Creativity Research Journal

ISSN: 1040-0419 (Print) 1532-6934 (Online) Journal homepage: http://www.tandfonline.com/loi/hcrj20

Fluency or Similarities? Cognitive Abilities that Contribute to Creative Metaphor Generation

Anat Kasirer & Nira Mashal

To cite this article: Anat Kasirer & Nira Mashal (2018) Fluency or Similarities? Cognitive Abilities that Contribute to Creative Metaphor Generation, Creativity Research Journal, 30:2, 205-211, DOI: 10.1080/10400419.2018.1446747

To link to this article: https://doi.org/10.1080/10400419.2018.1446747

CREATIVITY RESEARCH JOURNAL, *30*(2), 205–211, 2018

ISSN: 1040-0419 print/1532-6934 online
DOI: https://doi.org/10.1080/10400419.2018.1446747

Fluency or Similarities? Cognitive Abilities that Contribute to Creative Metaphor Generation

Anat Kasirer
Bar Ilan University

Nira Mashal
Bar Ilan University

This study focused on the cognitive abilities that contribute to creative metaphor generation. A concept explanation task was used to test conventional and novel (creative) metaphor generation. Conceptual fluency and similarities were measured using the Tel-Aviv Creativity Test (TACT). The main goal was to investigate how fluency of ideas and similarities contribute to creative metaphor generation. Fifty-four children (M = 12.59, SD = 2.05) participated in the study. The findings demonstrated that fluency of ideas contributed to the prediction of creative potential, but not conventional metaphor generation, beyond similarities, cognitive abilities, executive functions, verbal abilities, and age. The results thus show that novel metaphor generation is unique and separate estimate of creative potential, which is reciprocally related to conceptual fluency.

Creativity is commonly viewed as the production of something that is novel, different, and innovative, yet at the same time useful, relevant, and appropriate to the task at hand (Runco & Jaeger, 2012). Effectiveness (relevance or appropriateness) and originality (uniqueness or novelty) determine the extent of its creativity (Runco, 2014, 2015). The spontaneous flow of ideas and images (i.e., fluency) has been considered an important characteristic of a creative mind. It has been argued that metaphors form the kernel of creative thought (Ricoeur, 1981). Metaphor processing relies on the ability to link disparate conceptual domains and to find the similarity between two apparently unrelated concepts (Bowdle & Gentner, 2005). Despite the numerous studies that tested which cognitive abilities contribute to metaphor generation (Chiappe & Chiappe, 2007; Dietrich, 2004; Kasirer & Mashal, 2016a; Landa & Goldberg, 2005), how similarities and fluency contribute to creative metaphor generation remained underexplored

This study focuses on the cognitive abilities that contribute to verbal creativity potential as assessed through a novel metaphor generation task. The generation of a novel metaphor reflects the ability to break conventional or obvious patterns of thinking, to adopt creative or higher order rules, and to think conceptually and abstractly (Dietrich, 2004). Metaphors are the most powerful source for linguistic innovation, and hence provide a fruitful context for studying creative thought (Levorato & Cacciari, 2002). For instance, *mercy* and *blanket* are two apparently unrelated concepts, but *mercy blanket* can be combined into a novel concept and interpreted as wrapping someone with a sense of compassion.

Metaphor generation evolves in early stages of childhood (Billow, 1981; Chukovsky, 1968; Fourment, Emmenecker, & Pantz, 1987; Gentner, 1988) and continues to develop further with the development of cognitive and linguistics capacities. A 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 can attribute physical properties to psychological states, such as the utterance, "This boy is fat like a balloon". Gentner (1988) and Nall (1983) explained the development change in metaphor processing as identifying similarities between objects that occur during development. According to Gentner (1988), children under age 7 interpret metaphorical compression in terms of object similarity, whereas older children do so in terms of relational similarity. Levorato and Cacciari (1995) presented a psycholinguistic model for the

Correspondence should be sent to Nira Mashal, School of Education Bar Ilan University, Ramat Gan 52900, Israel. E-mail: mashaln@mail.biu.ac.il

development of figurative language comprehension and generation, called the *global elaboration model*. According to this model, it is by default that children, until the age of seven, process language literally. Further, children acquires the knowledge that the same communicative intention can be realized through different sentence forms (literally, idiomatically, metaphorically). Metaphor processing capabilities gradually develop until adolescence. Around the age of 15, children can comprehend and generate figurative language at an adult level, with further development even in adulthood.

