
The Development of Metaphoric Understanding: Implications for a Theory of Creativity

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The ability to comprehend and use metaphor has been argued to be the kernel of creative thought. The development of this ability was assessed in 40 children 4 years of age and 40 children 6 years of age who were individually presented with a match-to-sample metaphor comprehension task comprising six different types of metaphorical relations in both pictures and words (color, shape, physiognomic, cross-modal, psychological-physical, and taxonomic matches). Two hypotheses were tested: (a) that metaphoric comprehension develops from a reliance on biologically constrained categories to a dependence on more socially constructed ones and (b) that pictures would aid the comprehension of metaphor over words in the younger groups. Overall, younger children did significantly better in the pictorial medium, suggesting a picture superiority effect for more perceptible metaphorical relations (perceptual, physiognomic), whereas older children showed a word superiority effect for more conceptual metaphors (psychological-physical, taxonomic). The implications for a theory of creativity were discussed.

The nature of creativity is vastly complex because it goes to the heart of what is uniquely human. It differentiates the higher achievements of humans from the often simple stimulus-response learning of infrahuman species. Although it has had a modest but cumulative tradition in scientific research (Feldman, Csikszentmihalyi, & Gardner, 1994; Gardner, 1988), one could argue that our knowledge of what psychological processes underlie creative achievement is still in a rudimentary stage of development. Although one can study creativity at a number of different levels (Gardner, 1986, 1993), the present study approaches it at the level of the individual—at the cognitive level. In doing so, other intraindividual and interindividual components, such as genes, personality, motivation, and culture, are temporarily ignored in order to draw manageable re-

search hypotheses. Certainly, genetic and neurobiological substrates support and social enclaves contribute to the efflorescence of creative behavior.

The study of metaphor was chosen because it has been argued to form the kernel of creative thought (Ricoeur, 1978, 1981). *Metaphorical thought* was defined, for the purposes of this study, as the ability to link disparate perceptual, affective, and conceptual domains. Whereas a traditional divergent thinking task taps the breadth of a child's real-world categories (Guilford, 1950), children perceive the similarity between disparate categories, the heart of creative thought, on chiefly metaphoric grounds (Kogan, 1983). These include the perceptual domains of color, shape, and movement (e.g., Dent, 1984; Winner, McCarthy, & Gardner, 1980) and a cross-modal or a synesthetic ability to perceive likeness in different sensory modalities (e.g., Gardner, 1974; Kogan, 1983; Marks, Hammeal, & Bornstein, 1987). Both originate in infancy, with rudimentary physiognomic experiences (the attribution of affective properties to visually perceived objects) gaining prominence in the early preschool years (Seitz & Beilin, 1987). Later developing metaphorical abilities are predominantly the result of conceptual and linguistic development, although they arise from prior category abilities (Bornstein, 1984). They include the capacity to link the psychological and physical domains (e.g., Asch & Nerlove, 1960) and to compare an abstract

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property of two different things lacking in physical resemblance (e.g., Tourangeau & Sternberg, 1981). The domains, however, are limited by two primary constraints on development. These include biological constraints, such as the maturation of the cross-modal zones in the parietal cortex enabling the linking of sensory modalities that are not fully mature in humans until the beginning of the fifth year of life, and more general constraints on concepts arising from earlier category abilities (Mervis & Rosch, 1981). With regard to the latter, Seitz and Beilin (1987) argued that attributing affective properties to inanimate objects may serve as a precursor to the ability that develops later to link the psychological and physical domains.

Metaphor is central to creativity because it involves the ability to detect unity in variety. In this regard, Lakoff and Johnson (1980) contended that it is an important component of how adults construct and use their conceptual systems in understanding the everyday world. One could say, then, that our ordinary experience is built on a metaphorical foundation. Accordingly, the position taken here is that creative processes share much in common with ordinary psychological processes, whether in the ability of the infant to discriminate color hues, the increasing competence of the preschool child to categorize the natural world, or the school-age child's amassing of real-world knowledge in solving complex problems. At each developmental level, one observes both protometaphorical or protocreative abilities operating alongside ordinary psychological processes. For instance, the infant can detect the synchrony between visual and auditory stimuli (Wagner, Winner, Cicchetti, & Gardner, 1981) and the preschool child can cross-classify experience using a piece of string in play, calling it a *snake* (Winner, McCarthy, Kleinman, & Gardner, 1979). Likewise, the school-age child possesses some ability to discover the motivations underlying human behavior in his or her attribution of physical properties to psychological states, such as the utterance, "Tommy is as hard as a rock" (Cicone, Gardner, & Winner, 1981).

