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The Effects of High Versus Low Imagery Humor on Spatial and Verbal Problem Solving

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THE EFFECTS OF HIGH VERSUS LOW IMAGERY HUMOR ON SPATIAL AND VERBAL PROBLEM SOLVING

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APPROVAL SHEET

This thesis is submitted in partial fulfillment of the requirements for the degree of

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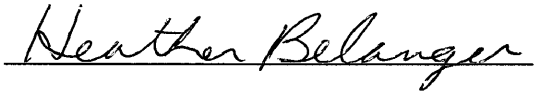

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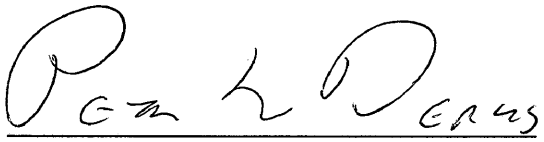

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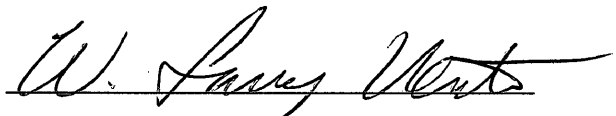

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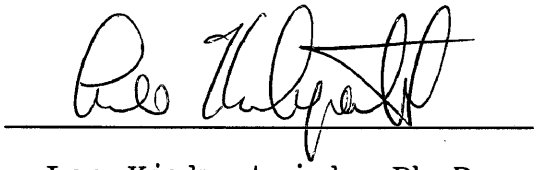

Lee Kirkpatrick, Ph.D.

TABLE OF CONTENTS

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LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The effects of high and low imagery humor on spatial and verbal problem solving were examined in a sample of 80 college students. Subjects were divided into eight groups, half of whom took an analogy test and half of whom took a mental rotations test. These groups differed in whether or not they read humorous or nonhumorous materials prior to the test and whether or not this textual material was high or low in imagery. The materials were categorized in a pilot study. Results indicated that humor seems to facilitate performance of females in terms of time, whereas for males, this is only the case on the rotation test. In terms of error rates, a variable that appeared to be independent of time, subjects performed better following humorous stimuli only on the analogy test. No significant imagery effects were found. Discussion focuses on possible explanations of the results in light of brain lateralization research.

THE EFFECTS OF HIGH VERSUS LOW IMAGERY HUMOR ON SPATIAL AND VERBAL PROBLEM SOLVING

Humor and creativity both entail manipulating thoughts in unique and surprising ways. Koestler (1964) created a model in which humor, art, and science are viewed as being similar in that they require creativity, or reframing ideas in new ways. Humor requires that one "be free from the constraints of rational thoughts and decisions" (Levine, 1969, p.16). Humor, like art and science, depends upon a successful attempt to reformulate old ideas to create new ones. This takes creativity. Indeed, many studies have illustrated this relationship.

Rouff (1975), for example, found significant correlations between humor appreciation and creativity test scores in 108 college students. In her study, subjects completed Mednick's Remote Associates Test (RAT) as the measure of creativity. It entails the synthesis of "disparate cognitive elements." Humor appreciation was measured by the degree to which subjects could explain the incongruity of a cartoon, and hence why the disparity resulted in humor. Comprehension of humor and the RAT scores were

significantly correlated, suggesting that they share a common ability to link disparities.

Furthermore, humor is often viewed as a form of creativity. Ziller, Behringer, and Goodchilds (1962), for example, used the production of cartoon captions as their only measure of creativity. When people are asked to generate captions, there seems to be very little overlap among ideas (Derks, 1987), suggesting that humor production is a divergent process. Divergence, or uniqueness, is an important facet of creativity (Derks, 1987; O'Quinn & Derks, in press).

It is reasonable to assume then that because humor allows one to conceptualize things in divergent ways, it will therefore facilitate creativity in problem solving. Humor processing and problem solving have been thought of as similar processes by some theorists. Suls (1972, 1983) argued that the recognition and resolution inherent in humor processing provide a model of problem solving. The recognition of an incongruity corresponds to problem recognition and the resolution of the incongruity corresponds to solution creation. If humor and problem solving are similar cognitive

processes, it is certainly possible that humor will facilitate problem solving. Experimental studies have been designed to test this idea.

The Facilitation of Problem Solving by Humor

Ziv (1976) did in fact find that adolescents who had listened to a humorous record performed significantly better on a creativity test than did the control group. Humor, it seems, frees people from conventional modes of thinking.

Ziv (1983) extended these results to humor production when he found that students instructed to come up with humorous answers while working on a creativity test did significantly better than those not given such instructions. Here, then, humor was functioning as a cue allowing subjects the freedom to think unconventionally, although the creativity scores were confounded by giving creative points for humor.

A series of studies by Isen and associates examined the effects of "positive affect" on a variety of tasks. Isen, Johnson, Mertz, and Robinson (1985) demonstrated that people tend to give more unusual first-associates in a word association task when in the

positive affect condition. In this experiment, a pilot study was conducted which demonstrated that subjects who had been given refreshments produced more unusual first associates. The second study showed the same effect but positive affect was induced using positively valenced words as target stimuli. The final study again demonstrated the same effect using a comedy film or a free gift to induce positive affect. These results are not due to arousal alone. Subjects in a separate condition who underwent physical exercise or negative affect induction did not manifest comparable improvements in creativity (Isen, Daubman, & Nowicki, 1987). It is difficult to extrapolate any information from these studies regarding the unique contributions of humor because the comedy film and free gift conditions were analyzed together as representing the "positive affect" group.

A compilation of studies conducted later however did assess the unique contribution of humor (Isen, Daubman, & Nowicki, 1987). In the first experiment, a comedy film was used as the sole affect induction technique. It was found that people who viewed a

comedy film versus a neutral film were more likely to produce correct answers to a creative problem solving task, namely Duncker's (1945) candle task. In the second experiment, positive affect was induced using a comedy film or a free gift. Results indicated that a higher percentage of the comedy film subjects solved the problem than of the control film subjects. More importantly, subjects who had received a candy bar did not perform significantly better than subjects in the control condition. Watching a humorous film, then, seems to facilitate problem solving, while receiving a free gift does not.

Additional experiments using a Remote Associates Test rather than Duncker's candle task were conducted using a gift of candy to induce positive affect in one study, and using a humorous film to induce positive affect in the other (Isen, Daubman, & Nowicki, 1987). Although a post hoc t-test done by the author did not reveal a significant difference between the performance means, the mean of the humor group ($\underline{x}$=5.00) was larger than the mean of the candy group ($\underline{x}$=4.38).

In summary, then, the aforementioned studies suggest that humor facilitates problem solving. However, the problem solving is of a specific nature. Humor has usually been studied experimentally in relation to word association tasks, which tap an individual's ability to come up with unusual ideas, and Duncker's candle task, which taps an individual's ability to break set and see unique uses for a common object. These tasks clearly represent tests of what we typically think of as "creativity," or the ability to create and combine ideas in new ways.

So, problem solving and humor appreciation can be thought of as similar cognitive processes. Because humor seems to facilitate creative problem solving ability, it could be proposed that similar cognitive processes will facilitate one another.

