Verbal analogy items, consisting of an ambiguous stimulus word pair and two unambiguous response word pairs as choice alternatives, were presented to psychology students in a counterbalanced design to discover if preferences existed between the two competing relations in each item. The data were analyzed to see if these preferences ordered themselves into a hierarchy. With only half of a full paired-comparisons matrix available for study, the data suggest that a hierarchical ordering of preferences for relations exists, with the cause-effect relation judged most readily and the order-time relation least readily. The results also suggest a need for developmental research into the origins of these preferences and investigation of the role of both individual differences and cultural differences. (Author/LL)
Technical Report No. 8

THE HIERARCHICAL ORDERING OF PREFERENCE FOR RELATIONS IN SOLVING VERBAL ANALOGY ITEMS

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February 1975

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Office of Naval Research

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Analogy
Analogy reasoning
Analogy test
Cognition of relations

Semantic relations
Verbal reasoning
Verbal analogies

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The Hierarchical Ordering of Preferences for Relations in Solving Verbal Analogy Items

Eileen Q. Monson and Rene' V. Dawis

In previous technical reports in this series, it has been shown that type of relation and relation education frequency are important variables influencing the difficulty of verbal analogy items. The Relation Education Index (REI) was developed as a measure of the frequency with which a given logical relation is educed in a given word pair. In developing REI norms, it was found that REIs differed from word pair to word pair for given relations, and from relation to relation for given word pairs. It was also found that the same word pair could have equivalent REIs for two or more relations.

If two relations are both available to be educed at the same high strength, is there a preference for one over the other? Would such preferences, if they exist, order themselves into a hierarchy? These questions were among those raised by the data on REI norms. The present report is about a study conducted to investigate these two questions.

Method

Instrumentation

Using the REI norms for college students (Technical Report No. 4; Soriano, Dawis, & Siojo, 1974) verbal analogy items were constructed, consisting of an "ambiguous" word pair as the stimulus and two "unambiguous" word pairs as the response alternatives. "Ambiguous" word pairs, i.e., with two highly educible relations, were selected according to the following rules:

1. The word pair must have only two relations with REIs of 70 or higher.
2. The two relations should not differ in REI value by more than five points.
3. The two relations should have REI values higher than all other relations by at least 20 points.
"Unambiguous" word pairs were selected to meet the following rules:

1. The word pair must have only one relation with an REI of 70 or higher.
2. This relation should have an REI value higher than all other relations by at least 20 points.

Thus, an analogy item could be constructed with an ambiguous word pair as the stimulus pair, and two unambiguous word pairs (one for each of the stimulus-pair's highly educible relations) as the response pairs (alternatives). One additional rule was needed: The two unambiguous word pairs chosen for the same item should not differ in REI value for their most highly educible relation by more than 10 points. (A more stringent criterion of five points was set originally, but only a few items could be constructed which met this criterion.) Furthermore, stimulus and response word pairs were matched as closely as possible in REI value for the relations of concern (the most highly educible relations).

The items were put together in an instrument called the Relation Recognition Exercise. Two forms, A and B, of the Exercise were constructed with different item order and with the order of the two response word pairs for each item reversed on the second form. The Exercise booklet, shown in the Appendix, contained a cover page, biographical information sheet, instructions, and 68 items.

Table 1 shows the number of items written for each pairing of relations. As Table 1 shows, it was easier to write items for some pairings than for others, and items could not be written for half of the possible pairings.

The eight relations used in the Relation Recognition Exercise were:

1. Class-member—when one member of the pair includes the other or is a member of the other.
2. Extrinsic Functional—when both members in the pair perform the same activity or have the same use.
3. Intrinsic Functional—when one member of the pair performs some activity on or for the other.
Table 1

Number of Verbal Analogy Items

Written for Each Pairing of Relations

<table>
<thead>
<tr>
<th>First Relation</th>
<th>Second Relation&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>1. Class-Member</td>
<td>3</td>
</tr>
<tr>
<td>2. Extrinsic Functional</td>
<td>1</td>
</tr>
<tr>
<td>3. Intrinsic Functional</td>
<td>--</td>
</tr>
<tr>
<td>4. Similarity/Equivalence</td>
<td>--</td>
</tr>
<tr>
<td>5. Conversion/Process</td>
<td>2</td>
</tr>
<tr>
<td>6. Order/Time</td>
<td>6</td>
</tr>
<tr>
<td>7. Opposite</td>
<td></td>
</tr>
<tr>
<td>8. Cause-Effect</td>
<td></td>
</tr>
</tbody>
</table>

Note. Two items were dropped (see text), to leave a total of 66 items.

<sup>a</sup>Same relation as designated under "First Relation,"
(4) Similarity/Equivalence—when both members of the pair are similar or equivalent.

(5) Conversion/Process—when one member of the pair is converted or processed from the other.

(6) Order/Time—when both members of the pair follow one another in a certain order or in time.

(7) Opposite—when the two members of the pair are opposites to each other.

(8) Cause-Effect—when one member of the pair is a cause of the other (the other is an effect of the first).

Subjects

The subjects for this study were college students from an introductory psychology course. The majority of students were middle to upper class, white, freshmen or sophomores, and included roughly equal numbers of males and females. Each subject volunteered for the study in exchange for two points toward the final course grade. A total of 71 individuals completed the Relation Recognition Exercise, with 35 taking Form A and 36, Form B.