The generation of novel and original metaphors relies on several cognitive processes that require higher cognitive resources, such as fluid intelligence and executive processes (Beaty & Silvia, 2013). Indeed, the property attribution model of metaphor comprehension (Glucksberg, 2001; Glucksberg, McGlone, & Manfredi, 1997) argues that creating a metaphor implies an underlying process of categorization (class inclusion) that involves several executive processes. To generate a metaphor that contains a topic and a vehicle, a speaker must first select the property that will be attributed to the topic, and then scan semantic knowledge for suitable vehicle that exemplify the abstract, higher-order attributive category. This process requires maintaining access to the category while inhibiting irrelevant features. Carriedo et al. (2016) investigated the contribution of relational verbal reasoning (analogical and class-inclusion reasoning) and executive functioning to metaphor comprehension in three age groups (11 years; 15 years and young adults between 21 and 25). Consistent with previous studies (Gentner, 1988; Levorato & Cacciari, 1995; Van Herwegen, Dimitriou, & Rundblad, 2013; Winner, Rosenstiel, & Gardner, 1976) the findings showed gradual development of metaphor comprehension until adulthood. Furthermore, although at the age 11 children relied on analogical reasoning to comprehend metaphors, 15-year-old adolescents used two different alternative strategies to resolve metaphors: Either they interpreted metaphors using cognitive inhibition or they did so using analogical and class-inclusion reasoning. The contribution of executive functions, as well as verbal and nonverbal skills, to metaphor generation among children with and without autistic spectrum disorder (ASD) aged 9–16 was also demonstrated by Kasirer and Mashal (2016a). The findings showed that children were able to generate spontaneously novel and conventional metaphors (18.97%; 24.1%, respectively). Furthermore, phonemic fluency contributed to the prediction of novel metaphor generation in children with and without ASD. Nevertheless, only age predicted novel metaphor generation in typically developing (TD) children. Interestingly, group (TD vs. ASD) but not verbal or executive skills predicted the level of conventional metaphor generation with TD participants scored higher than did participants with ASD.

DIVERGENT THINKING

Divergent thinking is a necessary variable of creativity (Milgram & Livne, 2006; Runco, 2010). According to Guilford (1968), divergent thinking is the ability to generate a wide variety of ideas and associations to a given problem. Such ability consists of fluency (number of responses), flexibility (different categories of ideas), originality (uniqueness of ideas), and elaboration (diverse of ideas). Divergent thinking is assessed by open-ended tests that establish the fluency ability to generate multi solutions as possible (Guilford, 1956). A well-known test is the Torrance Tests of Creative Thinking (TTCT; Rosenthal, DeMers, Stilwell, Graybeal, & Zins, 1983; Torrance, 1974). This test measures fluency of ideas, flexibility, originality, and elaboration. The TTCT includes both verbal and figural open-ended subtests that require a spontaneous generation of many responses as possible for a given item. A shortened version of the TTCT, Tel-Aviv Creativity Test (TACT; Milgram, Milgram, & Landau, 1974) was used in this study.

Given the importance of fluency of ideas to creative thinking, it remains unknown whether fluency of ideas contributes to creative metaphor generation beyond similarities (Carriedo et al., 2016), executive abilities (Bowdle & Gentner, 2005; Damasio, 2001; Dietrich, 2004; Kaufman & Baer, 2004, 2005; Landa & Goldberg, 2005; Mashal, 2013), verbal abilities (Hocevar, 1980), and nonverbal intelligence (Beaty & Silvia, 2013; Nusbaum & Silvia, 2011; Silvia & Beaty, 2012). Two generation tasks were used in this study: conventional metaphor generation and creative (novel) metaphor generation task. The aims of this study are threefold: first, to examine whether the two types of creativity potential tests (metaphor generation and TACT) are intercorrelated; second, to investigate how fluency of ideas and similarities contribute to creative metaphor generation; and third, to investigate whether different cognitive abilities (fluency, similarities, verbal and non-verbal skills) contribute to conventional and novel metaphor generation. One hypothesis was that because both tasks (metaphor generation and TACT) rely on similar activities (fluency, flexibility, originality, and elaboration), novel metaphor generation and TACT will be intercorrelated. A second hypothesis was that both fluency and similarities will contribute to creative metaphor generation. In addition, because metaphor generation develop throughout childhood, another hypothesis was that age will contribute to the development of metaphor generation. Furthermore, because novel metaphor generation relies on different cognitive capabilities than conventional metaphor generation (Beaty & Silvia, 2013; Kasirer & Mashal, 2016a), a final hypothesis was that different skills would predict each metaphoric task.