Lateralization of Humor

Theoretically, one type of humor appreciation depends upon the cognitive ability to recognize and resolve incongruities. Research conducted with brain damaged patients has suggested a distinction between those with right hemisphere damage and those with left

hemisphere damage in humor appreciation capability. Left hemisphere patients, when asked to do humor completion tasks, tend to choose coherent endings at the expense of humor, while right hemisphere patients are more likely to choose surprising endings, regardless of whether or not they are coherent (Bihrle, Brownell, Hiram, & Powelson, 1986). Right hemisphere patients have trouble understanding others' jokes and they often miss "the point" of conversations in general (Brownell & Gardner, 1989).

Many studies have confirmed the idea that brain damage results in an altered appreciation of humor, with right hemisphere patients having problems with coherence, or the joke as a whole and left hemisphere patients having problems with abstractness (Brownell & Gardner, 1989; Brownell, Michel, Powelson, & Gardner, 1983). The problems manifested by right hemisphere patients with emotional material are well known (Cicone, Wapner, & Gardner, 1980; Benowitz, Bear, Rosenthal, Mesulam, Zaidel, & Sperry, 1983; Ross, 1981). Research has demonstrated their difficulties in expressing emotions and their impairments in perceiving

emotion in the communication of others. Additionally, the right hemisphere appears necessary for comprehending word connotations (Gardner & Denes, 1973), understanding metaphors (Winner & Gardner, 1977), interpreting antonymic contrasts (Gardner, Silverman, Wapner, & Zurif, 1978) and utilizing context clues (Wapner, Hamby, & Gardner, 1981). The right hemisphere, then, is seemingly involved in the comprehension of subtleties in conversation. Subtleties are precisely what often make a joke funny. The right hemisphere has further been implicated in the understanding of sarcasm and indirect requests (Foldi, 1987; Hirst, LeDoux, & Stein, 1984; Jacobs, Brownell, & Gardner, 1985).

Now, given the possibility that incongruity recognition is mediated largely by the right hemisphere and given that humor facilitates problem solving, the question arises as to whether different types of humor will differentially affect different types of problems depending on the hemispheric differences. In other words, will humor that is designed to prime the right

hemisphere facilitate performance on so-called "right hemisphere" tasks?

Lateralization of Imagery

Imagery is purported to be a right hemisphere function, with people varying in ability (Ley, 1982). Electroencephalographic studies of normal subjects have implicated the right hemisphere in tasks involving the "forming of pictures in one's mind" (Robins & McAdam, 1974; Morgan, McDonald, & MacDonald, 1971; Davidson & Schwartz, 1976). Seamon and Gazzaniga (1973) demonstrated that people who are asked to remember information with imagery respond faster to target stimuli in the left visual field, an indicator of right hemisphere functioning; whereas people asked to remember information verbally respond faster to probes in the right visual field, an indicator of left hemisphere functioning.

However, this conclusion is highly debatable. Ehrlichman and Barrett (1983) point out that a left visual field advantage could be obtained even if the image were bilaterally represented. The process of deciding whether the probe and the mental image match

can produce a left visual field effect, regardless of whether or not the image is being generated in the right hemisphere or both hemispheres.

Indeed, much of the work in imagery lateralization is subject to different interpretations and much of it has been difficult to replicate. In thorough reviews of the literature, both hemispheres have been implicated in image generation (Ehrlichman & Barrett, 1983; Hellige, 1990; Sergent, 1990). Ehrlichman and Barrett (1983) find that there is an implicit assumption in the literature that mental imagery is under the control of the right hemisphere. If the definition of imagery given by Sergent (1990) is employed, this is not the case. Specifically, Sergent states that "visual image generation can be defined as the process by which information about an object stored in long-term memory is reactivated to give rise to a visual representation of its physical attributes that can then be revisualized and inspected" (p.99).

This definition excludes visuospatial tasks, such as mental rotation. The linear relationship between angle of rotation and the time required to distinguish

whether the objects are the same or different is well established (Corballis, Macadie, & Beale, 1985; Corballis & McLaren, 1984; Shepard & Metzler, 1971). This suggests that an "image" is being manipulated by the subject. Clearly, however, there is more to a rotation task than merely creating an image. It is therefore possible to think of imagery as a subset or component of visuospatial tasks (Ley, 1979). Furthermore, despite lack of evidence that the right hemisphere has a distinct role in image generation, it cannot be assumed that imagery does not have a special role in right hemisphere functioning. Humor, for example, is a potential right hemisphere phenomenon that may be facilitated by imagery.

Johnson (1990) used neurologically intact subjects in an attempt to demonstrate that humor is a right hemisphere activity by relating it to mental rotation ability, which has been linked to the right hemisphere (Dellantonio & Spagnolo, 1989; Johnson, 1990; Jones & Anuza, 1982; Ratcliff, 1979; Yamamoto & Hatta, 1980). Johnson (1990) found that subjects who rated jokes funnier also tended to have faster mental rotation

times. He asked subjects to read jokes from a computer screen and rate them on a scale from 1 to 7 as to their funniness. The mental rotation task consisted of either identical or mirror image shapes that were rotated to varying degrees. The subjects were asked to determine if the two shapes on the screen were the "same" or "different" as quickly as possible.

The data from this study suggested that subjects who rate jokes funnier have faster mental rotation times, but only when making the more difficult distinction of "different." Waller and Ventis (1993), who performed a similar experiment controlling for humor aggressiveness and complexity, found that mental rotation was a significant predictor of humor ratings for females, but not for males. Because right hemisphere patients manifest intact incongruity recognition but impaired resolution (Brownell, Michel, Powelson, & Gardner, 1983), Johnson (1990) reasoned that incongruity resolution enlists right hemisphere processes which may vary from person to person.

Froman (1991) found that people who scored highly on the Vividness of Visual Imagery Questionnaire (VVIQ;

Marks, 1973) enjoyed jokes more than those who scored lower on the VVIQ. When analyzed by gender, however, the data seem to indicate that this was only true for men. Women of medium ability on the VVIQ enjoyed the jokes more than the other women. So, this study demonstrated a relationship between humor appreciation and at least a medium "imagery ability." These studies then demonstrate that there does seem to be a relationship between humor and right hemisphere tasks, although this relationship may be mediated by sex differences.

In summary, then, it can be speculated that humor, based on the brain damage literature and the relationship between humor and performance on "right hemisphere tasks," can be considered a largely right hemisphere function. If this is so, based on the idea that similar cognitive processes prime one another, humor should differentially affect performance on some tasks, but not others. Specifically, humor that is high in imagery content might facilitate performance on spatial tasks more than on verbal tasks, for instance.

The Facilitation of Problem Solving by Imagery

It has been demonstrated that imagery may facilitate problem solving. Houtz and Frankel (1988) grouped students into left hemisphere, right hemisphere, or integrated preferences according to their scores on the Human Information Processing Survey (HIPS; Torrance, Taggart, & Taggart, 1984) and found that anagram solutions for "high imagery" words were significantly related to integrated and right brain preferences.

Evidence for direct priming effects comes from a study by Bryden and Ley (cited in Perecman, 1983). In their first experiment, subjects first participated in a visual right hemisphere task, namely, identifying cartoon drawings of human faces presented with a tachistoscope. In the second experiment, subjects first participated in an auditory left hemispheric task, namely, a dichotic listening task. The first and second experiments were identical in all other ways. Subjects were asked to study a word list, which varied in imagery and affective value, and were told that they would be asked to recall this information later. They

were then retested on the laterality task to see if any changes in performance had occurred. Finally, they were asked to recall the words they had initially been presented. Results indicated that a right hemisphere effect found initially in the face recognition task was significantly enhanced by the studying of high imagery words and by the studying of affectively loaded words. Similar results were obtained with a dichotic listening task. In other words, the initial right ear advantage (and hence, left hemisphere process) observed was enhanced by high affect and high imagery words, with a slight shift to the left ear when high imagery words were studied.