Data Collection Procedure

The subjects were given alternative blocks of time during which they could report for the study. Subjects reported usually alone or in small groups of two or three. Upon reporting, the subjects were told about the study (which was described to them as a "relation recognition exercise"), and they were given the test booklets. The subjects first filled out the biographical information sheet (see Appendix for a copy). Then they read the directions silently and proceeded to complete the Exercise. No time limits were given for completion of the Exercise.

Data Analysis

Two items were eliminated from the study. One of them was found to be
reproduced incorrectly on Form B. A recheck had earlier shown that the two items failed to meet the criteria for item construction discussed above.

To check for response set, the influence of order of presentation of the response alternatives was analyzed by comparing response distributions on the two forms. This analysis was done first, before proceeding with other analyses.

The main data analyses were directed at the two research hypotheses: (a) whether, for a given item, there was a difference in choice of alternative, i.e., in preference for one relation over the other in the eduction of relations; and (b) if such differences existed, whether the relations were ordered in these preferences in a recognizable hierarchy. For the first hypothesis, the significance of the observed deviation from a 50-50 response distribution, expected under the null hypothesis, was tested. This was done for each item from each form and from both forms combined. For the second hypothesis, the results of the preceding analysis were summarized in an incomplete paired comparisons matrix, pairing each relation with every other relation, and a ratio was calculated of the number of times a given relation was preferred to the number of pairings for the given relation. Furthermore, the proportion of preferences (frequency of preference over total number of pairings across all subjects) for each relation was cumulated for the total data set to see if a hierarchy emerged.

Results

Table 2 shows the distribution of responses across all items in each form of the Relation Recognition Exercise. It will be recalled that order of presentation for the response alternatives was reversed for Form B, i.e., response alternative a for each item on Form A was response alternative b on the same item on Form B. A visual inspection of Table 2 shows an almost identical proportion of choices for the same response alternative regardless of position. It was therefore concluded that response set (i.e., a position preference) did not influence the results of the study to any significant degree.
Table 2
Distribution of Response Choices Across All Items of the Relation Recognition Exercise, by Form

<table>
<thead>
<tr>
<th>Response Alternative</th>
<th>Form</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>Combined</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>a</td>
<td>1,091</td>
<td>47.23</td>
<td>1,225</td>
<td>51.56</td>
<td>2,316</td>
</tr>
<tr>
<td>b</td>
<td>1,172</td>
<td>50.72</td>
<td>1,131</td>
<td>47.60</td>
<td>2,303</td>
</tr>
<tr>
<td>No response</td>
<td>47</td>
<td>2.03</td>
<td>20</td>
<td>0.84</td>
<td>67</td>
</tr>
</tbody>
</table>

Note. Response alternative a in Form A is response alternative b in Form B and vice versa.
Table 3

Distribution of Response Choices to the Relation Recognition Exercise, by Item and Form

<table>
<thead>
<tr>
<th>Relation(^a)</th>
<th>Form A</th>
<th></th>
<th>Form B</th>
<th></th>
<th>Combined</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Item</td>
<td>% Choosing</td>
<td>Item</td>
<td>% Choosing</td>
<td>% Choosing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td>P(^b) Q(^b)</td>
<td>No.</td>
<td>P Q</td>
<td>P Q</td>
<td></td>
</tr>
<tr>
<td>Relation 1 (P)(^b)</td>
<td>vs. 2 (Q)(^b)</td>
<td>46</td>
<td>71.4 28.6</td>
<td>63 41.7 55.6(^c)</td>
<td>56.3 42.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>20.0 77.2</td>
<td>46  36.1 63.9</td>
<td>28.2 70.4(^*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>5.7 91.4</td>
<td>44  16.7 83.3</td>
<td>11.3 87.3(^*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All(^d)</td>
<td>32.4 65.7</td>
<td>All  31.5 67.6</td>
<td>31.9 66.7(^**)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relation 1 (P)</td>
<td>vs. 3 (Q)</td>
<td>2</td>
<td>68.6 31.4</td>
<td>10  36.1 63.9</td>
<td>52.1 47.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2.9 97.1</td>
<td>54  5.6 94.4</td>
<td>4.2 95.8(^**)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>51.4 48.6</td>
<td>5  50.0 50.0</td>
<td>50.7 49.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>0.0 97.1</td>
<td>60  8.3 88.9</td>
<td>4.2 93.0(^**)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>65.7 31.4</td>
<td>20  63.9 33.3</td>
<td>64.8 32.4(^**)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>11.4 85.7</td>
<td>67  16.7 80.6</td>
<td>14.1 83.1(^**)</td>
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<td></td>
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<tr>
<td></td>
<td>39</td>
<td>40.0 60.0</td>
<td>32  27.8 72.2</td>
<td>33.8 66.2(^**)</td>
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<tr>
<td></td>
<td>45</td>
<td>94.3 5.7</td>
<td>37  88.9 11.1</td>
<td>91.6 8.5(^**)</td>
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<td></td>
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<tr>
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<td>49</td>
<td>68.6 31.4</td>
<td>19  69.4 30.6</td>
<td>69.0 31.0(^**)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>51.4 48.6</td>
<td>58  47.2 50.0</td>
<td>49.3 49.3</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>63</td>
<td>34.3 62.9</td>
<td>33  38.9 61.1</td>
<td>36.6 62.0(^*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>44.4 54.6</td>
<td>All  41.2 57.8</td>
<td>42.8 56.2(^**)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(continued)
Table 3 continued

