The Processing of Analogous Problems in the Verbal and Visual-Humorous (Cartoons) Modalities by Gifted/Average Children

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Abstract

Children encounter problem solving in their formal schooling mainly in the verbal modality, whereas they are exposed to cartoons in their leisure time in a context perceived as nonlearning and nonthreatening. Yet, cartoons can be conceived of as problems in the visual-humorous modality, analogous to verbal problems. This article examines how gifted and average children solve analogous problems in these two modalities (verbal and visual-humorous), including their ability to consciously transfer solutions from one modality to the other. Specifically, four variables are considered: (1) the correctness of solutions of analogous problems in both modalities; (2) the students' perceived difficulty of these problems; (3) their awareness of the correctness of their solutions; and (4) their awareness of the contribution of a learned source problem in one modality to the solution of an analogous target problem in the other. Gifted children, as expected, did better on the verbal problems, but improved their skills in both modalities once exposed to the solution of analogous problems in the visual-humorous modality. Average children tended to solve cartoons better than verbal problems, but working with cartoons increased their verbal problem-solving skills. Results suggest that cartoon solving in the classroom can enhance the problem-solving capabilities of both populations.

Even sternly serious textbooks are open to the friendly little cartoons. Perhaps most surprising, scholars are looking at the cartoon as a phenomenon worth studying” (p. 13).

Because of their communicative potential for a wide range of people, cartoons have become very popular in politics, social criticism, and advertisement. The communication media seem to unanimously exploit their influence. Usually based on everyday content, cartoons are perceived as a common, intellectually nondemanding way of expressing ideas. They have a unique ability to crystallize complex ideas or a vast amount of information into a succinct symbol (Harrison, 1985). The popularity of cartoons, and their vast distribution in the media, is training viewers in visual literacy that eventually will enhance cartoons’ popularity even more (Lucie-Smith, 1981).

Putting the Research to Use

As a general trend, cartoons were found to be effective learning resources for the gifted/average populations. Both populations seemed to gain from the intentional introduction of the visual-humorous modality as a means for learning problem solving. The average children seemed to benefit more from analogous problems in the visual-humorous (cartoons) than in the verbal modality. Thus, cartoons can be used as a vehicle for promoting problem solving in that population. On the other hand, the gifted seemed to have developed specifically high skills in the verbal modality. More structured exposure to the visual-humorous modality may encourage the development of complementary competencies.

The visual-humorous modality is due to become a legitimate learning environment within the school system. Its humor, friendliness, and everyday content can add playfulness and enjoyment to the learning situation, providing a vivid, “easy,” and highly communicative approach to problem solving for all students.
Cartoons as a Form of Problem Solving

Webster’s Dictionary defines a cartoon as “a drawing . . . caricaturing or symbolizing, often satirically, some event, situation, or person” (Neufeld, 1994, p. 216). This definition calls attention to two salient features of cartoons: their presentation in the visual modality and their humorous nature. What this definition fails to convey is that “understanding” cartoons can actually be considered a form of “friendly” problem solving requiring insight and that the cartoon’s humor stimulates internal motivation to search for a solution.

There are grounds to assume that the visual nature of cartoons can aid learning. The visual modality in general enhances understanding, retention, and retrieval of text by directing the learner to concentrate on important and critical information (Mayer & Sims, 1994). When presented visually, rather than verbally, even meaningless information is retained better (Kobus, Moses, & Bloom, 1994). Simons and Elster (1990) found that a text of words and pictures when integrated (rather than side by side) was effective in teaching reading to first graders. Diagrams and illustrations had a similar positive effect in learning geometry (Lovett & Anderson, 1994) and physics (Mayer, 1989), as did visual cues in insight problem solving (Beveridge & Parkins, 1987). This effect is attributed to the high imageability of the visual analogy, which focuses the solver’s attention on those elements important for understanding and solving the problem and aids in retention of the solution. The positive experience of solvers in the solution process also contributes to retrieval and transfer to new situations (Plyne, 1989). Moreover, the pleasure associated with the encounter with illustrations, and later through their recall, increases motivation (Levine & Redlich, 1986).