METHOD

Participants

The participants of this study included 54 Hebrew-speaking participants (31 boys and 23 girls). The age of participants ranged from 10 to 16 years (M = 12.59, SD = 2.05). All participants were recruited from elementary schools and junior high schools. To be included in the study, all participants had to score within the age-appropriate range on the screening tests described in the following. A participant who scored outside this range did not continue with the experimental tasks. All parents received an introductory letter about the experiment and signed an informed consent prior to the beginning of the study. The study was approved by the Israeli Ministry of Education. Participant recruitment was conducted in accordance with institutional research guidelines

Materials

Screening tests

The following screening tests were used. The Test of Nonverbal Intelligence (TONI-3; Brown, Sherbenou, & Johnsen, 1997) consists of 45 black-and-white items arranged according to degree of difficulty. This test assesses the subject's ability to solve abstract/figural problems without depending on the verbal skills of the subject. A Hebrew picture-naming test (Kavé, 2005a) consists of 48 black-and-white line drawings; the participant was instructed to say, in one word, the name of the item in the picture. The final test was the vocabulary subtest from the Wechsler Intelligence Scale for Children (WISC-IV^{HEB}; Wechsler, 2003). One participant who scored outside the normal range on any of these three tests (e.g., scored two standard deviations below age-appropriate scores, or under 7 on the vocabulary test) was excluded.

Executive functions tests

Language-based executive function tests were assessed by the Ambiguous Word Meaning Generation Test (AMGT; Mashal & Kasirer, 2011) and two verbal fluency tests (Kavé, 2005b).

AMGT

This test is based on mental flexibility. It tested the ability to activate different meanings of ambiguous words and then shift between them. Participants were presented with a list of 20 short, unbiased sentences that ended with ambiguous words (e.g., *Look at this bank*). They were instructed to say aloud all meanings of the final word. The score was the number of correct answers provided for all ambiguous words.

Phonemic fluency

The fluency tests investigated flexible search strategies (Kavé, Kigel, & Kochva, 2008) and executive control (Hurks et al., 2006). Following Kavé (2005b), phonemic fluency was assessed by obtaining the number of words generated in 1 min for the letters *bet* (b), *gimel* (g), and *shin* (sh). A sum of the words produced on all three letters was used as the score.

Semantic fluency

Following Kavé (2005b), semantic fluency was assessed by obtaining the number of words generated in 1 min. for each of the following three semantic categories: animals, fruits and vegetables, and vehicles. A sum of the words produced on all three categories was used as a score.

Creativity Potential

Metaphor generation: Concept explanation

First, 16 concepts from Levorato and Cacciari's (2002) stimuli were selected and then they were tested whether they were appropriate for Hebrew speakers. Twenty Hebrew speaking adults (age range 18–25) were presented with these concepts and were asked to generate new expressions. Half of the concepts were presented in the form of a metaphor (e.g., *love is*____) and the other half were presented in the form of a simile (e.g., *feeling worthless is like*____). Three constructions of each kind did not produce figurative responses, and thus the final questionnaire included five metaphors and five similes. Participants of this study were asked to come up with a new way of expressing the meaning of the concept. Instructions emphasized originality so as to encourage participants to create a new expression, rather than to simply paraphrase the one presented in the questionnaire. Thus, participants were asked "to create and write down a new expression, which is more comprehensible within your peer group than outside it."