These results indicate that remembering high imagery words seems to prime the right hemisphere. Humor, which arguably is mediated by the right hemisphere, facilitates problem solving involving flexible thinking. It is therefore reasonable to speculate that humor high in imagery evocation will facilitate problem solving, particularly problem solving tasks involving the right hemisphere to a

greater extent than the left hemisphere because imagery primes the right hemisphere.

The Present Study

This experiment is designed to test several hypotheses regarding the effects of high versus low imagery humor on analogy task performance and mental rotation task performance. Analogy tasks have been found to activate the left hemisphere (Gur, Gur, Skolnick, & Resnick, 1988; Gur & Reivich, 1980), while mental rotation tasks have consistently been associated with the right hemisphere (Dellantonio & Spagnolo, 1989; Johnson, 1990; Jones & Anuza, 1982; Ratcliff, 1979; Yamamoto & Hatta, 1980). Because spatial tasks engage more right hemispheric activity than verbal tasks, it is hypothesized that high imagery jokes will facilitate performance on mental rotation tasks more than they will on analogy tasks.

Because humor has been demonstrated to have a facilitative effect only on "creative" tasks, performance on a rotation task, which requires spatial ability, will probably only be facilitated by high-imagery humor which will prime the right hemisphere.

An analogy task, however, which demands that the problem solver see relationships between words and make connections, seems to have more in common with the "creative" tasks that have been linked to humor. Hence, both high and low imagery jokes will facilitate performance on this task.

Pilot Study

A pilot study was conducted to obtain imagery and humor ratings for the jokes and sentences to be used in the study.

Method

Participants

Participants in the pilot study were 93 undergraduates from the College of William and Mary, with an approximately equal number of males (N=44) and females (N=49). They were participating voluntarily for credit as part of an introductory psychology class.

Materials

The 55 jokes to be rated came from a variety of sources (Cerf, 1945; Copeland, 1936; Eysenck & Wilson, 1976; Florio, 1988,1990; Handey, 1992, 1993; Johnson & Johnson, 1955; Mills, 1965; Mindess, Miller, Turek,

Bender, Corbin, 1985; Ruch, 1983; Untermeyer, 1946) and the 30 sentences were created in the following format: "The (adj.)(noun)(past tense verb) a(n) (adj.)(noun)." as outlined by Begg & Paivio (1969).

The imagery scale ranged from 1 to 10, with "1" being "no imagery associated with this joke" and "10" being "very vivid imagery" (see Appendix A).

A category scale from 1 to 10 was used to rate humor (Derks, Lewis, & White, 1981), with "1" being "not funny at all," and "10" being "one of the funniest jokes you've ever read/seen" (see Appendix B).

Procedure

Subjects were handed a packet when they entered the room, which contained their consent forms, sentences, jokes, and rating scales. They were randomly assigned to the task of rating imagery or the task of rating humor, depending on which packet they received.

They were told to open their packets, follow the directions given therein, and work at their own pace. Jokes and sentences were in one of four different orders.

Results and Discussion

Means were calculated for both imagery and funniness for each joke and sentence. Based on these means, the four conditions were established: high imagery, high humor; high imagery, low humor; low imagery, high humor; and low imagery, low humor. Six jokes/sentences were selected for each condition (see Appendix C). The means of these jokes/sentences are presented in Table 1.

Insert Table 1 about here

Experiment

A 2x2x2x2 design was utilized with 2 levels of humor, imagery, task, and sex to determine how high and low imagery jokes and sentences would affect performance on a mental rotation task or an analogy task.

Method

Participants

Participants in this study were 80 introductory psychology students at the College of William and Mary,

with an equal number of males and females in each condition. They were voluntarily participating for class credit in an introductory psychology course.

Materials

A group of six jokes previously rated in the pilot study as being funny and high in imagery were used along with six jokes previously rated as being funny and low in imagery. Additionally, six sentences previously rated as not being funny and high in imagery were used along with six sentences previously rated as being not funny and low in imagery.

Subjects were run in 8 groups of 10. The verbal task consisted of an analogy test taken from the Miller Analogies Test (Bader & Burt, 1986). The test consisted of twenty analogy problems (see Appendix D). An analogy is a verbal proportion presented in the form: A is to B as C is to D. In the task, one of these elements was missing and it was the job of the subject to determine the correct response from among four alternatives. This was the task of choice because it requires both verbal processing and analytical

thinking, which are primarily left hemisphere specializations (Springer & Deutsch, 1981).

The spatial task was one adopted from a mental rotation task (Vandenberg & Kuse, 1978) (see Appendix E). This was a paper-and-pencil version of the Shepard and Metzler (1971) mental rotation task. It consisted of 20 items, each composed of the criterion figure, two distractors and two correct alternatives. It correlates well with other measures of spatial ability (Bryden, 1982).

A digital clock was used by the subjects to record time in seconds.

Procedure

Subjects were randomly assigned to one of eight possible groups. In regard to humor and imagery, they were in the: low-imagery sentence/low humor, low-imagery joke/high humor, high-imagery sentence/low humor, or high-imagery joke/high humor condition. In regard to task, they were either in the spatial or verbal condition. They were randomly handed a packet when they walked in the door which contained their consent form and all the materials they needed.

Subjects first were asked to read a few instructional examples for the task they would be performing. This was designed to facilitate understanding of the task and to allow them to "warm up."

They then were asked to complete a pre-test to determine their general ability in the task that they later would be performing (see Appendix F). The pre-test consisted of ten items (either analogies or rotations, depending on which group the subject was in) and the subject was asked to note what time they finished by looking up at the digital clock. They were told to work as quickly as possible without making any errors. Their performance on this pre-test was used as a covariate to increase statistical power.

Subjects then were asked to rate jokes for funniness using the same scale that was used in the pilot study. This was to ensure that they were in fact processing the jokes. Those who were reading sentences instead of jokes were asked to do the same thing.

Also, subjects in the high imagery conditions were given imagery instructions because this has been shown

to induce the use of imagery (Hodes, 1992; Kulhavy & Swenson, 1975). Specifically, they were asked to "form a mental picture of these events before going on to the next item." In summary, then, subjects were asked to form images of the joke or sentence as they rated them for funniness.

They then performed a task, either verbal or spatial, depending upon which group they were in. They were again asked to record the time they finished by looking up at the digital clock. Again they were told to work as quickly as possible without compromising accuracy.

Results

The two dependent variables in these analyses were time in seconds and number of errors. Errors and time were weakly correlated for both the analogy task, $\underline{r}$ = .0058, and the rotation task, $\underline{r}$ = .1362. Because these two variables appear to be independent, they are presented separately. Correlations computed by each condition suggest that the high humor/rotation conditions offset the overall negative correlation.

Time A 2 x 2 x 2 x 2 analysis of variance was conducted using two levels of task (rotations and analogy), two levels of humor (high and low), two levels of imagery (high and low) and two levels of sex (male and female) as independent variables, and time in seconds as the dependent variable. These means and analyses can be found in Tables 2 and 3.