Humor, as another aspect of cartoons, has also been found to promote problem solving (Peter & Bill, 1982), as it provides a possible route to unconventional and original ideas and solutions (McGhee, 1979). Kohn (1988), the founder of the Journal of Irreproducible Results, claimed that some ideas that were raised as imaginative humorous anecdotes eventually led to inspiring creative inventions.

Cartoons can be characterized, then, as visual-humorous insight problems (or riddles). This is in keeping with Mayer’s (1992) broad definition of problem solving:

[An]y definition of “problem” should consist of the three ideas that (1) the problem is present in some state, but (2) it is desired that it be in another state, and (3) there is no direct, obvious way to accomplish the change. This definition is broad enough to include problems ranging from geometry ... and chess ... to riddles. (p. 5)

Solving these visual-humorous riddles involves the resolution of the incongruity among various constituents. This is an insight process that culminates in the “solution,” that is, getting the punch line (Shultz, 1972). Such a process requires the individual to abstract logical interrelationships among the visual, iconic, and verbal cues into a congruent solution. The gap between the incongruent and congruent situations is the source of amusement; the larger the gap, the stronger the laughter (Pien & Rothbart, 1976). Feuerstein and Hoffman (1988) claimed that the depicted incongruent situation brings the observer into a state of disequilibrium that becomes the driving force toward the resolution (i.e., toward reorganization of the incongruent pieces of the cartoon). For Perkins (1981), achieving laughter is a process of insight, an “a-ha” effect. To achieve this state, the viewer has to filter out critical pieces of information essential for the solution and then rearrange them into a coherent solution. This leads to a feeling of revelation and satisfaction followed by the laughter of relief. Along this process, as with insight problems, the viewer has to be active, use previous knowledge, and be imaginative in “filling in” missing pieces or resolving detected inconsistencies from other sources of information. Laughter serves as both motivation and a reassuring reward for a correct solution.

Verbal Versus Visual Modality in Analogical Problem Solving

McGhee (1979) equated the strategies needed to solve mathematical problems, nonhumorous puzzles that contain incongruities, and humorous stimuli, including cartoons. He provided an example of two analogous representations of an equivalent riddle in different modalities: a story and a cartoon. The story tells about Mr. Jones ordering a pizza in a restaurant. When asked by the waiter whether to cut it into six or eight slices, Mr. Jones answers that he prefers six, as he will be unable to finish eight pieces. In the analogous cartoon, a fat woman replaces Mr. Jones, the pizza is replaced by a cream-topped cake, and, instead of six pieces, the waiter refers to four. The presentation in the visual modality is situated in a coffee shop and includes one verbal sentence: “No! Don’t cut it into four pieces. I’m on a diet!” Notwithstanding the superficial differences, the two problems share the same deep structure, and the solution lies in realizing that no matter how many pieces a whole is divided into, their combination is still a whole. This analysis illustrates that cartoons are problems and that they can be structured as isomorphic analogies to verbal mathematical or insight problems that contain elements of incongruity. As such, cartoons can be considered analogous “hee-hee” problems to “a-ha” insight problems.

Analogies have been found to be instrumental in problem solving. When solvers are faced with a new problem, the spontaneous retrieval of an analogous one aids in the solution process (Coletta, Dominowski, Buyere, & Rellinger, 1995; Morrin, Law, & Pellegrino, 1994). To encourage analogical transfer, worked-out analogous examples are used to increase the stu-
dent’s reservoir of available solutions (Renkl, 1997; Robins & Mayer, 1993). Moreover, the more the problems differ in their surface structure, the wider the range of problems to which they can be transferred (e.g., Vollmeyer, Burns, & Holyoak, 1996).

Along this line, cartoons, whose concise, everyday content and visual humor promote the intrinsic motivation to search for solutions, may be useful as analogous examples. Their widespread distribution among ages and populations, as well as their clear out-of-school components, further contribute to making them an interesting subject of study in regard to analogical problem solving—not just as an added component that facilitates the understanding of verbal problems (e.g., Mayer, 1989), but as the modality in which the problem is presented. Though cartoons seem to be intuitively accepted as having some advantages over verbal presentations, there is little rigorous research regarding their potential as source problems for analogical learning and transfer.