The same five adult judges (who rated the previous questionnaire) independently coded the data, determining whether each expression was literal or figurative (when there was disagreement, judges discussed and decided on the scores together). The judges were told that a novel metaphor is an unfamiliar, unique, and creative metaphoric (nonliteral) expression (e.g., *feeling worthless is like a mirror smashed to pieces*); a conventional metaphor is a familiar expression or an idiom (e.g., *feeling embarrassed is like having a red face*); and a literal response is a simple description with no figurative meaning (e.g., *feeling successful is like a victory*). They were then asked to give novel metaphors 3 points, conventional metaphors 2 points, literal responses 1 point, and no points to unrelated or inappropriate responses. The general inter-rater reliability was high r = .93

Conventional metaphor generation scores

Responses that received 2 points (conventional metaphors) from the concepts presented in both the form of a metaphor and a simile were summed up. The maximum score was 20 (10 for metaphors and 10 for similes). Each final score was converted to percentages.

Novel metaphor generation (creativity) scores

Creative ability was measured by the number of responses that received 3 points on the concept explanation test for each of the 10 items (concepts presented in both the metaphoric and the simile form). The maximum score was 30 and each final score was converted to percentages.

TACT

The shortened version of Milgram et al. (1974) measure was used. The original scale (Wallach & Kogan, 1965) measures creative thinking and is highly reliable. This 16-item instrument is the most standard creativity test in Israel. Participants were asked to give as many responses as they can to each item for two verbal tasks (A, B) and two figural tasks (C, D). Two measures are examined for each item: (a) conceptual fluency, defined as the number of responses given for each item, and (b) originality, defined as responses given by 5% or less of the participants. The instrument consists of four subtests. In subtest A (uses) participants are expected to produce as many uses as they can for four objects (a newspaper, a car's tire, a shoe, and a chair). Cronbach's alpha of this subtest in thise present study was .79. In subtest B (similarities) participants are asked to point out as many similarities as they can between two objects of each of the following pairs: a potato and a carrot, a train and a tractor, a grocery store and a restaurant, and a radio and a telephone. Cronbach's alpha of this subtest in this study was .85. In subtest C (paintings) four paintings are presented. Participants are asked to point out all the things that the painting can represent, drawing their attention to the fact that they can turn the painting any way they want. Cronbach's alpha of this subtest in this study was .79. In subtest D (lines) four lines are presented; participants were asked to point out as many meanings of each line. Cronbach's alpha of this subtest in this study was .83. Cronbach's alpha of the entire measure in this study was .90.

Procedure

Participants were tested individually in schools or in their homes. Screening tests and executive functions tasks were administered on a separate initial session. On a second session, half of the participants were tested on the TACT task first and then the metaphor generation task. The rest of the participants were tested in the reverse order.

RESULTS

Means (and SD) and the range for each test including the percent of metaphor generation are presented in Table 1.

Before examining which skill predicted the generation of novel and conventional metaphors, Pearson correlations were conducted between the performance on the metaphor generation tests and the TACT scores. Positive correlations were found between the performance on the novel metaphor generation test and TACT scores in A (uses) to C (paintings) parts ($r(52) = .42$, $p < .01$ for TACT–A; $r(52) = .28$, $p < .05$ for TACT–B, similarities; and $r(52) = .28$, $p < .05$ for TACT–C). No significant correlation was found between the performance on the novel metaphor generation test and the TACT–D (lines) scores $r(52) = .15$, $p = .29$. No significant correlations were found between the performance on the conventional metaphor generation test and TACT scores ($r(52) = .10$, $p = .49$ for TACT–A, $r(52) = .18$, $p = .20$ for TACT–B (similarities), $r(52) = .15$, $p = .29$ for TACT–C, and $r(52) = .07$, $p = .64$ for TACT–D).

The Prediction of Novel Metaphor Generation

To examine which variable best predicted the generation of novel metaphors, a hierarchical and stepwise regression analysis was conducted. Predictors included the background characteristics (age and gender), scores on the nonverbal and verbal intelligence (TONI-3, naming test, and vocabulary subtest of the WISC), scores on tests of executive functions (AMGT, two verbal fluency tasks), the performance on the generation of conventional metaphors, as well as scores on the four TACT parts. First, the two background characteristics were entered to the regression, and then scores on the three nonverbal and verbal intelligence tests, the three executive functions measures, the performances on the conventional metaphor generation test and the scores on the four TACT parts in a stepwise manner.