Insert Tables 2 and 3 about here

The interaction between humor level and task was nearly significant, $F(1,72) = 3.28$, $p<.07$. Those subjects exposed to humor in the rotations condition did better than those who were not, whereas the opposite trend occurred with the subjects completing the analogy task. Removing those subjects who made more than two errors, a cut-off determined by the upper quartile of subjects on the time distribution, produced a significant humor level by task interaction, $F(1,50) = 6.45$, $p<.01$ (see Figure 1 and Table 4).

Insert Figure 1 and Table 4 about here

The original analysis also revealed a triple interaction, $F(1,64) = 4.15$, $p<.04$, which mediates the previous interaction. Specifically, in the high humor conditions, women performed faster on both tasks, while men performed faster only while taking the rotations tests. Furthermore, this improvement was much greater than the improvement seen in women (see Figure 2 and Table 5).

Insert Figure 2 and Table 5 about here

When the covariate was included, a nearly significant triple interaction resulted that was not present in the original analysis, $F(1,63) = 3.47$, $p<.067$. This analysis is presented in Table 6.

Insert Table 6 about here

The interaction suggests that females are facilitated by humor only in the high imagery conditions, while males are facilitated by humor in both high and low imagery conditions (see Figure 3 and Table 7).

Insert Figure 3 and Table 7 about here

Errors When errors were analyzed, a humor level by task interaction was obtained, $F(1,72) = 5.78$, $p<.01$. These means and analyses can be found in Tables 8 and 9.

Insert Tables 8 and 9 about here

Subjects in the analogy conditions made fewer errors with humor stimuli present, with a reverse trend noted in the rotations conditions (see Figure 3 and Table 10).

Insert Figure 3 and Table 10 about here

So, unlike the time analysis, subjects in the humor conditions do better with analogies compared to mental rotation.

Furthermore, the sex variable does not mediate the interaction in this case. A sex by humor level interaction is nearly significant, $F(1, 64) = 3.40$, $p<.07$. When all subjects who took longer than 316 seconds are removed, this interaction becomes significant, $F(1,51) = 4.23$, $p<.04$. Again this removal was justified by dropping the upper quartile of subjects on the frequency distribution of errors. With these subjects removed, the analysis revealed that men make significantly fewer errors in humor conditions, while women make significantly fewer errors in nonhumor conditions (see Figure 4 and Table 11).

Insert Figure 4 and Table 11 about here

Including the covariate in the analysis did not change the results.

Finally, an analysis was conducted to determine if the manipulation had a different effect for males and

females. No significant differences were found in humor ratings by sex or humor condition. These means can be found in Table 12.

Insert Table 12 about here

Discussion

While all the hypothesized results were not manifested in these data, the results of this experiment did serve the underlying purpose of this experiment, which was to explore the potential effects of humor on problem solving. It is of great interest that a task by humor level interaction was obtained when subjects making more than two errors were removed. This interaction partially supports the initial hypothesis that humor will facilitate performance. Those subjects in the rotation conditions were aided by humor. This, however, is in stark contrast with the direction of the hypothesis, namely that analogies should be more affected by humor. This assertion was made because analogies require a type of thinking which is more similar to "creativity" than the rotation

tasks. Analogies, however, require convergent thinking, while creativity tasks require divergent thinking, so perhaps this distinction is the cause of discrepancy between the results and the hypothesis (Guilford, 1986).

When sex was included as an independent variable, it was found that women were slightly aided by humor in both tasks, whereas men were aided by humor on the rotations task and hindered by it on the analogy task. This might be explained by studies suggesting that men use primarily their right hemispheres while performing spatial tasks, whereas women are more bilateral (Bryden, 1990; Voyer & Bryden, 1990; Witelson, 1976). If this is indeed the case, humor, which may prime the right hemisphere, aids men to a greater extent because they are relying more on their right hemispheres to complete the rotation task.

When the data were analyzed using error rates as the dependent variable, the opposite picture emerges. Namely, those subjects in the analogy conditions perform better compared to those subjects in the rotation conditions. Furthermore, men make

significantly fewer errors in humor conditions than women, who make fewer errors in the nonhumor conditions.

So, overall, it appears as though humor made women faster in all conditions and it made men faster in the rotation conditions, but the men made more errors. Subjects tend to be slower following humor presentation in the analogy conditions and they make fewer errors. Humor then seems to speed men up in the rotation conditions, causing them to make more errors. Humor seems to slow both men and women in the analogy conditions, causing them to make fewer errors. Advancing the idea once again that humor may be largely mediated by the right hemisphere, it could be that humor only "primes" speed in right hemisphere tasks. This would explain the differential effects of humor in the rotation tasks as compared to the analogy tasks.

Clearly, it is difficult to utilize humor as an independent variable, as it is experienced differently by everyone. Individual differences in humor appreciation make it difficult to make humor conditions similar for all subjects.

Furthermore, the humor "effect," if there is one, may be somewhat ephemeral. Certain types of music facilitate performance on spatial tasks, but the effect only lasts for 10 to 15 minutes (Rauscher, Shaw, & Ky, 1993). Erber and Tesser (1992) demonstrated that complex tasks attenuate a previously positive mood. Perhaps the analogy and rotation tests were perceived by a majority of the subjects as being complex and hence the humor "wore off" prematurely.

It was surprising that there was no significant interaction between humor and imagery manifested in the rotation conditions. There is some debate as to whether imagery can be effectively evoked via prose, at least as it pertains to memory research (Wippich, 1988). Even if it is evoked, it may not prime the right hemisphere, and hence facilitate performance on the rotations task. Kosslyn and Koenig (1992) argue in fact that both hemispheres are capable of "imagery," but the left hemisphere is dominant for generating images, while the right hemisphere is dominant for imagery entailing coordinate manipulation. Since both processes were demanded of subjects in this experiment, it could be

that an inhibitory effect was created, rather than a priming one.

Furthermore, it may be that subjects in the low imagery conditions created images in their minds despite the absence of instructions to do so. Perhaps reading times could be measured to ascertain that those in the high imagery conditions are indeed creating images and those in the low imagery conditions are not. Theoretically, those receiving the imagery instructions should require more time to complete the humor ratings.

In addition, visual humor (i.e. cartoons) could be used instead of written jokes. Hodes (1992) found that recognition and recall were better in conditions in which illustrations were present, rather than just imagery instructions alone. It might be interesting to replicate this study using cartoons in the place of high imagery jokes.

This experiment could also be conducted by presenting one joke at a time followed by one analogy or rotation. This added control would allow a clearer interpretation of humor effects. Obviously, this would best be accomplished using a computer, in which the

subject could perhaps read the joke and hear it via headphones. This dual presentation might improve subject attentiveness because it would be a more interactive process. Additionally, the effects of peer pressure would be eliminated with the use of computers. Specifically, subjects would not feel the need to rush through the task, and hence make errors, just because everyone else in the room is finished. The immediate presentation of the analogy or rotation following the joke would provide the best means to determine if humor does indeed affect performance, although individual differences in humor appreciation would again be a problem.

In summary, then, these data seem to elicit many questions. Imagery does not seem to differentially affect the way humor interacts with performance; at least not the way imagery was created in this experiment. It would undoubtedly be worthwhile to try different methods of inducing imagery within the subjects' minds. Because the imagery induction methods used in this experiment involved verbal encoding, the

desired priming effect may have been attenuated or not achieved at all.