The learnability potential of cartoons for different populations of children is of interest because they not only provide an alternative means of learning within the school system, but also because they can be geared to promote verbal problem solving and visual capabilities. The present study considers this issue in regard to gifted and average children. These populations have been chosen because the gifted are known to have good verbal and logical-mathematical skills (Gardner, 1993) and to excel at analogous connections (Davidson, 1986; Ferretti & Butterfield, 1992; Rahheim, 1988; Sternberg & Davidson, 1983), while little is known about the dispositions of the average population, which is much more heterogeneous. At the same time, both populations are exposed to the visual modality in the out-of-school environment. Thus, it is interesting to investigate what effect cartoons have upon the problem-solving capabilities of these two populations. Specifically, the paper addresses four questions that relate to possible differentiated performance of gifted and average children:

1. Are gifted and average children better able to solve cartoons than their analogous verbal problems?
2. Do they perceive cartoons as easier or more difficult problems than their analogous verbal ones?
3. Is there a difference in how gifted and average students assess the correctness or incorrectness of their solutions in either modality?
4. Is there a difference in their awareness of having learned from analogous source problems (verbal or visual)?

**Method**

**Subjects**

The research was conducted with 121 gifted and average students from an urban, middle-class background attending the same comprehensive school. The gifted subjects were seventh- and eighth-grade students with an IQ above 131 (n = 60) who were identified through IQ tests prepared by the Szold Institute for the Study of Behavioral Sciences and were in a high correlation with psychometric tests such as WISC. These students studied in special classes for gifted children. The average subjects were eighth and ninth graders defined as neither gifted nor as requiring special education (n = 61); they studied in regular classes. The difference in the ages of the populations was to ensure similar mental age (Planche, 1985).

**Materials**

Four main questionnaires were used: two that examined problem solving without prior learning (either visual or verbal modality) and two that reflected the transfer of solutions from one modality to the other after learning from worked-out analogous examples. Each student was given only one questionnaire out of each pair (1 or 2 and 3 or 4).

1. **Visual-Humorous Modality:** The questionnaire included two problems to be solved in the visual-humorous modality (cartoons). Also included were items in which students were asked to reflect upon the solution process. Specifically, they were asked to indicate the level of difficulty of the problem (subjective difficulty) and to assess the nature of their solution (correct, partially correct, or wrong).
2. **Verbal Modality:** This questionnaire comprised two verbal problems, analogous to the visual-humorous ones in the previous questionnaire. Here, too, subjects were asked about their solutions, as detailed above.
3. **Visual Sources/Verbal Targets:** The third questionnaire included two solved problems in the visual-humorous modality (cartoons), followed by two analogous verbal problems to be solved by the students. Additional items required students to reflect upon their solution process. In addition to questions about perceived difficulty and assessment of their correctness/incorrectness (see #1 above), the students were asked to state whether they had been aided by a similar problem they had already encountered and, if so, to specify its nature.
4. **Verbal Sources/Visual Targets:** This last questionnaire was identical to the previous one, except that the solutions were given for the verbal problems and subjects were required to solve the visual-humorous ones (cartoons). Here, too, they were asked about how they solved the problems.

The problems. All verbal problems took the form of riddles, such as the multiplying lilies problem used by Sternberg and Davidson (1983). These were presented as a short story (half a page), ending with instructions to “find the mistake.” The cartoons were collected from a variety of sources and adjusted to fit
the deep structure of the verbal problems. All were a single-panel cartoon (see Harrison, 1988) accompanied by one verbal statement tinged with humor. In the two questionnaires that tested for analogical transfer, the surface story of analogous problems was always different, and students did not receive any hints as to a possible connection between the source and target problems.

Validity of the analogous nature of the verbal and visual problems. The analogous nature of the source and target problems in the verbal and visual-humorous (cartoon) modalities was validated by two methods. Logical validation was achieved by the construction of an algorithm to represent the relational structure (the deep structure) of each problem (see Appendix A). This approach is similar to the process employed by Gick and Holyoak (1980) for the construction of analogous problems. For experimental validation, 37 teachers received a booklet containing 12 problems: 6 cartoons and 6 verbal. They were asked to match pairs of problems (visual and verbal) and provide a rationale for their answers. The agreement range between pairs was 78–92%. The pairs chosen for the research were those with the highest matches (81%, 86%, 89%, and 92%).