TABLE 1
Mean (and SD) scores and range for each test (N = 54)

Tests	*Subtests*	*M*	*SD*	*Range*
Non-verbal and verbal intelligence	TONI-3	32.09	6.80	20–44
	Naming	43.98	2.90	34–48
	Vocabulary	42.94	7.04	30–56
Executive function	AMGT	14.41	6.30	0–20
	Phonemic fluency	29.22	9.28	15–60
	Semantic fluency	41.35	10.11	21–64
Metaphor generation	Conventional	22.59	20.39	0–80
	Novel	15.00	15.99	0–60
TACT	Part A(Uses)	17.69	6.48	7–41
	Part B (Similarities)	14.31	4.92	5–31
	Part C (Paintings)	15.69	5.62	5–27
	Part D (Lines)	12.81	5.14	5–28

TABLE 2
Regression analysis predicting novel metaphor generation by age, gender, verbal ability, executive functions, conventional metaphor generation and the TACT scores

Dependent variables	*Steps*	*Independent variables*	*B*	*SE.B*	*β*	*t*	*p*	R^2	ΔR^2
Novel metaphor generation	1	Age	.28	1.11	.04	.26	.80		
		Gender	−6.70	4.51	−.21	−1.49	.14	.042	.042
	2	Age	.11	1.02	.01	.10	.92		
		Gender	−4.11	4.26	−.13	−.96	.34		
		TACT - A	−.98	.32	.40	3.06**	.01	.193*	.151**

***p* < .05, ****p* < .01**

Results of this regression analysis are presented in Table 2. The order of the variables presents the order of significance.

As can be seen in the Table 2, performance on TACT–A explained a significant share of the variance and contributed 15.1% to the explained variance, beyond the background characteristics, $F(3, 50) = 3.98$, $p < .05$. The positive beta coefficient, indicating that as the TACT–A scores increases, the performance on novel metaphor generation tests increases.

Prediction of Conventional Metaphor Generation

To examine which variable best predicted the generation of conventional metaphors, a hierarchical and stepwise regression analysis was conducted. Predictors included the background characteristics (age and gender), scores on the nonverbal and verbal intelligence (TONI-3, naming test, and vocabulary subtest of the WISC), scores on tests of executive functions (AMGT, two verbal fluency tasks), the performance on the generation of novel metaphors, as well as scores on the four TACT parts. First, the two background characteristics were entered to the regression, and then the scores on the three nonverbal and verbal intelligence tests, the three executive functions measures, the performances on the novel metaphor generation test and the scores on the four TACT parts in a stepwise manner. Results of this regression analysis are presented in Table 3. The order of the variables presents the order of significance.

As can be seen in the Table 3, none of the variables contributed significantly to the conventional metaphor generation variance. However, age marginally contributed to conventional metaphor generation. Thus, as the age increases, the performance on conventional metaphor generation test tend to increase as indicated by the positive beta coefficient.

DISCUSSION

This study examined creativity potential in children using two different tasks, TACT and two metaphor generation tasks (novel and conventional metaphor generation). The results show that performance on the novel metaphor generation task correlates with the two verbal subtests, TACT–A (uses) and TACT– B (similarities), and the figural subtest TACT–C (paintings). No correlations were found between the performance on the conventional metaphor generation test and the TACT scores. Furthermore, fluency of ideas (as assessed by TACT–A, uses), contributed to the prediction of novel metaphor generation beyond similarities, cognitive abilities, EF, verbal abilities and age.

Novel metaphor generation motivates the subject to break conventional patterns of thinking (e.g. "*Feel successful is like the sky opening up*"). Only the uses task (TACT–A) contributed to novel metaphor generation. Indeed, both tasks are based on diverting thinking (Guilford, 1956), which encourages creating relevant associations, original ideas, and various options to the same question. However, while in the uses task (TACT–A) the participant is expected to produce as many uses as he can for given objects; in the generation task the participant expected to produce one creative expression. This metaphor generation process probably involves uploading many ideas to select the most original idea and inhibit the conventional ones.