<table>
<thead>
<tr>
<th>Relation&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Form A</th>
<th>Form B</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pairing</td>
<td>Item</td>
<td>% Choosing</td>
<td>Item</td>
</tr>
<tr>
<td></td>
<td>No. P&lt;sub&gt;b&lt;/sub&gt; Q&lt;sub&gt;b&lt;/sub&gt;</td>
<td></td>
<td>No. P Q</td>
</tr>
</tbody>
</table>

Relation 1<sup>°</sup>(P) vs. 4 (Q)

<table>
<thead>
<tr>
<th>No.</th>
<th>P&lt;sub&gt;b&lt;/sub&gt; Q&lt;sub&gt;b&lt;/sub&gt;</th>
<th>Item % Choosing</th>
<th>No. P Q</th>
<th>Item % Choosing</th>
<th>% Choosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>80.0</td>
<td>17.1</td>
<td>66</td>
<td>80.6</td>
<td>16.7</td>
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<tr>
<td>67</td>
<td>37.1</td>
<td>57.1</td>
<td>3</td>
<td>41.7</td>
<td>58.3</td>
</tr>
<tr>
<td>All</td>
<td>58.6</td>
<td>37.1</td>
<td>61.1</td>
<td>37.5</td>
<td>59.9</td>
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</table>

Relation 1 (P) vs. 5 (Q)

<table>
<thead>
<tr>
<th>No.</th>
<th>P&lt;sub&gt;b&lt;/sub&gt; Q&lt;sub&gt;b&lt;/sub&gt;</th>
<th>Item % Choosing</th>
<th>No. P Q</th>
<th>Item % Choosing</th>
<th>% Choosing</th>
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<tbody>
<tr>
<td>18</td>
<td>74.3</td>
<td>22.9</td>
<td>8</td>
<td>58.3</td>
<td>41.7</td>
</tr>
<tr>
<td>22</td>
<td>51.4</td>
<td>45.7</td>
<td>17</td>
<td>63.9</td>
<td>33.3</td>
</tr>
<tr>
<td>25</td>
<td>11.4</td>
<td>85.7</td>
<td>31</td>
<td>38.9</td>
<td>61.1</td>
</tr>
<tr>
<td>28</td>
<td>62.9</td>
<td>34.3</td>
<td>29</td>
<td>63.9</td>
<td>36.1</td>
</tr>
<tr>
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<td>0.0</td>
<td>97.1</td>
<td>34</td>
<td>11.1</td>
<td>88.9</td>
</tr>
<tr>
<td>41</td>
<td>31.4</td>
<td>68.6</td>
<td>39</td>
<td>27.8</td>
<td>72.2</td>
</tr>
<tr>
<td>44</td>
<td>65.7</td>
<td>34.3</td>
<td>16</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>48</td>
<td>74.3</td>
<td>25.7</td>
<td>61</td>
<td>52.8</td>
<td>41.7</td>
</tr>
<tr>
<td>52</td>
<td>40.0</td>
<td>60.0</td>
<td>13</td>
<td>38.9</td>
<td>61.1</td>
</tr>
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<td>59</td>
<td>2.9</td>
<td>94.3</td>
<td>12</td>
<td>13.9</td>
<td>86.1</td>
</tr>
<tr>
<td>61</td>
<td>8.6</td>
<td>88.6</td>
<td>22</td>
<td>11.1</td>
<td>88.9</td>
</tr>
<tr>
<td>64</td>
<td>37.1</td>
<td>60.0</td>
<td>41</td>
<td>36.1</td>
<td>63.9</td>
</tr>
<tr>
<td>All</td>
<td>38.3</td>
<td>59.8</td>
<td>All</td>
<td>38.9</td>
<td>60.4</td>
</tr>
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Relation 1 (P) vs. 6 (Q)

<table>
<thead>
<tr>
<th>No.</th>
<th>P&lt;sub&gt;b&lt;/sub&gt; Q&lt;sub&gt;b&lt;/sub&gt;</th>
<th>Item % Choosing</th>
<th>No. P Q</th>
<th>Item % Choosing</th>
<th>% Choosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>74.3</td>
<td>22.9</td>
<td>45</td>
<td>69.6</td>
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<td>48.6</td>
<td>48.6</td>
<td>68</td>
<td>33.3</td>
<td>66.9</td>
</tr>
<tr>
<td>24</td>
<td>40.0</td>
<td>57.1</td>
<td>47</td>
<td>44.4</td>
<td>55.6</td>
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<td>20.0</td>
<td>77.1</td>
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<td>27.8</td>
<td>72.2</td>
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<tr>
<td>47</td>
<td>97.1</td>
<td>2.9</td>
<td>40</td>
<td>91.7</td>
<td>8.3</td>
</tr>
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<td>56.0</td>
<td>41.7</td>
<td>All</td>
<td>53.3</td>
<td>46.1</td>
</tr>
</tbody>
</table>