Procedure

Each student randomly received one questionnaire that examined problem solving without prior formal learning (in either visual or verbal modality) and, a month later, received another questionnaire that examined problem solving after learning from worked-out analogous examples (visual to verbal, or verbal to visual). In both situations, the questionnaires were randomly distributed. In the second set of questionnaires, students were not advised of the analogous nature of the problems or which pairs of problems matched one another. The time factor of a month between administrations of the two pairs of questionnaires was meant to neutralize possible connections between them (Gick & Holyoak, 1983; Holyoak & Koh, 1987).

Variables

Independent variables. The study comprised three independent variables: population (gifted or average students), modality (verbal or visual–humorous), and learning situation (no prior learning or transfer of worked-out analogous examples).

Dependent variables. The dependent variables were related to the solution process: the correctness of answers (reflecting actual difficulty); perceived difficulty; awareness of correctness or incorrectness; and conscious analogical transfer of the solution.

Scores for correctness were derived from students’ solutions. A correct answer received a score of 3, a partially correct one was scored 2, and an erroneous solution was scored 1. If the student did not solve a problem, this was considered a missing value. Thus, the measure of correctness was defined as the arithmetic mean of these scores for the two problems in the same modality (for each learning situation). When one of the solutions was coded as a missing value, the learning situation was considered a one-problem situation, and the correctness of solution measure was based on this problem only. Such cases were very rare. The highest possible average was 3 (all correct solutions); the lowest was 1 (no correct solutions).

The measure of perceived difficulty reflects how difficult the students believed the problems were (as opposed to how hard they actually were, as determined by correctness of solution, above). If a solver said that a problem was hard, a score of 3 was assigned; if of moderate difficulty, a score of 2 was given; and if the problem was easy, the score was 1. When no level of difficulty was indicated, it was considered a missing value. The measure of perceived difficulty for each solver was the arithmetic mean of these scores per learning situation (for the two problems in the same modality). When one of the solutions was coded as a missing value, the learning situation was considered a one-problem situation, and the perceived difficulty measure was based on this problem only. Such cases were very rare. The highest perceived difficulty measure was 3; the lowest was 1.

The measure of awareness of the nature of the solution reflects the degree of fit between actual performance (correctness of the solution) and the solver’s own assessment. Students who accurately assessed the nature of their solution (as correct, partially correct, or wrong) received a score of 2, indicating agreement between their assessment and their performance. A score of 1 was assigned when there was disagreement between perceived correctness and actual solution. Here, too, the measure for each solver was the arithmetic mean of these scores per learning situation. Cases in which the solver did not provide any information as to the nature of the solution were scored as a missing value. When one of the
solutions was coded as a missing value, the learning situation was considered a one-problem situation, and the mean of awareness measure was based on this problem only. Such cases were very rare. The highest mean was 2 (accurate awareness of the nature of one’s solution in all problems in the learning situation); the lowest was 1 (none of the student’s assessments were correct).

Conscious analogical transfer reflects the individual’s awareness that the worked-out source problems aided him or her in solving the analogous target problems in the other modality. It was calculated only for Situation 2, where an explicit solution process for the source problem was provided (although no explicit connection was made between target and source problems). When the solver indicated that he or she was aided by an analogous source problem, a score of 2 was assigned. When the solver stated that he or she was not aided in this manner, the score was 1. If the issue was not alluded to at all, the item was scored as a missing value. The measure for each solver was the arithmetic mean of these scores for the two problems. In cases where one of the solutions was coded as a missing value, the learning situation was considered a one-problem situation, and the measure of conscious transfer was based on this problem only. Such cases were very rare. Thus, the highest mean of conscious transfer was 2 and the lowest was 1.