Recent studies (Kasirer & Mashal, 2016a, 2016b) highlight the contribution of fluency, and specifically phonemic fluency, to the generation of creative metaphors. Kasirer and

TABLE 3
Regression analysis predicting conventional metaphor generation by age, gender, verbal ability, executive functions, novel metaphor generation and the TACT scores

Dependent variables	*Steps*	*Independent variables*	*B*	*SE.B*	*β*	*t*	*p*	R^2	ΔR^2
Conventional metaphor generation	1	Age	2.61	1.36	.26	1.92	.06	.094	.094
		Gender	4.40	5.59	.11	.79	.43		

Mashal (2016a) found that only age contributed to novel metaphor generation among typically developing children aged 9–16. However, in that study fluency (as assessed with TACT) was not used. This study revealed that fluency of ideas (as assessed by the uses task, TACT–A) contributed to novel metaphor generation beyond age, vocabulary and cognitive performance. The ability to come up with various uses to a given object (e.g. a newspaper, a car's tire) requires, first, an extensive vocabulary and a retrieval capability. Second, it requires flexible capabilities that enable one to think otherwise, to activate different associations, and to then shift between them (i.e., a car's tire can also be a chair). Third, to produce novel and original uses of object and evaluate the resulting ideas. As follows, all those abilities are required to metaphor-generation processing (Beaty & Silvia, 2013; Silvia & Beaty, 2012). The findings show that fluency of ideas seems to be the most influencing ability on verbal creativity. Thus, although similarity is essential variable to metaphor processing (Bowdle & Gentner, 2005; Gentner, 1983), our findings pinpoint the important contribution of fluency of ideas to novel metaphor generation.

These results also show that conventional metaphor generation did not predict novel metaphor generation. This finding may suggest that novel metaphor generation is a distinct verbal ability, which is independent of previously stored figurative phrases. Finally, none of the other cognitive variables (the TACT scores, the vocabulary or the executive functions) contributed to the conventional metaphor generating test. Unlike novel metaphor generation, the ability to generate conventional metaphors does not rely on fluency of ideas.

This study has some limitations. First, the sample of participants was relatively small. Future studies need to expand the sample and include adults. Another potential limitation is the fact that the measures of executive functions were rather limited. The executive functions of this study were language-based. However, studies have highlighted the contribution of working memory to metaphor generation and other creativity tasks (e.g., Chiappe & Chiappe, 2007; Kaufman & Baer, 2005). Future studies need to include additional measures, such as working memory and attention.

REFERENCES

Beaty, R. E., & Silvia, P. J. (2013). Metaphorically speaking: Cognitive abilities and the production of figurative language. *Memory and Cognition*, *41*, 255–267. doi:10.3758/s13421-012-0258-5

Billow, R. M. (1981). Observing spontaneous metaphor in children. *Journal of Experimental Child Psychology*, *31*, 430–445. doi:10.1016/0022-0965(81)90028-X

Bowdle, B. F., & Gentner, D. (2005). The career of metaphor. *Psychological Review*, *112*, 193–216. doi:10.1037/0033-295X.112.1.193

Brown, L., Sherbenou, R. J., & Johnsen, S. K. (1997). *Test of Nonverbal Intelligence: TONI-3* (3rd ed.). Austin, TX: Pro-Ed.

Carriedo, N., Corral, A., Montoro, P. R., Herrero, L., Ballestrino, P., & Sebastián, I. (2016). The development of metaphor comprehension and its relationship with relational verbal reasoning and executive function. *PLoS One*, *11*(3). doi:10.1371/journal.pone.0150289

Chiappe, D. L., & Chiappe, P. (2007). The role of working memory in metaphor production and comprehension. *Journal of Memory and Language*, *56*, 172–188. doi:10.1016/j.jml.2006.11.006

Chukovsky, K. (1968). *From two to five* (Rev. ed.). Berkeley, CA: University of California Press.

Cicone, M., Gardner, H., & Winner, E. (1981). Understanding the psychology in psychological metaphors. *Journal of Child Language*, *8*, 213–216. doi:10.1017/S0305000900003123

Damasio, A. R. (2001). Some notes on brain, imagination and creativity. In K. H. Pfenninger, & V. R. Shubik (Eds.), *The origins of creativity* (pp. 59–68). Oxford, UK: Oxford University Press.