(continued)
Table 3 continued

| Relation \* \Pairing | Form A | | Form B | | Combined | |\% Choosing | |\% Choosing | |\% Choosing |
|----------------------|------------------|------------------|------------------|------------------|
|                      | Item \[^{p}\] | No. | % Choosing | | Item \[^{q}\] | No. | % Choosing | | % Choosing |
| Relation 1 (P)       |                  |      |            | |                  |      |            | | |
| vs. 8 (Q)           | 32               | 0.0  | 97.1       | | 15               | 11.1 | 88.9       | | 5.6   | 93.0** |
| Relation 2 (P)       |                  |      |            | |                  |      |            | | |
| vs. 3 (Q)           | 51               | 20.0 | 80.0       | | 9                | 27.8 | 72.2       | | 23.9  | 76.1** |
| Relation 2 (P)       |                  |      |            | |                  |      |            | | |
| vs. 4 (Q)           | 1                | 14.3 | 85.7       | | 18               | 11.1 | 88.9       | | 12.7  | 87.3** |
|                     | 4                | 40.0 | 60.0       | | 4                | 27.8 | 66.7       | | 33.8  | 63.4** |
|                     | 10               | 14.3 | 82.9       | | 38               | 25.0 | 75.0       | | 19.7  | 78.9** |
|                     | 17               | 22.9 | 74.3       | | 56               | 13.9 | 83.3       | | 18.3  | 78.9** |
|                     | 19               | 40.0 | 57.1       | | 55               | 41.7 | 55.6       | | 40.9  | 56.3 |
|                     | 20               | 20.0 | 77.1       | | 48               | 33.3 | 66.7       | | 26.8  |       |
|                     | 26               | 34.3 | 62.9       | | 36               | 33.3 | 66.7       | | 33.8  | 64.9* |
|                     | 27               | 42.9 | 54.3       | | 64               | 55.6 | 41.7       | | 49.3  | 47.9 |
|                     | 29               | 14.3 | 82.9       | | 51               | 27.8 | 72.2       | | 21.1  | 77.5** |
|                     | 35               | 22.9 | 74.3       | | 65               | 22.2 | 75.0       | | 22.5  | 74.6** |
|                     | 36               | 60.0 | 27.1       | | 21               | 69.4 | 30.6       | | 64.8  | 33.8* |
|                     | 42               | 3.7  | 94.3       | | 27               | 25.0 | 75.0       | | 15.5  | 84.5** |
|                     | 53               | 48.6 | 51.4       | | 24               | 50.0 | 50.0       | | 49.3  | 50.7 |
|                     | 54               | 51.4 | 48.6       | | 49               | 38.9 | 61.1       | | 45.1  | 54.9 |
|                     | 58               | 40.0 | 57.1       | | 57               | 58.3 | 36.1       | | 49.3  | 46.5 |
|                     | 60               | 37.1 | 57.1       | | 43               | 69.4 | 30.6       | | 63.5  | 43.7 |
|                     | 68               | 11.4 | 85.7       | | 35               | 22.2 | 77.8       | | 16.9  | 81.7** |
|                     | All              | 30.6 | 67.2       | | All              | 36.8 | 61.9       | | 33.7  | 64.5** |

(continued)
Table 3 continued

<table>
<thead>
<tr>
<th>Relation a Pairing</th>
<th>Form A</th>
<th>Form B</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Item</td>
<td>% Choosing</td>
<td>Item</td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td>p&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Q&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Relation 2 (P)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vs. 5 (Q)</td>
<td>11</td>
<td>20.0</td>
<td>77.1</td>
</tr>
<tr>
<td>Relation 2 (P)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vs. 8 (Q)</td>
<td>62</td>
<td>31.4</td>
<td>65.7</td>
</tr>
<tr>
<td>Relation 3 (P)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vs. 7 (Q)</td>
<td>65</td>
<td>.25.7</td>
<td>71.4</td>
</tr>
<tr>
<td>Relation 5 (P)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vs. 6 (Q)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>Q</td>
<td>17.1</td>
</tr>
<tr>
<td></td>
<td>42</td>
<td>54.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>61.4</td>
<td>35.7</td>
</tr>
<tr>
<td>Relation 6 (P)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vs. 7 (Q)</td>
<td>14</td>
<td>51.4</td>
<td>45.7</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>17.1</td>
<td>80.0</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>60.0</td>
<td>37.1</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>37.1</td>
<td>60.0</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>54.3</td>
<td>45.7</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>14.3</td>
<td>85.7</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>39.1</td>
<td>59.1</td>
</tr>
<tr>
<td>Relation 6 (P)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vs. 8 (Q)</td>
<td>21</td>
<td>5.7</td>
<td>91.4</td>
</tr>
<tr>
<td></td>
<td>57</td>
<td>20.0</td>
<td>77.1</td>
</tr>
<tr>
<td></td>
<td>66</td>
<td>17.1</td>
<td>80.0</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>14.3</td>
<td>82.9</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>P and Q designate the response alternatives as indicated in the relation pairing column.</td>
</tr>
<tr>
<td>c</td>
<td>Sums may not total 100.0% due to nonresponse.</td>
</tr>
<tr>
<td>d</td>
<td>Data for all items combined for particular pairing of relations.</td>
</tr>
<tr>
<td>*P ≤ .05 that a 50-50 hypothesis is correct.</td>
<td></td>
</tr>
<tr>
<td>**P ≤ .01 that a 50-50 hypothesis is correct.</td>
<td></td>
</tr>
</tbody>
</table>
Table 3 contains the distribution of response choices for each item, separately for each form and for the two forms combined. The data are grouped by each pairing of relations. Table 3 also gives the combined data for all items of a given relation pairing. Only the data for the last two columns—for the two forms combined—were tested for significant deviation from a 50-50 hypothesis.