Humor does seem to differentially affect performance, but the exact nature of this relationship is still unclear. In terms of time, women seem to be positively affected by humor in a more general sense than men. On the other hand, men tend to make fewer errors than women in the humor conditions. Humor seems to make subjects more accurate in the analogies conditions, while it makes them faster in the rotation conditions. Because analogies are more similar to the creative tasks used in previous humor research than are rotations, these findings are particularly compelling. Further research is clearly indicated.

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Table 1

Means for the Final Sample of Jokes and Sentences

Group	Imagery Ratings			
	Males	Std.Dev.	Females	Std.Dev.
LowHumor,HighImagery	7.55	1.99	8.24	1.94
LowHumor,LowImagery	2.55	1.88	1.76	1.59
HighHumor,HighImagery	6.78	2.23	7.43	2.17
HighHumor,LowImagery	3.60	2.44	2.69	2.16

Group	Humor Ratings			
	Males	Std.Dev.	Females	Std.Dev.
LowHumor,HighImagery	1.24	.78	1.17	.55
LowHumor,LowImagery	1.27	.93	1.17	.29
HighHumor,HighImagery	4.15	2.63	3.76	2.44
HighHumor,LowImagery	4.35	2.46	4.33	2.19

Table 2

Means and Standard Deviations for Time to Complete Task

	Mean	Std.Dev.	N
Analogy			
Males			
High Humor			
High Imagery	198.20	34.30	5
Low Imagery	210.20	34.76	5
Low Humor			
High Imagery	142.20	25.34	5
Low Imagery	196.80	35.42	5
Females			
High Humor			
High Imagery	169.20	44.09	5
Low Imagery	197.80	59.77	5
Low Humor			
High Imagery	201.00	35.00	5
Low Imagery	202.00	69.24	5

Table 2 (Continued)

Means and Standard Deviations for Time to Complete Task

Rotation	Mean	Std.Dev.	N
Males			
High Humor			
High Imagery	280.00	75.39	5
Low Imagery	228.60	83.81	5
Low Humor			
High Imagery	352.00	121.44	5
Low Imagery	345.20	79.78	5
Females			
High Humor			
High Imagery	306.20	103.57	5
Low Imagery	344.20	87.58	5
Low Humor			
High Imagery	383.80	114.36	5
Low Imagery	289.40	86.29	5

Table 3

Analysis of Variance by Sex, Humor Level, Task, and Imagery Level with Time as the Dependent Variable

Source	df	SS	MS	F	p
Humor Level(HL)	1	9901.25	9901.25	1.79	.186
Task(T)	1	320045.00	320045.00	57.81	.000
Imagery Level(IL)	1	105.80	105.80	.02	.890
Sex(S)	1	6160.05	6160.05	1.11	.295
HL x T	1	18727.20	18727.20	3.38	.071
HL x IL	1	1656.20	1656.20	.30	.586
HL x S	1	1140.05	1140.05	.21	.652
T x IL	1	13886.45	13886.45	2.51	.118
T x S	1	2832.20	2832.20	.51	.477
IL x S	1	387.20	387.20	.07	.792
HL x T x IL	1	3302.45	3302.45	.60	.443
HL x T x S	1	22984.20	22984.20	4.15	.046
HL x IL x S	1	19096.20	19096.20	3.45	.068
T x IL x S	1	470.45	470.45	.08	.772
HL x T x IL x S	1	3564.45	3564.45	.64	.425

Table 4

Mean Time (in seconds) for Subjects Committing Two Errors or Less

	Analogy	Rotation	Mean
High Humor	198.53	263.34	230.94
Low Humor	182.81	341.45	262.13
Mean	190.67	302.40	

Table 5

Mean Time (in seconds) by Sex, Humor Level, and Task

	Females		Males	
	Analogy	Rotation	Analogy	Rotation
High Humor	183.50	325.20	204.20	254.30
Low Humor	201.50	336.60	169.50	348.60
	192.50	330.90	186.85	301.45

Table 6

Analysis of Covariance by Humor Level, Task, Imagery Level, and Sex, with Time as the Dependent Variable

Source	df	SS	MS	F	p
Humor Level(HL)	1	6040.89	6040.89	1.56	.22
Task(T)	1	206538.51	2066538.89	53.21	.00
Imagery Level(IL)	1	2349.52	2349.52	.61	.44
Sex(S)	1	13653.19	13653.19	3.52	.07
HL x T	1	5357.76	5357.76	1.38	.24
HL x IL	1	8925.82	8925.82	2.30	.13
HL x S	1	3717.39	3717.39	.96	.33
T x IL	1	2499.61	2499.61	.64	.43
T x S	1	8772.36	8772.36	2.26	.14
IL x S	1	298.43	298.43	.08	.78
HL x T x IL	1	14155.91	14155.91	3.65	.06
HL x T x S	1	29163.82	29163.82	7.51	.01
HL x IL x S	1	13452.96	13452.96	3.47	.07
T x IL x S	1	6.52	6.52	.00	.10
HL x T x IL x S	1	5349.80	5349.80	1.38	.25

Table 7

Mean Time (in seconds) by Sex, Imagery Level, and Humor Level

	Females		Males	
	High IM	Low IM	High IM	Low IM
High Humor	237.70	271.00	239.10	219.40
Low Humor	292.40	245.70	247.10	271.00
	265.05	258.35	243.10	245.20

Table 8

Means and Standard Deviations for Errors

	Mean	Std.Dev.	N
Analogy			
Males			
High Humor			
High Imagery	1.40	1.52	5
Low Imagery	.60	.55	5
Low Humor			
High Imagery	2.20	3.35	5
Low Imagery	1.80	.447	5
Females			
High Humor			
High Imagery	1.80	1.10	5
Low Imagery	1.80	1.30	5
Low Humor			
High Imagery	2.20	.45	5
Low Imagery	2.00	1.58	5

Table 8 (Continued)

Means and Standard Deviations for Errors

Rotation

	Males		
High Humor			
High Imagery	1.40	1.67	5
Low Imagery	2.40	3.29	5
Low Humor			
High Imagery	2.00	2.92	5
Low Imagery	1.20	1.79	5
	Females		
High Humor			
High Imagery	4.20	3.42	5
Low Imagery	5.60	4.98	5
Low Humor			
High Imagery	2.00	1.58	5
Low Imagery	1.00	1.00	5

Table 9

Analysis of Variance by Sex, Humor Level, Task, and Imagery Level, with Errors as the Dependent Variable

Source	df	SS	MS	F	p
Humor Level(HL)	1	7.20	7.20	1.36	.248
Task(T)	1	11.25	11.25	2.12	.150
Imagery Level(IL)	1	.20	.20	.04	.847
Sex(S)	1	18.05	18.05	3.40	.070
HL x S	1	18.05	18.05	3.40	.070
HL x T	1	31.25	31.25	5.89	.018
HL x IL	1	5.00	5.00	.94	.335
T x IL	1	1.25	1.25	.24	.629
T x S	1	5.00	5.00	.94	.335
IL x S	1	.45	.45	.08	.772
HL x T x IL	1	6.05	6.05	1.14	.290
HL x T x S	1	7.20	7.20	1.36	.248
HL x IL x S	1	.45	.45	.08	.772
T x IL x S	1	.20	.20	.04	.847

Table 10

Mean Errors by Task and Humor Level

	Analogy	Rotation	
High Humor	1.40	3.40	2.40
Low Humor	2.05	1.55	1.80
	1.73	2.48	

Table 11

Mean Errors by Subjects Taking Less Than 316 Seconds

	Females	Males	
High Humor	2.70	1.43	2.07
Low Humor	1.36	2.38	1.87
	2.03	1.91	

Table 12

Humor Ratings by Sex

	Humor Conditions		Nonhumor Conditions	
	Mean	Std.Dev.	Mean	Std.Dev.
Females	3.70	1.54	1.67	0.96
Males	4.16	1.10	1.63	0.90

Figure Caption

Figure 1. Mean Time (in seconds) for Subjects Committing Two Errors or Less.