In the current study, 4- and 6-year-olds were presented with metaphorical relations in both pictures and words. The core task consisted of a match-to-sample metaphoric comprehension task of identical triads (target, nonliteral match, and literal match) comprising color, shape, physiognomic, cross-modal, psychological-physical, and taxonomic matches. For color and shape matches, a child might compare a cherry lollipop

to a frying pan (shape) or to blood (color), the similarity or "ground" for the match being the nonliteral feature of shape (or color) rather than the more literal features considered in comparing—for example, a cherry lollipop to an orange one. Cross-modal or synesthetic metaphors cross-classified sensory modalities, such as comparing a sound to a smell or visual experience to touch. To give an example, "The smell of her perfume was like bright sunshine." Physiognomic matches involved predicating emotional qualities to inanimate objects, as in the child saying that a pretzel looks like a human face that is smiling. Psychological-physical matches compared a physical aspect of an object to a psychological characteristic or mental state of a person—for example, "She is a warm person." Taxonomic matches equated an abstract property of two different things where there was no physical resemblance—for example, comparing a violin to a singing canary.

Metaphor is commonly thought of as an embellishment of language. This is the Aristotelian perspective. Contemporary research has shown (e.g., Kogan, Connor, Gross, & Fava, 1980), however, that metaphor is comprehended across different media of presentation (e.g., pictures and words). Moreover, nonverbal tasks that highlight perceptual or functional similarity enable younger children to make metaphorical comparisons at earlier ages (Seitz & Beilin, 1987). In the present study, the six metaphorical types were presented in both picture and word triads. Pictures were hypothesized to facilitate the comprehension of metaphor over words in the younger groups but the reverse in the older groups, because of a dual-coding hypothesis (Paivio, 1979). That is to say, pictures are more easily recalled and make for more efficient information storage because they are multimodal. They provide both visual and verbal storage, and they possess high imageability (i.e., one can easily form mental images of them) and are redintegrative (i.e., access to one part accesses the whole and they can be scanned). Therefore, they should provide an additional subjective, referential context and, thus, aid comprehension. Visual metaphor tasks were hypothesized to facilitate comprehension in the younger age group, but a greater effect as a function of age rather than medium because of a *picture superiority effect*, where pictorial media, as compared to linguistic, have been found to facilitate children's performance across a range of tasks (Reznick, 1977).

I hypothesized a two-stage process in development of metaphoric ability. In Stage 1, children 4 years old

and younger violate category boundaries from an innate sense of similarity. Children prefer natural and concrete metaphors (perceptual, physiognomic, and cross-modal). In Stage 2, children older than 4 years begin to violate category boundaries that rely on learning and the rejection of conventions. They prefer more abstract, socially constructed metaphors (psychological–physical and taxonomic). The media (pictures) and type of metaphor were expected to play a significant role in enabling children to make metaphorical attributions at younger ages and to provide an integrative developmental model in which metaphoric understanding proceeds through a succession of stages modulated by medium effects. Nonetheless, this developmental approach to metaphorical thought is to be viewed in a more general model of creativity applicable to both the arts and sciences and makes no claim to specificity.

Method

Participants

Forty 4-year-old children (range = 4;0 to 4;11, $M = 4;5$) and forty 6-year-old children (range = 6;0 to 6;11, $M = 6;6$), middle-class and multiethnic with English as their first language, participated in the study. All 6-year-olds were enrolled in the first grade. Children were recruited from early childhood centers and private and public schools in a large metropolitan area. In individual classrooms, all children were sent home with parental consent forms, but only those children who received parental consent were included as experimental participants.