Examination of Table 3 shows that for the most part (in 59 of the 66 items), the data for Form A and Form B are similar, i.e., the two sets of data agree in direction of choice (which relation appeared to be preferred). Data for the two forms also agree to a large extent on degree of choice (percentage making the choice). The average absolute difference between the two forms in percentage choosing the preferred relation was 8.6%, with the difference exceeding 20% in only six of the 66 items.

Table 3 also shows that in 46 of the 66 items, one relation was endorsed significantly more frequently than the other. When the data for all the items pertinent to a particular relation pairing were combined, a significant preference for one relation over the other was observed for all but one of the 14 relation pairings (the exception was Class-Member vs. Order/Time). The preference results for these combined data are summarized in Table 4.

Table 4 shows that Relations 5 and 8 were most preferred, with each being preferred three times out of the three pairings; Relations 3 and 7 were next most preferred (two out of three pairings); Relation 1 was preferred 1.5 times; Relations 2 and 4 were preferred once each, and Relation 6 was preferred only 0.05 times.

A different way of estimating the hierarchy of preference might proceed as follows: Relation 8 is preferred over Relations 1, 2, and 6 but Relation 1 is preferred over Relation 4, so by the rule of transitivity, Relation 8 is preferred over Relation 4 as well. By applying this rule, we get:
Table 4
Preference Matrix for the Pairing of Relations in the Relation Recognition Exercise

<table>
<thead>
<tr>
<th>Relation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Class-Member</td>
<td>1²</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>.05</td>
<td>--</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2. Extrinsic Functional</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3. Intrinsic Functional</td>
<td>0</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>4. Similarity/Equivalence</td>
<td>1</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>5. Conversion/Process</td>
<td>0</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>6. Order/Time</td>
<td>.05</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Opposites</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>8. Cause-Effect</td>
<td>0</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

¹ = Column relation is preferred
0 = Column relation is not preferred
.05 = Neither relation is preferred
-- = No pairing
We find that there are two groups of relations in terms of preferences: the preferred group consists of Relations 8, 5, 7, and 3, while the less preferred group consists of Relations 1, 2, 4, and 6.

Yet another way of estimating the hierarchy of preference is by summarizing the data in terms of the proportion of items in which a clear preference was exhibited for one relation over another. This summary is shown in Table 5. If the percentage of item preference were used as the index, the order of preference would be as follows:

8, 7, 4, 5; 3, 1, 2, 6

This ordering would be consistent with the rank order shown in preceding ways of looking at the hierarchy of preferences, except for the position of Relation 4 (which is ranked much higher here than in other estimates).

A final method of estimating the hierarchy of preference would be to sum the number of times (items x subjects) a relation was preferred and to take this sum as a proportion of the number of possible times it could have been preferred. Table 6 shows the results for this method. Again, the hierarchy of relation preference shown in Table 6 is consistent with previously derived hierarchies.
Table 5

Item Preference Matrix for the Pairing of Relations in the Relation Recognition Exercise

<table>
<thead>
<tr>
<th>Relation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-Member</td>
<td>2.5</td>
<td>6.5</td>
<td>0.5</td>
<td>7.5</td>
<td>2</td>
<td>--</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Extrinsic Functional</td>
<td>0.5</td>
<td>1</td>
<td>13</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Intrinsic Functional</td>
<td>4.5</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Similarity/Equivalence</td>
<td>1.5</td>
<td>4</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Conversion/Process</td>
<td>4.5</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>1.5</td>
<td>0.5</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Order/Time</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>1.5</td>
<td>4.5</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opposite</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>1.5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Cause-Effect</td>
<td>0</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

Total preferences: 14.0 6.5 7.5 13.5 10.0 4.0 5.5 5
Number of item pairings: 34 23 13 19 15 16 7 5
Preference percentage: 41.2 28.3 57.7 71.0 66.7 25.0 78.6 100
Rank order: 6 7 5 3 4 8 2 1
Table 6
Frequency of Preference for Relations
Across Items x Subjects

<table>
<thead>
<tr>
<th></th>
<th>N Preference</th>
<th>N Possible</th>
<th>% Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>294</td>
<td>355</td>
<td>82.8</td>
</tr>
<tr>
<td>7.</td>
<td>322</td>
<td>497</td>
<td>64.8</td>
</tr>
<tr>
<td>5.</td>
<td>660</td>
<td>1,065</td>
<td>62.0</td>
</tr>
<tr>
<td>4.</td>
<td>832</td>
<td>1,349</td>
<td>61.7</td>
</tr>
<tr>
<td>3.</td>
<td>513</td>
<td>923</td>
<td>55.6</td>
</tr>
<tr>
<td>1.</td>
<td>1,014</td>
<td>2,414</td>
<td>42.0</td>
</tr>
<tr>
<td>2.</td>
<td>598</td>
<td>1,633</td>
<td>36.6</td>
</tr>
<tr>
<td>6.</td>
<td>421</td>
<td>1,136</td>
<td>34.0</td>
</tr>
</tbody>
</table>
Conclusion

It would appear, from this study, that in analogy test situations in which there is a choice between relations to educe, some relations are preferred over others. In this study, the relations Cause-Effet, Opposite, Conversion/Process, and Intrinsic-Functional tended to be preferred over Similarity/Equivalence, Class-Member, Extrinsic-Functional and Order/Time. There is some suggestion from the data that a hierarchy of preference for relations exists. However, definitive evidence for such a hierarchy will require a complete paired-comparisons matrix, which was not possible to achieve for this study. Nevertheless, the data from this study are not incompatible with a hierarchy hypothesis, and indeed lend support and warrant to further investigation of the hypothesis.