### Results

#### Correctness of Solution

ANOVA of the correctness measure indicated that gifted children were significantly better at solving problems than average children ($F[1,105] = 65.56, p < .0001$). Moreover, children in both groups were better in Situation 2 (learning from worked-out analogous examples in the other modality) than in Situation 1 (no previous learning); $F[1,105] = 25.68, p < .0001$. A triple-order interaction was found among the independent variables: Population (gifted vs. average), modality (cartoons vs. verbal problems), and situation ($F[1,105] = 5.69, p < .05$; see Figure 1).

In order to analyze this interaction, simple interaction and simple main effects were calculated. The simple main effect of the difference between gifted and average children remained the same for the two situations, but not so the simple interaction of population and modality. The findings of this interaction are therefore presented separately for each learning situation (Table 1).

**Situation 1 (no previous learning).** A significant interaction was found between modality and population within this learning situation ($F[1,105] = 13.69, p < .001$). Gifted children performed better on the verbal tasks ($F[1,110] = 5.83, p < .05$), whereas average children did better on the visual ones.
(F[1,105] = 2.96, p = .088; a less rigid criteria for significance, but still acceptable).

**Situation 2 (learning from analogous problems).** Once worked-out problems were provided, a change in performance trend was perceptible. That is, there was no preferred modality for either population: No significant difference was found between the mean scores for gifted children (2.72 for cartoons and 2.90 for verbal problems) or for average children (1.96 vs. 2.28, respectively). Nor was there a significant interaction effect between population and modality. The gifted children performed better than the average children in both modalities (F[1,105] = 20.93, p < .0001).

**Perceived Difficulty**

Results indicate a main effect of situation upon perceived difficulty (F[1,105] = 4.98, p < .05). In Situation 2 (after learning), both populations considered the problems in both modalities as easier (1.98) than those in Situation 1 (2.04). Nonetheless, a triple-order interaction was found among population, modality, and situation (F[1,105] = 4.57, p < .05) (see Figure 2). Thus, the findings for each situation will be presented separately (Table 2).

**Situation 1.** When there was no previous formal learning, a main effect was found for Modality (F[1,105] = 9.35, p < .01): The cartoons were perceived as more difficult (2.32) than the verbal problems (1.98). There was no main effect of population, however, nor an interaction between this variable and modality. Furthermore, in the gifted population, there was a significant difference (F[1,106] = 10.78, p < .001) between the perceived difficulty of the cartoons (2.39) and that of the verbal problems (1.90), while there was no significant difference.

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**Figure 2. Mean Scores of Perceived Difficulty in Solving Verbal Problems and Cartoons in Two Situations (Without and With Prior Learning)**

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**Table 2**

Perceived Difficulty of Problems by Situation, Modality, and Population

<table>
<thead>
<tr>
<th>Situation</th>
<th>BMP</th>
<th>Modality</th>
<th>Population</th>
<th>Modality x Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>VH</td>
<td>Verbal</td>
</tr>
<tr>
<td>Situation 1</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.04</td>
<td>2.32</td>
<td>1.98</td>
<td>1.99</td>
</tr>
<tr>
<td>SD</td>
<td>.75</td>
<td>.56</td>
<td>.57</td>
<td>.80</td>
</tr>
<tr>
<td>N</td>
<td>115</td>
<td>55</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>Situation 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.98</td>
<td>1.86</td>
<td>2.08</td>
<td>2.16</td>
</tr>
<tr>
<td>SD</td>
<td>.74</td>
<td>.72</td>
<td>.78</td>
<td>.65</td>
</tr>
<tr>
<td>N</td>
<td>115</td>
<td>55</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>Beyond Situation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.15</td>
<td>2.00</td>
<td>2.29</td>
<td>2.22</td>
</tr>
<tr>
<td>SD</td>
<td>.47</td>
<td>.41</td>
<td>.48</td>
<td>.45</td>
</tr>
<tr>
<td>N</td>
<td>115</td>
<td>55</td>
<td>54</td>
<td>60</td>
</tr>
</tbody>
</table>

**Note.** BMP = Beyond Modality & Population; VH = Visual-humorous. * No missing value for either problem in the modality; ** One case of a missing value in one of the two problems in the modality; *** Two cases of a missing value in one of the problems in the modality.
for the average group. The latter perceived the difficulty of the cartoons (2.25) as similar to that of the verbal problems (2.08).