Materials and Procedure

Metaphor comprehension tasks. Each picture or word was drawn or printed on 12.5 × 17.5 cm heavy art supply cards. Words were generated by computer, centered, in boldface, and approximately 2.5 cm in height. Pictures were hand drawn by a graphics artist using pen, ink, and colored pencils. From an original sample of 42 triads that were piloted, 16 were selected from six categories: 2 color, 2 shape, and 3 each of physiognomic, cross-modal, psychological–physical,

and taxonomic (see the Appendix). In constructing psychological–physical metaphors, chronological word norms for emotion words were found in Ridgeway, Waters, and Kuczaj (1985). Only basic-level terms in the top 75 of the list were used. Two naive adult judges were instructed in the use of the six-category system and asked to classify the 16 picture triads for the nonliteral matches. They were informed that the categories were not mutually exclusive and could be included under more than one category. There was 93.8% interrater agreement between them on the assignment of a primary classification of an item to a category. Similarly, two additional naive adult judges rated the corresponding word triads with 87.5% interrater agreement between them on the assignment of an item to a primary classification.

The child and experimenter were seated across from each other at a small desk or table (whatever was available at the school location). The experimenter laid out the target item in front of the child on the table and then presented the literal or nonliteral items to the left and right of the child, in randomized order. The experimenter pointed to the bottom item (target) and asked the child to pick one of the top two items that was “like” the bottom one: “Is this (points to target) like this (points to item on left) or like this (points to other item)?” The child was then asked to explain the basis for her answer using the accompanying verbal probes: “How are they like each other?” “Could you tell me other ways that they are like each other?” For words, the experimenter read the word if the child could not read the word himself or herself. If the child made a literal match on the first trial (of a triad), the experimenter pointed to the nonliteral item and asked the child whether it “is like” the target item and to explain his answer. Piloting determined that “like” facilitated metaphoric (nonliteral) responding whereas “go together” promoted literal responding; therefore, the former was used. Stimuli were laid out in two tiers in order to inhibit thematic responding, that is, making up a story about the items. Responses were both written down and recorded on an Aiwa TPS-30 cassette recorder (J & R Computers & Audio, New York, NY).

Semantic Features Task. In order to assess that the 4- and 6-year-olds knew certain key features necessary for comprehending the visual metaphors used in the metaphor comprehension tasks, a separate pilot

group of five 4-year-olds (range = 4;5 to 4;10 years, $M = 4;7$ years) and five 6-year-olds (range = 6;0 to 6;11 years, $M = 6;7$ years) were asked a series of questions for each picture in each triad. The questions were designed to tap the relevant information necessary to comprehend the metaphorical relations, such as information about the ground, and key features in the pictures, such as the child's understanding of pictorial "runes" (Kennedy, 1982). Children appear to be well-acquainted with this kind of nonmimetic information (e.g., waft lines to connote odor) by 4 years of age (Friedman & Stevenson, 1980; Newton, 1985). The task was adapted from Nippold, Leonard, and Kail's (1984) study. Ninety-five percent of the individual pictures in the metaphor triads were correctly identified by the 4-year-olds and 98% by the 6-year-olds.

Word recognition task. For all 48 words (3×16 triads), a separate pilot group of participants, five 4-year-olds (range = 4;0 to 4;10 years, $M = 4;4$ years) and five 6-year-olds (range = 6;3 to 6;10 years, $M = 6;6$ years) were asked to identify and define the word on each card. The task was adapted from Nippold et al.'s (1984) study. Ninety-eight percent of the individual words in the metaphor triads were correctly identified and defined by the 4-year-olds and 99% by the 6-year olds.

Results

Scoring of nonliteral matches. A 3-point scale, directly adopted from Kogan et al.'s (1980) study, was used to quantify a child's understanding of nonliteral similarity within each triad. According to the scale, each possible assigned score from zero to two represented the following:

- 0. Child matched on a literal basis or gave no response at all.
- 1. Child demonstrated partial knowledge of the nonliteral similarity, but failed to offer an adequate explanation (e.g., for Triad 8—consisting of sweet perfume, bright sunshine, and a bottle top—the child responded, "That's spraying and the sun is shining." This response was a purely perceptual one failing to demonstrate comprehension of the underlying cross-modal equivalence).