Dietrich, A. (2004). The cognitive neuroscience of creativity. *Psychonomic Bulletin and Review*, *11*, 1011–1026. doi:10.3758/BF03196731

Fourment, M.-C., Emmenecker, N., & Pantz, V. (1987). Etude de la production de etaphores chez des enfants de 3 a 7 ans [A study of metaphors production on 3–7 years old children]. *L'Annee Psychologique*, *87*, 535–551. doi:10.3406/psy.1987.29233

Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science*, *7*, 155–170. doi:10.1207/s15516709cog0702_3

Gentner, D. (1988). Metaphor as structure mapping: The relational shift. *Child Development*, *59*, 47–59. doi:10.2307/1130388

Glucksberg, S. (2001). *Understanding figurative language: From metaphors to idioms*. Oxford, UK: Oxford University Press.

Glucksberg, S., McGlone, M. S., & Manfredi, D. (1997). Property attribution in metaphor comprehension. *Journal of Memory and Language*, *36*, 50–67. doi:10.1006/jmla.1996.2479

Guilford, J. P. (1956). Structure of intellect. *Psychological Bulletin*, *53*, 267–293. doi:10.1037/h0040755

Guilford, J. P. (1968). *Intelligence, creativity, and their educational implications*. San Diego, CA: Knapp.

Hocevar, D. (1980). Intelligence, divergent thinking and creativity. *Intelligence*, *4*, 25–40. doi:10.1016/0160-2896(80)90004-5

Hurks, P. P. M., Vles, J. S. H., Hendriksen, J. G. M., Kalff, A. C., Feron, F. J. M., Kroes, M., ... Jolles, J (2006). Semantic category fluency versus initial letter fluency over 60 seconds as a measure of automatic and controlled processing in healthy school-aged children. *Journal of Clinical and Experimental Neuropsychology*, *28*, 684–695. doi:10.1080/13803390590954191

Kasirer, A., & Mashal, N. (2016a). Comprehension and generation of metaphors by children with autism spectrum disorder. *Research in Autism Spectrum Disorders*, *32*, 53–63. doi:10.1016/j.rasd.2016.08.003

Kasirer, A., & Mashal, N. (2016b). Comprehension and generation of metaphoric language in children, adolescents, and adults with Dyslexia. *Dyslexia*. Advance online publication. doi:10.1002/dys.1550

Kaufman, J. C., & Baer, J. (2004). Sure, I'm creative—But not in mathematics! Self-reported creativity in diverse domains. *Empirical Studies of the Arts*, *22*, 143–155. doi:10.2190/26HQ-VHE8-GTLN-BJJM

Kaufman, J. C., & Baer, J. (2005). The amusement park theory of creativity. In J. C. Kaufman, & J. Baer (Eds.), *Creativity across domains: Faces of the muse* (pp. 321–329). Mahwah, NJ: Erlbaum.

Kavé, G. (2005a). Standardization and norms for a Hebrew naming test. *Brain and Language*, *92*, 204–211. doi:10.1016/j.bandl.2004.06.004

Kavé, G. (2005b). Phonemic fluency, semantic fluency, and difference scores: Normative data for adult Hebrew speakers. *Journal of Clinical and Experimental Neuropsychology*, *27*, 690–699. doi:10.1080/13803390490918499

Kavé, G., Kigel, S., & Kochva, R. (2008). Switching and clustering in verbal fluency tasks throughout childhood. *Journal of Clinical and Experimental Neuropsychology*, *30*, 349–359. doi:10.1080/13803390701416197

Landa, R. J., & Goldberg, M. C. (2005). Language, social, and executive functions in high functioning autism: A continuum of performance.