Reference

APPENDIX

Biographical Information Sheet
Relation Recognition Exercise, Form A
Relation Recognition Exercise, Form B
BIOGRAPHICAL INFORMATION

1. School

2. Grade _____

3. Sex
   1. Male
   2. Female

4. Age at last birthday _____

5. Race:
   1. Afro-American (Negro)
   2. Mexican-American (Chicano)
   3. American-Indian
   4. Oriental-American
   5. White
   6. Other

6. Number of children in family:
   1. 1 to 3
   2. 4 to 6
   3. 7 to 9
   4. 10 or more

7. Annual family income:
   1. less than $5,000
   2. $5,000 - $10,000
   3. $10,001 - $15,000
   4. $15,001 - $20,000
   5. more than $20,000

8. Which of the following is true of your family?
   1. Owns the house in which you live
   2. Rents the house in which you live
   3. Rents an apartment unit
   4. Lives in a public housing project

9. Which is true of your father's education?
   1. Finished eighth grade or less
   2. Went to high school but did not graduate
   3. Finished high school but did not go to college
   4. Went to college but did not get a degree
   5. Graduated with a bachelor's degree or its equivalent
   6. Did college study beyond the bachelor's level
   7. If other, please specify
10. Which is true of your mother's education?

1. Finished eighth grade or less
2. Went to high school but did not graduate
3. Finished high school but did not go to college
4. Went to college but did not get a degree
5. Graduated with a bachelor's degree or its equivalent
6. Did college study beyond the bachelor's level
7. If other, please specify

11. In which of the following categories does your father's main occupation belong? Examples of job titles within a category are shown in parenthesis.

1. Professional, technical, and managerial occupations (lawyers, doctors, teachers, engineers, writers and managers)
2. Clerical and sales occupations (typists, stenographers, salesmen and merchants)
3. Service occupations (domestic servants, barbers, protective servants, and waiters)
4. Farming, fishery, forestry, and related occupations (farmers, foresters, hunters and fishermen)
5. Processing occupations (processors of chemicals, wood, metal, food and tobacco)
6. Machine trades occupations (machinists, printers and textile workers)
7. Bench work occupation (fabricators, assemblers, repairmen)
8. Structural work occupations (metal fabricators, welders, and construction workers)
9. Miscellaneous occupations (truck drivers, packers, loggers and graphic artists)

12. In which of the following categories does your mother's main occupation belong? Examples of job titles within a category are shown in parenthesis.

1. Professional, technical, and managerial occupations (lawyers, doctors, teachers, engineers, writers and managers)
2. Clerical and sales occupations (typists, stenographers, salespersons and merchants)
3. Service occupations (domestic servants, barbers, protective servants, and waiters)
4. Farming, fishery, forestry, and related occupations (farmers, foresters, hunters and fishermen)
5. Processing occupations (processors of chemicals, wood, metal, food and tobacco)
6. Machine trades occupations (machinists, printers and textile workers)
7. Bench work occupation (fabricators, assemblers, repairmen)
8. Structural work occupations (metal fabricators, welders, and construction workers)
9. Miscellaneous occupations (truck drivers, packers, loggers and graphic artists)
10. Housewife
University of Minnesota
Department of Psychology

Relation Recognition Exercise
Form A

Spring, 1974
Instructions

This exercise contains 68 items. For each item, the numbered word-pair is followed by two lettered word-pairs, a and b. Look at these two lettered word-pairs and choose the one that best represents the same relation found in the numbered word pair. Circle the letter of the word-pair you chose. Here is an example:

1. Light : Dark
   a. Book : Chapter
   b. Peace : War

The correct answer is b, because Light and Dark are opposites and Peace and War are opposites. You would thus circle the b.

You may now proceed with the exercises below. Try to answer all of the items, but do not spend too much time on any one.

1. Cash : Money
   a. Imitate : Copy
   b. Bullet : Arrow

2. Motor : Car
   a. Food : Body
   b. Coconut : Palm Tree

3. Problem : Remedy
   a. Rank : Military
   b. Vote : Elect

4. Orchard : Grove
   a. Gun : Lance
   b. Dismal : Dark

5. Foot : Shoe
   a. Planet : Earth
   b. Cigarette Butt : Ash Tray

6. Letter : Stamp
   a. Floor : Walk
   b. Orange : Section
7. Daybreak : Sunset
   a. Spring : Summer
   b. Iron : Rust

6. Egg : Bird
   a. Metal : Bullet
   b. April : September

9. Negotiation : Treaty
   a. Sand : Glass
   b. Hunger : Eat

10. Cube : Block
    a. Dismal : Dark
    b. Tomato : Carrot

11. Bran : Wheat
    a. Tomato : Carrot
    b. Butter : Milk

12. Ink : Pen
    a. Scales : Fish
    b. Gasoline : Automobile

13. Root : Stem
    a. April : September
    b. Eye : Hand

14. Summer : Winter
    a. Sunrise : Evening
    b. Buy : Sell

15. Garbage : Trash Can
    a. Spoon : Soup
    b. Angels : Heaven

16. Colt : Horse
    a. Today : Yesterday
    b. Door : Car

17. Mean : Average
    a. Box : Jar
    b. Miss : Lass

18. Grass : Seed
    a. Wheat : Chaff
    b. Metal : Bullet

19. Hver : Loom
    a. Dull : Blunt
    b. Harbor : Refuge

20. Faith : Trust
    a. Ski : Bobsled
    b. Miss : Lass

21. Boil : Steam
    a. Work : Wages
    b. Sunrise : Evening

22. Cone : Pine
    a. Metal : Bullet
    b. Water : Pool
23. Winter : Summer
   a. Success : Failure
   b. Monday : Tuesday