- 2. Child demonstrated complete knowledge of the underlying nonliteral similarity as revealed through an appropriate explanation (e.g., for Triad 14, the child responded, "The bird sings sometimes and you can use it (violin) to make music." This response correctly identified the conceptual equivalence underlying the match).

The child's score times the number of triads within each metaphorical type represented the dependent variable. Total scores were derived by summing across participants and type of metaphor. Interrater reliability was assessed using a sample of 30% of the protocols and two independent adult judges to establish reliability of scoring. There was 98.7% agreement on the assignment of a score within a triad.

Age differences. Multivariate analysis of variance indicated that age was significant, Pillai's $F(6, 71) = 17.22, p < .001$. Univariate analyses of variance (ANOVA), computed for each dependent variable, indicated that for each metaphorical type there was a significant difference, with the 6-year-olds favored in all cases. Means and F values are presented in Table 1.

Medium effects. The effect of medium was significant, Pillai's $F(6, 71) = 13.48, p < .001$. Univariate ANOVAs were computed for each dependent variable. Pictures facilitated the comprehension of color matches, $F(1, 76) = 22.79, p < .001$, shape matches, $F(1, 76) = 15.76, p < .001$, and cross-modal matches, $F(1,$

Table 1. Means and F Ratios for the Effect of Age

Type	Error	M		$F(6, 71)$
		4-Year-Olds ^a	6-Year-Olds ^b	
PC	1.10	1.93	2.93	18.25*
PS	1.21	1.70	3.58	58.31*
PH	1.54	2.23	4.18	49.44*
CM	1.04	1.33	2.78	40.50*
PP	1.48	1.45	2.78	23.73*
TX	1.61	1.40	2.83	25.22*

Note: PC = perceptual/color, PS = perceptual/shape, PH = physiognomic, CM = cross-modal, PP = psychological-physical, and TX = taxonomic matches; $df = (6, 71)$.

^a $N = 40$. ^b $N = 40$.

* $p < .001$.

Table 2. Means and *F* Ratios for the Effect of Age and Medium

Type	4-Year-Olds ^a		6-Year-Olds ^b		<i>F</i> 1	<i>F</i> 2	<i>F</i> 3	<i>F</i> 4
	Pictures	Words	Pictures	Words				
PC	2.70	1.15	3.25	2.60	21.36***	11.63**	4.72*	29.91***
PS	2.45	0.95	3.80	3.35	13.38**	2.23	16.04**	72.97***
PH	0.90	1.55	3.55	4.80	8.17**	10.80**	2.29	65.06***
CM	1.25	1.40	1.90	3.65	0.19	68.36***	1.01	38.56***
PP	1.55	1.35	2.55	3.00	0.23	8.93**	3.27	33.66***
TX	1.40	1.40	2.30	3.35	0.00	10.61**	7.92**	25.95***

Note: *F*1 = pictures-words (4-year-olds), *F*2 = pictures-words (6-year-olds), *F*3 = 4- to 6-year-olds (pictures), *F*4 = 4- to 6-year-olds (words). PC = perceptual/color, PS = perceptual/shape, PH = physiognomic, CM = cross-modal, PP = psychological-physical, and TX = taxonomic matches; *df* = (2, 76).

^a*N* = 40. ^b*N* = 40.

p* < .05. *p* < .01. ****p* < .001.

76) = 17.39, *p* < .001. Physiognomic matches were not significant, *F*(1, 76) = 0.05, *p* > .05.