**Situation 2.** As with the measure for correctness of solution (actual difficulty), the pattern of results changed once worked-out analogous problems were provided in the other modality. The simple main effect of modality disappeared, and a simple main effect of population appeared ($F[1,105] = 6.79, p = .01$); the gifted perceived the problems in both modalities as more difficult than did the average. The average children perceived a similar difficulty for cartoons (1.79) and for verbal problems (1.78), whereas the gifted perceived the verbal problems as more difficult (2.34) than the visual ones (1.94; $F[1,10] = 4.32, p < .05$).

### Awareness of the Nature of the Solution

In terms of awareness of the correctness of their solutions, the gifted were significantly more accurate in their assessments than the average children ($F[1,105] = 44.56, p < .0001$). Moreover, the awareness of both populations was higher in Situation 2 (after learning) than in Situation 1 (no previous learning; $F[1,105] = 17.77, p < .0001$). In Situation 2, both the gifted and the average were scored higher in the verbal (1.97 and 1.56 respectively) and the visual-humorous modalities (1.81 and 1.46 respectively), as compared to Situation 1 (1.79 and 1.22 respectively vs. 1.48 and 1.34 respectively). As an interaction was found between Population and Modality ($F[1,105] = 4.86, p < .05$; see Figure 3), simple interaction and simple main effects were calculated for each situation (Table 3).

![Figure 3. Awareness of the Nature of the Solution of Verbal Problems and Cartoons in Two Situations (Without and with Prior Learning)](image)

### Table 3

*Awareness of the Nature of the Solution by Situation, Modality, and Population*

<table>
<thead>
<tr>
<th>Situation</th>
<th>BMP</th>
<th>Modality</th>
<th>Population</th>
<th>Modality x Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VH</td>
<td>Verbal</td>
<td>Gifted</td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>Gifted</td>
<td>Average</td>
<td></td>
<td></td>
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<tr>
<td><strong>Situation 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.39</td>
<td>1.41</td>
<td>1.53</td>
<td>1.53</td>
</tr>
<tr>
<td>SD</td>
<td>.48</td>
<td>.29</td>
<td>.42</td>
<td>.51</td>
</tr>
<tr>
<td>N</td>
<td>115</td>
<td>55</td>
<td>54</td>
<td>60</td>
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<tr>
<td><strong>Situation 2</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.72</td>
<td>1.64</td>
<td>1.78</td>
<td>1.90</td>
</tr>
<tr>
<td>SD</td>
<td>.53</td>
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<td>.38</td>
</tr>
<tr>
<td>N</td>
<td>115</td>
<td>55</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td><strong>Beyond Situation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.69</td>
<td>1.65</td>
<td>1.69</td>
<td>1.87</td>
</tr>
<tr>
<td>SD</td>
<td>.30</td>
<td>.34</td>
<td>.26</td>
<td>.19</td>
</tr>
<tr>
<td>N</td>
<td>115</td>
<td>55</td>
<td>54</td>
<td>60</td>
</tr>
</tbody>
</table>

*Note:* BMP = Beyond Modality & Population; VH = Visual-humorous. *No missing value for either problem in the modality; **One case of a missing value in one of the two problems in the modality; ***Two cases of a missing value in one of the problems in the modality.
Table 4

Conscious Analogical Transfer From Source to Target Problem (For Correct or Partially Correct Solutions)

<table>
<thead>
<tr>
<th>Situation 1</th>
<th>BMP</th>
<th>Modality</th>
<th>Population</th>
<th>Modality x Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>VH 1.13</td>
<td>Verbal 1.10</td>
<td>Gifted 1.16</td>
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<tr>
<td></td>
<td></td>
<td>VH 1.06</td>
<td>Verbal 1.21</td>
<td>Gifted 1.22</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.27</td>
<td>.23 .31</td>
<td>.29 .22</td>
<td>.21 .26</td>
</tr>
<tr>
<td>SD</td>
<td>83</td>
<td>43 40</td>
<td>56 27</td>
<td>31** 12**</td>
</tr>
<tr>
<td>N</td>
<td></td>
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</tbody>
</table>

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Discussion

Because of the encounter with cartoons and verbal problems in different contexts, one can expect that children develop different dispositions toward these two modalities. Cartoons are associated with something to enjoy and laugh at, whereas verbal problems are commonly associated with something to be solved. Verbal problems are much more common within formal education, and cartoons, when used in the classroom, are usually meant to support the verbal text without carrying an independent message. Thus, it was not surprising that students of different capabilities (gifted vs. average) coped with the two modalities in different ways.