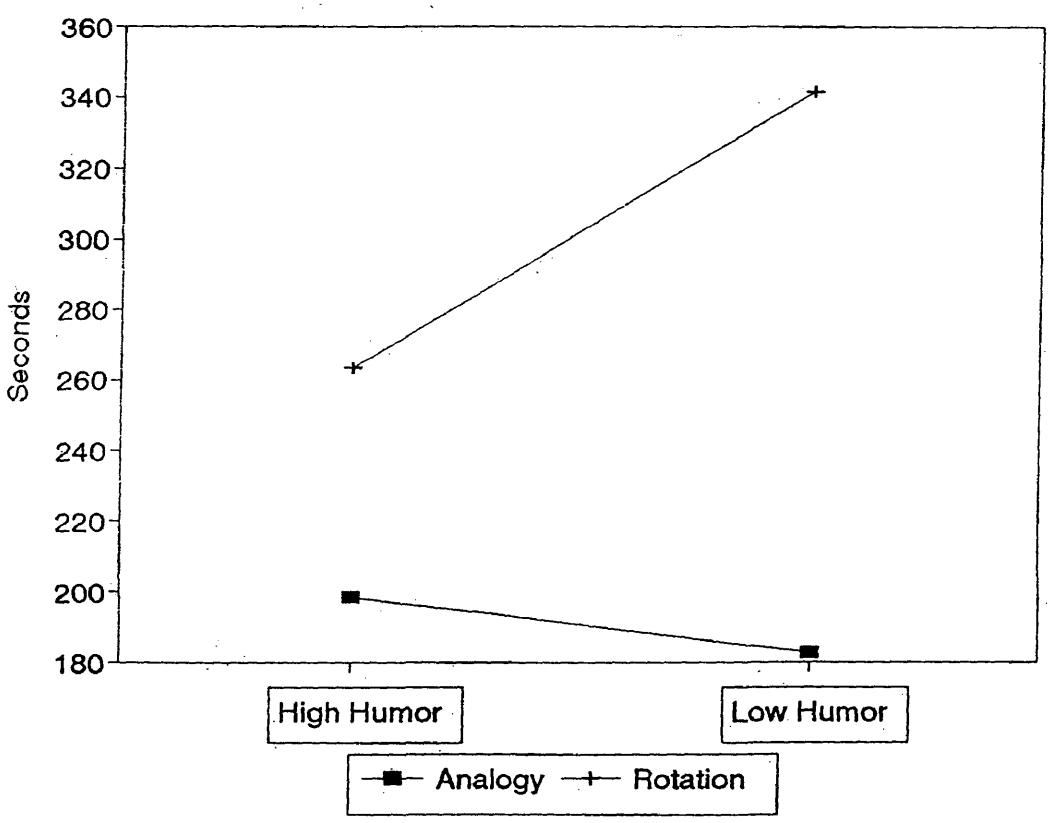
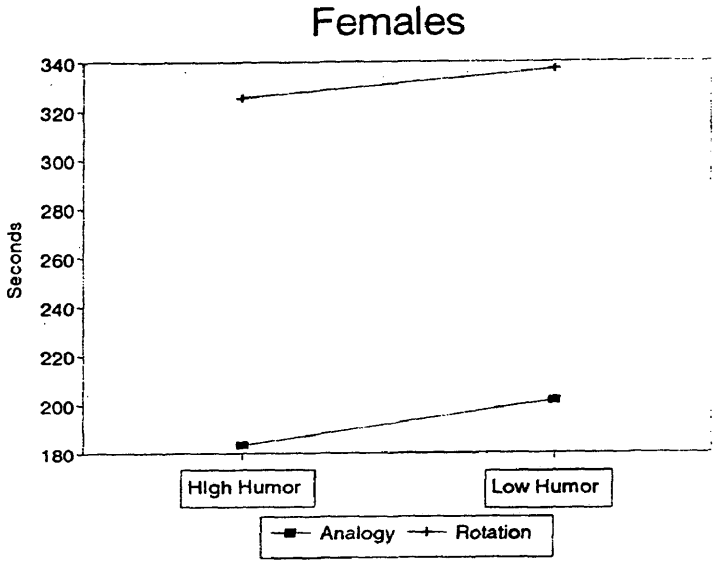

360
340
320
300
280
260
240
220
200
180
Seconds
High Humor
Low Humor
Analogy
Rotation

Figure Caption

Figure 2. Mean Time (in seconds) by Sex, Humor Level, and Task.


Females
340
320
300
280
260
240
220
200
180
Seconds
High Humor
Low Humor
Analogy
Rotation

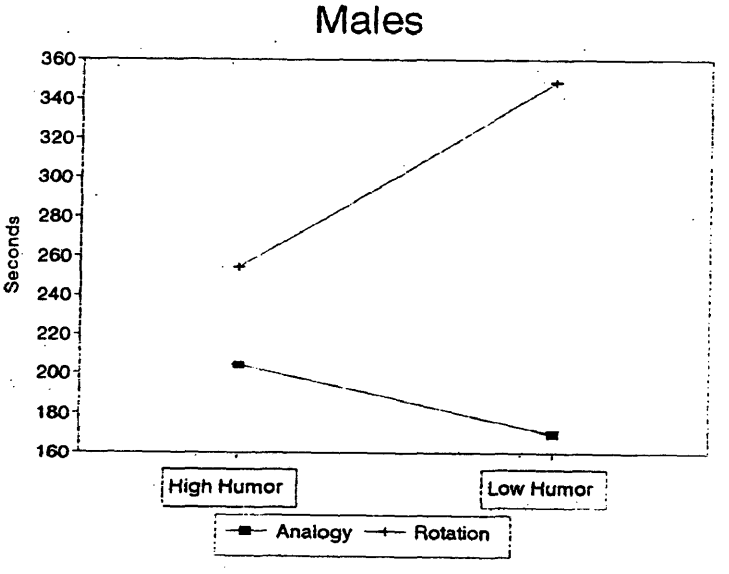

Males
360
340
320
300
280
260
240
220
200
180
160
Seconds
High Humor
Low Humor
Analogy
Rotation

Figure Caption

Figure 3. Mean Errors by Task and Humor Level.