The Age × Medium interaction was significant, Pillai's *F*(6, 71) = 5.63, *p* < .001. Separate two-way ANOVAs were assessed for each dependent variable. Color matches were significant, *F*(1, 76) = 5.15, *p* < .05, as were shape matches, *F*(1, 76) = 7.56, *p* < .01, and physiognomic matches, *F*(1, 76) = 19.21, *p* < .001. Cross-modal matches nearly reached significance, *F*(1, 76) = 3.71, *p* < .06. The results indicated that, for all six metaphorical types, 6-year-olds had larger differences on both word and picture tasks. The differences were greater, moreover, for the word task. Means and *F* values are presented in Table 2.

Concerning age groups, 4-year-olds performed significantly better on perceptual (color/shape) and physiognomic picture tasks. They achieved equivalent performance in both media for cross-modal, psychological-physical, and taxonomic matches. Six-year-olds did significantly better on color matches in pictures, and better on physiognomic, cross-modal, psychological-physical, and taxonomic matches in words. Across age, 6-year-olds did significantly better on perceptual (color/shape) and taxonomic matches in the pictorial medium and on all six metaphoric matches in the linguistic medium.

Discussion

From a developmental perspective, younger children performed better on the perceptual and physiognomic matches when presented in pictures, and worse

on the psychological-physical and taxonomic matches, regardless of medium of presentation. Thus, they evidenced a preference for more natural, concrete metaphors. For the older children, although they outperformed their younger counterparts on the perceptual and physiognomic matches in both media, they performed significantly better on the psychological-physical and taxonomic matches—particularly when they were presented in the linguistic medium. Thus they exhibited a preference for more abstract, socially constructed metaphoric relations. The two-stage model was borne out: Younger children in Stage 1 exhibited a proclivity to violate category boundaries from an innate sense of similarity, whereas older children in Stage 2 evidenced an inclination to violate category boundaries that relied on learning (e.g., formal schooling) and the rejection of conventions.

The present study suggests, then, that if the process of metaphoric understanding is considered more of an agency of thought or cognition (Lakoff & Johnson, 1980) than from a semiotic perspective, different symbol systems vary in how they highlight similarity because of their inherent differences. To be sure, perceptual features of color and shape are more easily highlighted in the visual modality and more easily understandable to younger children because they draw on natural relations in the world and are partly a product of biological constraints. Conceptual relations, on the other hand, such as psychological-physical and taxonomic similarity, are better highlighted in the linguistic medium. They derive from sensory, conceptual, and linguistic experience (the latter two a partial result of sociocultural factors) and are thus understood at later

ages. Thus, the ability to cross conventional boundaries of experience at later ages is based on prior category abilities resulting from maturational, developmental, and sociocultural constraints. Presumably, mature adult creativity draws on the sensorimotor and symbolic realms of childhood (Gardner, 1991) engendered in perceptual, enactive, cross-modal, physiognomic, and conceptual metaphoric understanding of the kind discussed in this study. This enables the scientist or artist to create spatial models depicting the relation between subatomic particles, to conceive the rhetorical aspects of film, to invent nonliteral dance, to produce nonrepresentational painting, and so on. Thus, the important function of metaphor in creative thought is creating similarity not highlighting existing similarity, since similarity is not found in the world but is the effect of thinking.

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**Appendix: List of Metaphor
Task Items**

1. Ice cream, clouds, scoop (PC)
2. Long haired girl, hanging plant, hat (PS)
3. Stick of butter, school bus, bread (PC)
4. Building, giraffe, window (PS)
5. Sad girl, weeping willow tree, park bench (PH)
6. Tired runner, dry plant, sneakers (PH)
7. Angry man, storm, coat (PH)
8. Sweet perfume, bright sunshine, bottle top (CM)
9. Soft sound, pillow, ear (CM)
10. Smelly trash, noisy tires, paper (CM)
11. Unfriendly man, rock, shoes (PP)
12. Happy man, sun, car (PP)
13. Kind mother, heater, purse (PP)
14. Violin, singing bird, music stand (TX)
15. Baby, rosebud, diapers (TX)
16. Fish on hook, plane on fire, ocean (TX)

Note: PC = perceptual/color, PS = perceptual/shape, PH = physiognomic, CM = cross-modal, PP = psychological-physical, and TX = taxonomic. The order of items in each triad is target, nonliteral match, literal match.