24. Bud : Flower
   a. Legs : Chair
   b. Autumn : Winter

25. Wax : Candles
   a. Lumber : Arrow
   b. Furniture : Sofa

26. Herd : Pack
   a. Automobile : Wagon
   b. Imitate : Copy

27. League : Union
   a. Check : Coins
   b. Imitate : Copy

28. Rope : Fiber
   a. Butter : Milk
   b. League : Team

29. Boss : Leader
   a. Miss : Lass
   b. Shoelace : Button

30. Court : Tennis
   a. Water : Fish
   b. Hatch : Ship

31. Chicken : Egg
   a. Sand : Glass
   b. Rat : Pets

32. Rain : Flood
   a. Kin : Cousin
   b. Poison : Death

33. Wound : Scar
   a. Lion : Animal
   b. December : January

34. Past : Present
   a. Hero : Villain
   b. Kid : Goat

35. Fable : Legend
   a. Cannon : Rifle
   b. Add : Increase

36. Hurl : Throw
   a. Gloom : Melancholic
   b. Military Handshake : Handshake

37. Steer : Cattle
   a. Ship : Fleet
   b. Latter : After

38. Birth : Death
   a. Seed : Pumpkin
   b. Top : Bottom
39. Sled : Runner
   a. Painter : Canvas
   b. December : Christmas

40. Begin : End
   a. Deny : Admit
   b. Sunrise : Evening

41. Grape : Wine
   a. Lumber : Arrow
   b. Music : Hymn

42. Essential : Necessary
   a. Horse : Mule
   b. Subtract : Reduce

43. Day : Night
   a. Calf : Cow
   b. Frown : Smile

44. Milk : Cheese
   a. Oyster : Pearl
   b. Iron : Rust

45. Sea : Wave
   a. Grove : Tree
   b. Scene : Artist

46. Dwelling : Cottage
   a. Paw : Claw
   b. Bowl : Plate

47. Walnut : Walnut Tree
   a. Hunger : Eat
   b. Peninsula : Land

48. Raisin : Grape
   a. Lumber : Arrow
   b. Hospital : Institution

49. Title : Book
   a. Fish : Fisherman
   b. City : Kingdom

50. Skin : Body
   a. Wednesday : Week
   b. Garage : Car

51. Hammer : Anvil
   a. Army Tank : Racing Car
   b. Pick : Violin

52. Hide : Leather
   a. Iron : Rust
   b. Arm : Elbow

53. Ring : Hoop
   a. Nest : Den
   b. Subtract : Reduce

54. Fool : Idiot
   a. Abide : Stay
   b. Lettuce : Cabbage
55. Boy : Child
   a. Bacon : Ham
   b. Finger : Hand

56. River : Brook
   a. Tablespoon : Teaspoon
   b. Oyster : Pearl

57. Wound : Pain
   a. Vote : Elect
   b. Success : Joy

58. Grade : Rank
   a. Hourglass : Pocket Watch
   b. Establish : Begin

59. Steel : Ore
   a. Eye : Needle
   b. Butter : Milk

60. Stack : Layer
   a. Sire : Father
   b. Bar : Block

61. Heat : Steam
   a. Sheep : Woolen Blanket
   b. Golf : Club

62. Famine : Hunger
   a. Battleship : Canoe
   b. Cut : Bleed

63. Door : Hinge
   a. Flower : Bee
   b. Animal : Elephant

64. Bean : Coffee
   a. Sand : Glass
   b. Second : Minute

65. Lord : Peasant
   a. Umbrella : Man
   b. Land : Sea

66. Infection : Fever
   a. War : Sorrow
   b. Autumn : Winter

67. Dog : Hound
   a. December : Christmas
   b. Subtract : Reduce

68. Notion : Idea
   a. How : Shave
   b. Add : Increase
University of Minnesota
Department of Psychology

Relation Recognition Exercise
Form B
Spring, 1974
Instructions

This exercise contains 68 items. For each item, the numbered word-pair is followed by two lettered word-pairs, a and b. Look at these two lettered word-pairs and choose the one that best represents the same relation found in the numbered word pair. Circle the letter of the word-pair you chose. Here is an example:

1. Light : Dark
   a. Book : Chapter
   b. Peace : War

The correct answer is b, because Light and Dark are opposites and Peace and War are opposites. You would thus circle the b.

You may now proceed with the exercises below. Try to answer all of the items, but do not spend too much time on any one.