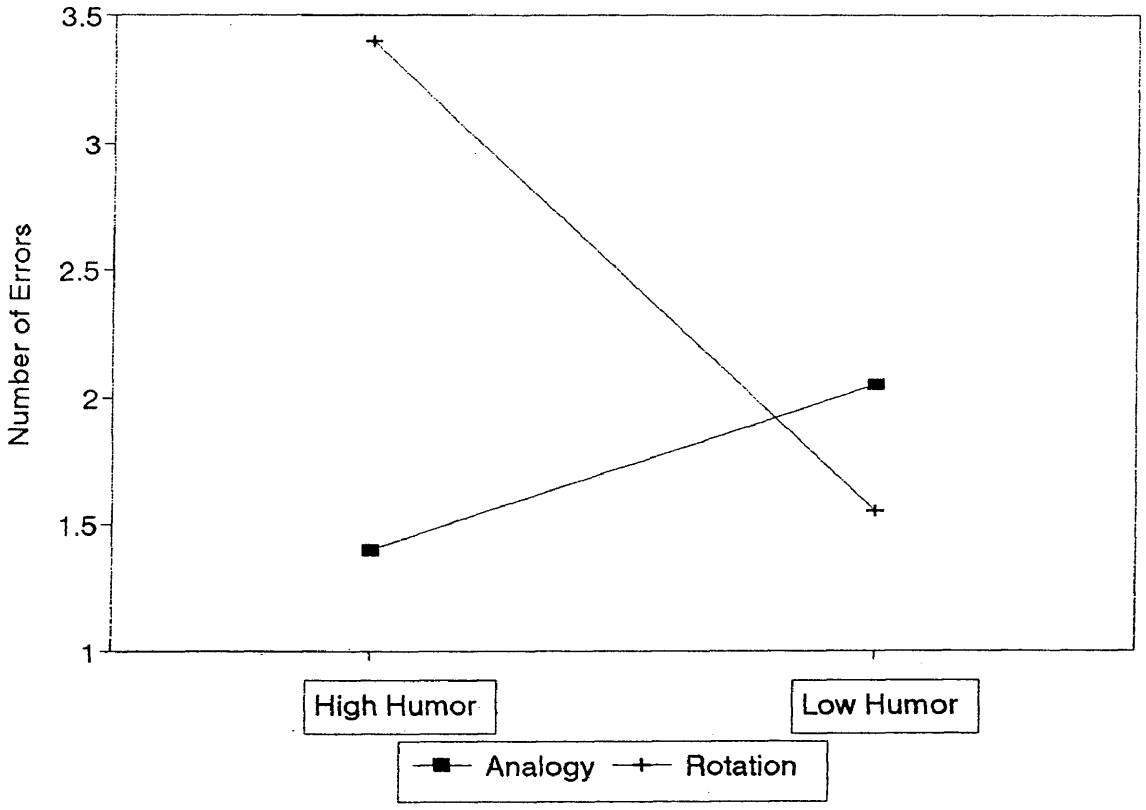
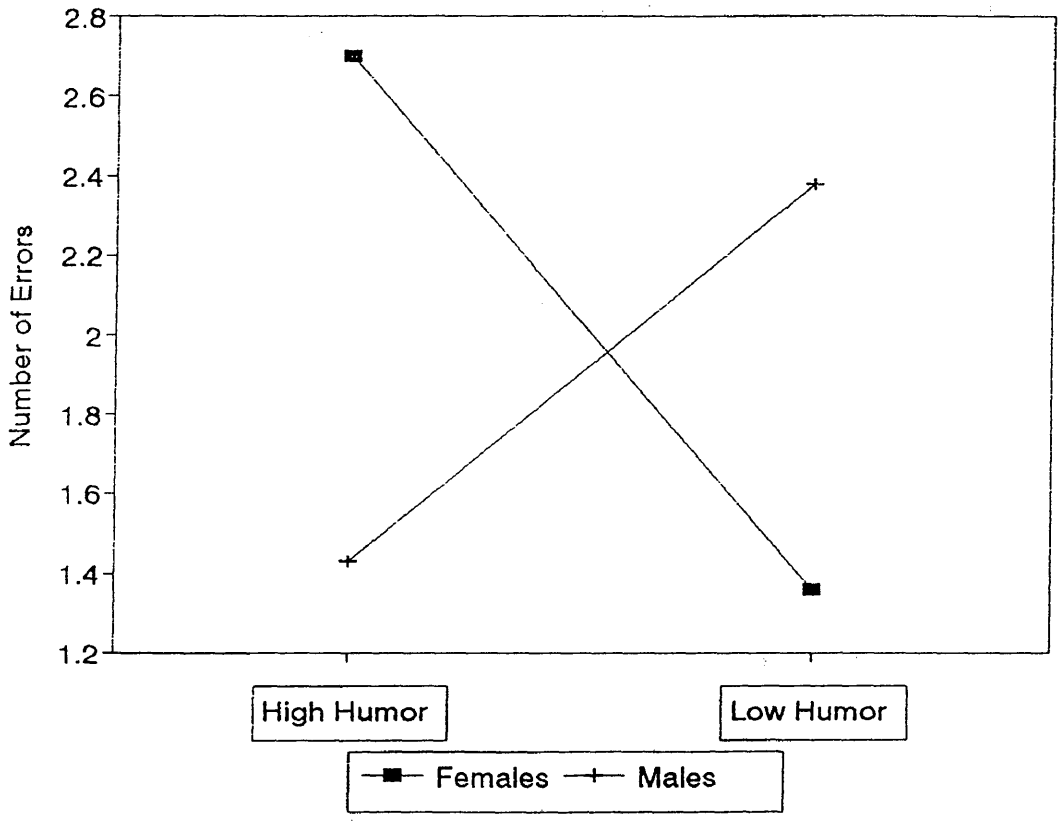

3.5
3
2.5
2
1.5
1
Number of Errors
High Humor
Low Humor
Analogy
Rotation

Figure Caption

Figure 4. Mean Errors by Sex and Humor Level.


2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
Number of Errors
High Humor
Low Humor
Females
Males

Appendix A

Imagery Rating Scale

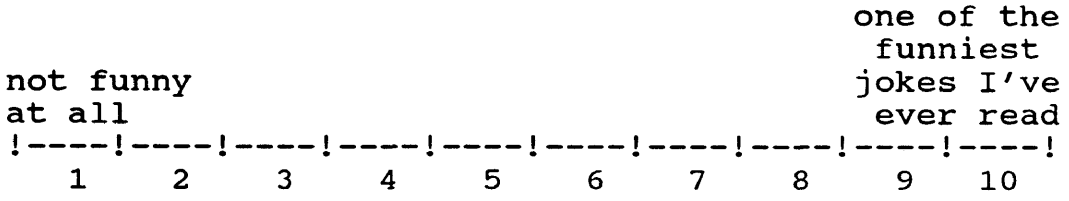
Please read the following jokes and sentences and rate them for imagery on a scale from 1 to 10 with "1" being "no imagery associated with this joke/sentence" and "10" being "very vivid imagery." "Imagery" will refer to the extent to which the joke/sentence enables you to form a picture in your mind. So if, for example, a joke/sentence enables you to form a very vivid image in your mind, give it a "10." If, on the other hand, a joke/sentence does not enable you to form an image at all, give it a "1." Please make sure that you are rating the jokes for imagery and NOT humor content.

Appendix B

Humor Rating Scale

Please read the following jokes and sentences and rate them for funniness on a scale of 1 to 10 with "1" being "not funny at all," and "10" being "one of the funniest jokes you've ever read." So if, for example, you find a joke/sentence completely unamusing, give it a "1." If, on the other hand, you find the joke to be one of the most amusing jokes you've ever read, give it a "10."