Correctness of Solution

When there was no prior learning (Situation 1), gifted children, as expected, were better solvers of the verbal problems, while average children did better on the cartoons. Whether these findings can be attributed to different dispositions the learners developed during their studies or to a need for different kinds of intelligence to cope with problems in the different modalities remains an open question.

The learning capabilities of the gifted are expressed in their significantly higher achievements in Situation 2 than in Situation 1: After learning the formal solution processes, their achievements increased in both modalities. The relative advantage of the average children in solving cartoon problems disappeared, so that both groups received similar scores for the verbal and visual-humorous modalities. This finding suggests that worked-out source problems in either of these modalities has a similar effect on the solution of target problems in the other modality. That is, both cartoons and verbal problems are effective sources of analogical problem solving.

In regard to conscious transfer of the solution from one modality to another, only students who met the following criteria in Situation 2 were considered in the calculation of the measure: (1) they admitted being helped by an appropriate analogous source problem; and (2) their solutions were correct or partially correct. A significant interaction was found between modality (of the source problems) and population ($F[1,82] = 5.631, p < .05$). Whereas the gifted reported that cartoons helped them less than verbal source problems (1.06 vs. 1.22, respectively), the average children reported that they helped them more (1.21 vs. 1.07 respectively; Table 4). No significant main effect of population or modality was found.
Considering the greater difficulty average children had in solving verbal (as opposed to visual-humorous) problems without formal learning (Situation 1), training in solving cartoons (Situation 2) seems to have enhanced their ability to cope with verbal problems. This improvement may indicate a preference of average children for the visual-humorous modality in learning and in transfer processes. In contrast, the initial difficulty the gifted had in solving cartoons (Situation 1) disappeared after they learned verbal problems (Situation 2), meaning the verbal problems had an aiding effect for the gifted that was similar to the aiding effect the cartoons had for the average students.

**Perceived Difficulty**

Exposure to the solutions of analogous source problems in either modality decreased the perceived difficulty of the target problems for the gifted, as well as the average (reflected also in the correctness of their solutions). These results can be indicative that both the cartoons and the verbal problems are effective learning source problems. It seems that the gains of the average children from learning in both modalities were similar. This is indicative from their similar perceived difficulties of cartoons and verbal problems, before and after learning. However, the gains of the gifted from learning were differential. Before learning (Situation 1), the gifted perceived the verbal problems as less difficult than cartoons. This preference for the verbal modality is also indicated in their learning (Situation 2) from verbal problems. The latter is evident from the decrease of the perceived difficulty of cartoons as a result of transfer from worked-out verbal problems. The learning pattern of the gifted from the cartoons seems to be different than from verbal analogous problems. After learning from solved cartoons, their perceived difficulty of verbal problems increased as compared to that of cartoons; the verbal problems were perceived to be relatively more difficult than the cartoons. This finding can be explained by the high verbal skills of the gifted population (Gardner, 1993). In contrast, the average children may be considered as a heterogeneous population with no definite strength.

It is of interest that the gifted, after learning, perceived the problems in both modalities as more difficult than did the average. It seems that, after learning, the gifted, because of their advanced metacognitive skills (Shore & Dover, 1987), came to appreciate the complexity of the solution processes.

**Awareness of the Nature of the Solution**

The gifted were more successful than the average children in assessing their performance, regardless of the modality of the problem. This can probably be attributed to their better metacognitive skills (Coleman & Shore, 1991). In Situation 1, however, the gifted children were significantly more accurate in assessing their success in solving verbal problems than cartoons (whereas, for average children, no difference was found between modalities). After learning (Situation 2), awareness of the nature of solutions increased for both modalities, and both populations attained a similar level. These results indicate that learning analogical source problems in either modality contributes to the level of accuracy in assessing the solutions of target problems.

