. F., & Brainerd, C. J. (1994). The origins of probability judgment: A review of data and theories. In G. Wright & P. Ayton (Eds.), *Subjective probability* (pp. 239-272). New York: Wiley.
- Reyna, V. F., & Kiernan, B. (1994). The development of gist versus verbatim memory in sentence recognition: Effects of lexical familiarity, semantic content, encoding instructions, and retention interval. *Developmental Psychology, 30*, 178-191.
- Reyna, V. F., & Kiernan, B. (1995). Children's memory and metaphorical interpretation. *Metaphor and Symbolic Activity, 10*, 309-331.
- Schwartz, B., & Reisberg, D. (1991). *Learning and memory*. New York: Norton.
- Small, M. Y., & Butterworth, J. (1981). Semantic integration and the development of memory for logical inferences. *Child Development, 52*, 732-735.
- Swanson, H. L., Cooney, J. B., & Brock, S. (1993). The influence of working memory and classification ability on children's word problem solution. *Journal of Experimental Child Psychology, 55*, 374-395.
- Turvey, M. T. (1974). Constructive theory, perceptual systems, and tacit knowledge. In W. B. Weimer & D. S. Palermo (Eds.), *Cognition and the symbolic processes* (pp. 165-180). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Winner, E. (1988). *The point of words*. Cambridge, MA: Harvard University Press.
- Winner, E., Rosenstiel, A., & Gardner, H. (1976). The development of metaphoric understanding. *Developmental Psychology, 12*, 289-297.