1. Bran : Wheat
   a. Butter : Milk
   b. Tomato : Carrot

2. Winter : Summer
   a. Monday : Tuesday
   b. Success : Failure

3. Dog : Hound
   a. Subtract : Reduce
   b. December : Christmas

4. Orchard : Grove
   a. Dismal : Dark
   b. Gun : Lance

5. Letter : Stamp
   a. Orange : Section
   b. Floor : Walk

6. Past : Present
   a. Kid : Goat
   b. Hero : Villain
7. Lord : Peasant
   a. Land : Sea
   b. Umbrella : Man
8. Grass : Seed
   a. Metal : Bullet
   b. Wheat : Chaff
9. Hammer : Anvil
   a. Pick : Violin
   b. Army Tank : Racing Car
10. Motor : Car
    a. Coconut : Palm Tree
    b. Food : Body
11. Negotiation : Treaty
    a. Hunger : Eat
    b. Sand : Glass
12. Steel : Ore
    a. Butter : Milk
    b. Eye : Needle
13. Hide : Leather
    a. Arm : Elbow
    b. Iron : Rust
14. Day : Night
    a. Frown : Smile
    b. Calf : Cow
15. Rain : Flood
    a. Poison : Death
    b. Kin : Cousin
16. Milk : Cheese
    a. Iron : Rust
    b. Oyster : Pearl
17. Cone : Pine
    a. Water : Pool
    b. Metal : Bullet
18. Cash : Money
    a. Bullet : Arrow
    b. Imitate : Copy
19. Title : Book
    a. City : Kingdom
    b. Fish : Fisherman
20. Garbage : Trash Can
    a. Angels : Heaven
    b. Spoon : Soup
21. Hurl : Throw
    a. Military Handshake : Handshake
    b. Gloom : Melancholic
22. Heat : Steam
    a. Golf : Club
    b. Sheep : Woolen Blanket
23. Summer : Winter
   a. Buy : Sell
   b. Sunrise : Evening

24. Ring : Hoop
   a. Subtract : Reduce
   b. Nest : Den

25. Daybreak : Sunset
   a. Iron : Rust
   b. Spring : Summer

26. Famine : Hunger
   a. Cut : Bleed
   b. Battleship : Canoe

27. Essential : Necessary
   a. Subtract : Reduce
   b. Horse : Mule

28. Boil : Steam
   a. Sunrise : Evening
   b. Work : Wages

29. Rope : Fiber
   a. League : Team
   b. Butter : Milk

30. Wound : Scar
   a. December : January
   b. Lion : Animal

31. Wax : Candies
   a. Furniture : Sofa
   b. Lumber : Arrow

32. Sled : Runner
   a. December : Christmas
   b. Painter : Canvas

33. Door : Hinge
   a. Animal : Elephant
   b. Flower : Bee

34. Chicken : Egg
   a. Rat : Pets
   b. Sand : Glass

35. Motion : Idea
   a. Add : Increase
   b. Mow : Shave

36. Cord : Pack
   a. Imitate : Copy
   b. Automobile : Wagon

37. Sea : Wave
   a. Scene : Artist
   b. Grove : Tree

38. Cube : Block
   a. Tomato : Carrot
   b. Dismal : Dark
39. Grape : Wine
   a. Music : Hymn
   b. Lumber : Arrow

40. Walnut : Walnut Tree
   a. Peninsula : Land
   b. Hunger : Eat

41. Bean : Coffee
   a. Second : Minute
   b. Sand : Glass

42. Begin : End
   a. Sunrise : Evening
   b. Deny : Admit

43. Stack : Layer
   a. Bar : Block
   b. Sire : Father

44. River : Brook
   a. Oyster : Pearl
   b. Tablespoon : Teaspoon

45. Root : Stem
   a. Eye : Hand
   b. April : September

46. Boy : Child
   a. Finger : Hand
   b. Bacon : Ham

47. Bud : Flower
   a. Autumn : Winter
   b. Log : Chair

48. Faith : Trust
   a. Miss : Less
   b. Ski : Bobsled

49. Fool : Idiot
   a. Lettuce : Cabbage
   b. Abide : Stay

50. Birth : Death
   a. Top : Bottom
   b. Seed : Pumpkin

51. Boss : Leader
   a. Shoelace : Button
   b. Miss : Less

52. Infection : Fever
   a. Autumn : Winter
   b. War : Sorrow

53. Wound : Pain
   a. Success : Joy
   b. Vote : Elect

54. Foot : Shoe
   a. Cigarette Butt : Ash Tray
   b. Planet : Earth
55.  Hove: Loom
    a.  Harbor: Refuge
    b.  Dull: Blunt

56.  Mean: Average
    a.  Miss: Lass
    b.  Box: Jar

57.  Grade: Rank
    a.  Establish: Begin
    b.  Hourglass: Pocket Watch

58.  Skin: Body
    a.  Garage: Car
    b.  Wednesday: Week

59.  Egg: Bird
    a.  April: September
    b.  Metal: Bullet

60.  Ink: Pen
    a.  Gasoline: Automobile
    b.  Scales: Fish

61.  Raisin: Grape
    a.  Hospital: Institution
    b.  Lumber: Arrow

62.  Problem: Ready
    a.  Vote: Elect
    b.  Rank: Military

63.  Dwelling: Cottage
    a.  Bowl: Plate
    b.  Paw: Claw

64.  League: Union
    a.  Imitate: Copy
    b.  Check: Coins

65.  Fable: Legend
    a.  Add: Increase
    b.  Cannon: Rifle

66.  Steer: Cattle
    a.  Latter: After
    b.  Ship: Fleet

67.  Court: Tennis
    a.  Hatch: Ship
    b.  Water: Fish

68.  Colt: Horse
    a.  Door: Car
    b.  Today: Yesterday
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