Journal of Autism and Developmental Disorders, *35*, 557–573. doi:10.1007/s10803-005-0001-1

Levorato, M. C., & Cacciari, C. (1995). The effects of different tasks on the comprehension and production of idioms in children. *Journal of Experimental Child Psychology*, *60*, 261–283. doi:10.1006/jecp.1995.1041

Levorato, M. C., & Cacciari, C. (2002). The creation of new figurative expressions: Psycholinguistic evidence in Italian children, adolescents and adults. *Journal of Child Language*, *29*, 127–150. doi:10.1017/S0305000901004950

Mashal, N. (2013). The role of working memory in the comprehension of unfamiliar and familiar metaphors. *Language and Cognition*, *5*, 409–436. doi:10.1515/langcog-2013-0024

Mashal, N., & Kasirer, A. (2011). Thinking maps enhance metaphoric competence in children with autism and learning disabilities. *Research in Developmental Disabilities*, *32*, 2045–2054. doi:10.1016/j.ridd.2011.08.012

Milgram, R. M., & Livne, N. (2006). Research on creativity in Israel: A chronicle of theoretical and empirical development. In J. C. Kaufman, & R. J. Sternberg (Eds.), *The international handbook of creativity* (pp. 307–336). New York, NY: Cambridge University Press.

Milgram, R. M., Milgram, N., & Landau, E. (1974). *Identification of gifted children in Israel: An empirical and theoretical investigation*. Tel Aviv, Israel: Tel Aviv University, School of Education.

Nall, S. L. (1983). *Dimensions of metaphor comprehension in third, fifth and seventh graders* (Unpublished Master's thesis). Wake Forest University, Department of Psychology, Winston-Salem, NC.

Nusbaum, E. C., & Silvia, P. J. (2011). Are intelligence and creativity really so different? Fluid intelligence, executive processes, and strategy use in divergent thinking. *Intelligence*, *39*, 36–45. doi:10.1016/j.intell.2010.11.002

Ricoeur, P. (1981). *Hermeneutics and the human sciences: Essays on language, action and interpretation*. (J. B. Thompson, Ed.). Cambridge, UK: Cambridge University Press.

Rosenthal, A., DeMers, S. T., Stilwell, W., Graybeal, S., & Zins, J. (1983). Comparison of interrater reliability on the Torance Tests of Creative Thinking for gifted and non-gifted students. *Psychology in the Schools*, *20*, 35–40. doi:10.1002/1520-6807(198301)20:1<35::AID-PITS2310200110>3.0.CO;2-Q

Runco, M. A. (2010). Education based on a parsimonious theory of creativity. In R. A. Beghetto, & J. C. Kaufman (Eds.), *Nurturing creativity in the classroom* (pp. 235–251). Cambridge, UK: Cambridge University Press.

Runco, M. A. (2014). *Creativity: Theories and themes: Research, development, and practice* (2nd ed.). Boston, MA: Elsevier Academic Press.

Runco, M. A. (2015). Meta-creativity: Being creative about creativity. *Creativity Research Journal*, *27*, 295–298. doi:10.1080/10400419.2015.1065134

Runco, M. A., & Jaeger, G. J. (2012). The standard definition of creativity. *Creativity Research Journal*, *24*, 92–96. doi:10.1080/10400419.2012.650092

Silvia, P. J., & Beaty, R. E. (2012). Making creative metaphors: The importance of fluid intelligence for creative thought. *Intelligence*, *40*, 343–351. doi:10.1016/j.intell.2012.02.005

Torrance, E. P. (1974). *The Torrance tests of creative thinking: Technical-norms manual*. Bensenville, IL: Scholastic Testing Services.

Van Herwegen, J., Dimitriou, D., & Rundblad, G. (2013). Performance on verbal and low-verbal false belief tasks in children with Williams syndrome. *Journal of Language and Communication Disorders*, *45*, 440–448. doi:10.1016/j.jcomdis.2013.10.002

Wallach, M. A., & Kogan, N. (1965). *Modes of thinking in young children: A study of the creativity intelligence distinction*. New York, NY: Holt, Rinehart & Winston.

Wechsler, D. (2003). *Wechsler intelligence scale for children: WISC-IV*^{HEB} (4th ed.). San Antonio, TX: Psychological Corporation.

Winner, E., McCarthy, M., Kleinman, S., & Gardner, H. (1979). First metaphors. *New Directions for Child Development*, *3*, 29–42. doi:10.1002/cd.23219790305

Winner, E., Rosenstiel, A. K., & Gardner, H. (1976). The development of metaphoric understanding. *Developmental Psychology*, *12*, 289–297. doi:10.1037/0012-1649.12.4.289