**Conscious Analogical Transfer**

The gifted are known to make better spontaneous transfer of source problems to new situations (Zook & Maier, 1994). Indeed, the gifted performed better after learning from both cartoons and verbal problems (Situation 2). As to acknowledging this help, there was no significant difference, beyond modality, between the two populations. However, there is an interesting significant difference in the modality each population acknowledged: The gifted acknowledged being helped by the verbal problems, whereas the average children acknowledged being helped by the visual-humorous modality (cartoons). This is congruent with all previous results that point to a preference of the gifted for the verbal modality and of the average children for cartoons.

We wish to suggest that these results may be interpreted by bearing in mind two different perspectives. One perspective suggests that both the gifted and the average are capable of learning from cartoons, but the former have developed a preferred predisposition toward verbal problems, which is within their expertise (Prawat, 1989). The other possible perspective attributes the results to an intrinsic difference between the populations. Gifted individuals are gifted because they have capabilities that are different from average individuals: The gifted are particularly good in verbal intelligence (Gardner, 1993), whereas average children perform better in terms of visual intelligence. Of course, this may be the question of what comes first, the chicken or the egg, and that concern is in line with the debate of what makes a gifted person gifted.

A general implication that derives from this research is the learning potential that cartoons can provide for problem solving in the formal school setting. The visual-humorous modality was found to be friendly to gifted and average children, though the average have benefited more from learning by worked-out analogous cartoons. The effectiveness of worked-out cartoons for learning may be indicative of the need for intentional analysis of cartoons to become learning sources. Just exposure and feelings of enjoyment may not suffice in developing schemas for problem solving.

**References**


**Author Note**

The reported research is part of the master’s thesis submitted by Rama Klavir to the Ben Gurion University.
Appendix A

The Verbal Insight Problem

Mr. Brown was the manager of the “Sun Shine” furniture factory. On Thursday, in an executive meeting, it was decided that Mr. Brown should go to Amsterdam to sign a contract. The news spread among the workers and to Sam, the factory’s night watchman. Sam ran into Mr. Brown’s head office in a panic and said: “Mr. Brown, I had a terrible dream last night. I dreamt all night about your trip to Amsterdam. In my dream an assassin attacked and killed you.” At that moment, the secretary entered and told Mr. Brown that he has to hurry if he wants to catch his plane. The manager didn’t pay attention to the night watchman’s warning and went on his trip.

A week later, Mr. Brown returned from Amsterdam safe and sound after signing the contract. The first thing he did was to fire the night watchman.

Who made the mistake here, and what led Mr. Brown to his decision?

The Cartoon

![Image of the cartoon]

The Analogue Elements Between the Cartoon and the Verbal Insight Problem

<table>
<thead>
<tr>
<th>Solution Structure</th>
<th>The Elements of the Deep Structure</th>
<th>The Verbal Insight Problem</th>
<th>The Cartoon</th>
</tr>
</thead>
</table>
| If, the duty of Person A is to execute X | • Person A
• A duty to execute X | • Night watchman
• Watching the factory at night | • Fireman
• Fire extinguishing |
| And if, Person B is responsible that Person A will execute X | • Person B is the employer of Person A
and is responsible that Person A will execute X | • Mr. Brown, the manager of the night watchman | • The captain of the fireman |
| And if, Person A does not execute X | • Person A does not execute X | • Sleeping at night instead of watching the factory | • Watching TV instead of extinguishing the fire |
| And if, Person A himself tells it to Person B | • The employee disclosed himself unintentionally | • By telling his dream he exposed his night sleep to the boss | • By telling what they say on TV he exposed his TV watching to the boss |
| Then, Person B knows that Person A is not executing his duty and may dismiss him. | • The employer of Person A knows that person A is not executing his duty and may dismiss him. | • The manager fired the night watchman. | • The captain will fire the fireman. |