FUNNINESS



Appendix C

Jokes and Sentences Used for Each Condition

Low Humor, High Imagery

1. The hired killer polished his new revolver.

2. The damp nylons hung from the shower rod.

3. The burning cross symbolized racial hatred.

4. The gigantic man was wearing purple gloves.

5. The rabid dog bit the tender, white flesh.

6. The black dog bled profusely from its right hind leg.

Low Humor, Low Imagery

1. Degraded stimuli caused a delayed reaction.

2. The intense desire to be successful determined his personal actions.

3. The alleged crime slandered his dubious reputation further.

4. The unrealistic goals proposed resulted in frequent disillusionment.

5. The outdated tradition had lost its previously popular appeal.

6. The timely argument elicited immediate response.

High Humor, High Imagery

1. I bet a funny thing about driving a car off a cliff is, while you're in midair, you still hit those brakes! Hey, better try the emergency brake!

2. If you ever reach total enlightenment while you're drinking a beer, I bet it makes beer shoot out your nose.

3. The boy stood on the burning deck,
Picking his nose like mad;
He rolled them into little balls
And flicked them at his Dad.

4. To me, boxing is like ballet, except there's no music, no choreography, and the dancers hit each other.

5. Q. What did Raggedy Ann say to Pinnochio when she was sitting on his face?
A. "Tell the truth. Tell a lie. Tell the truth. Tell a lie."

6. If you're robbing a bank, and your pants fall down, I think it's okay to laugh, and to let the hostages laugh too, because come on, life is funny.

High Humor, Low Imagery

1. Dad always thought laughter was the best medicine, which I guess is why several of us died of tuberculosis.

2. Some physicians direct their patients to lie always on the right side, declaring that it is injurious to the health to lie on both sides. Yet, lawyers as a class enjoy good health.

3. Q. Why do farts smell?
   A. For the deaf.

4. The trouble with political jokes is that they often get elected.

5. "Abstinence," said Dennis, "is a good thing. But it should always be practiced in moderation."

6. I hope life isn't a big joke, because I don't get it.

Appendix D

Analogy Test

1. BICYCLE:(A. walk, B. boat, C. motor, D. motorcycle)::SAILBOAT:YACHT

2. EXERCISE:STRENGTH::OLD AGE:(A. anger, B. weakness, C. solitude, D. joy)

3. WHEAT:FLOUR::GRAPE:(A. vintage, B. vine, C. wine, D. fruit)

4. HOUSE:BUILD::TRENCH:(A. dig, B. trap, C. obliterate, D. dry)

5. GLOVE:BALL::HOOK:(A. coat, B. line, C. fish, D. curve)

6. LETTUCE:LEAF::ONION:(A. bulb, B. cry, C. radish, D. tree)

7. (A. contempt, B. dislike, C. disagreement, D. distrust): HATE::ANGRY:FURIOUS

8. REFEREE:RULES::CONSCIENCE:(A. thought, B. regulations, C. morals, D. Freud)

9. BABY:CARRIAGE::MAN:(A. woman, B. automobile, C. child, D. adult)

10. LAWBREAKER:BAIL::HOSTAGE:(A. criminal, B. ransom, C. murder, D. threat)

11. WEEK:DAY::DAY:(A. month, B. second, C. hour, D. night)

12. RICH:OWN::WISE:(A. know, B. teach, C. divulge, D. save)

13. HAND:PAW::TEETH::(A. horns, B. tail, C. fangs, D. claws)

14. HE:HIM::WE:(A. me, B. us, C. them, D. you)

15. WOUND:BLOOD::ACCIDENT:(A. damage, B. case, C. car, D. murder)

16. ACT:(A. battle, B. song, C. play, D. fire)::FIGHT:WAR

17. IMMACULATE:CLEAN::(A. major, B. inordinate, C. gross, D. minute):SMALL

18. BEACH:SAND::OCEAN:(A. ship, B. waves, C. fish, D. water)

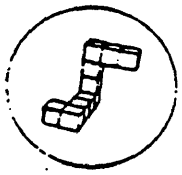
19. COMPOSER: SYMPHONY::(A. architect, B. contractor, C. mason, D. tenant):SKYSCRAPER

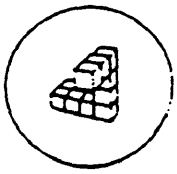
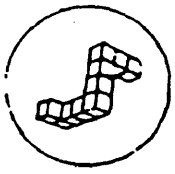
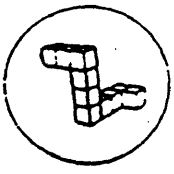
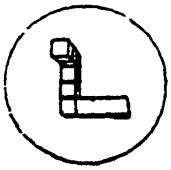
20. ASPIRATION:FUTURE::(A. hope, B. regret, C. joy, D. ire):PAST

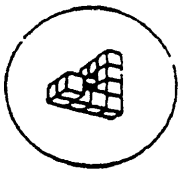
Time Finished:_____

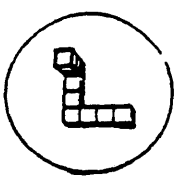
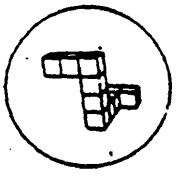
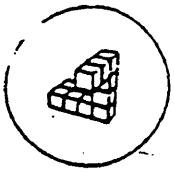
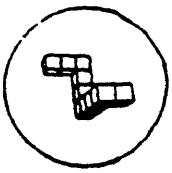
Appendix E

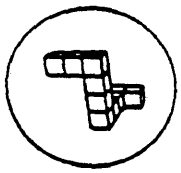
Rotations Test

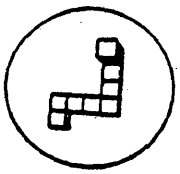
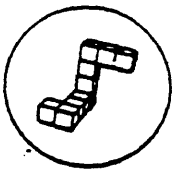
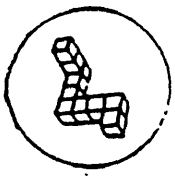
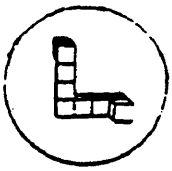
1. 

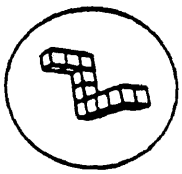





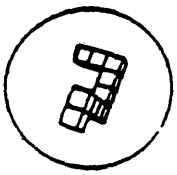
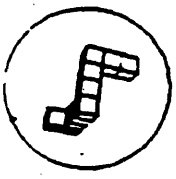
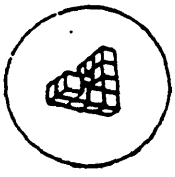
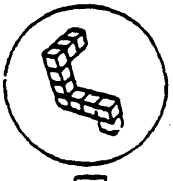
2. 

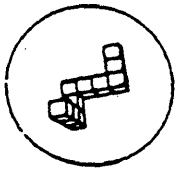





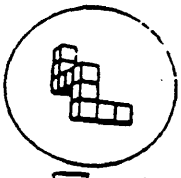
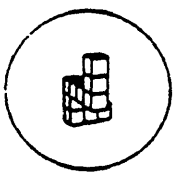
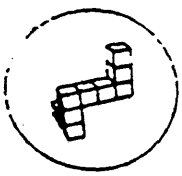
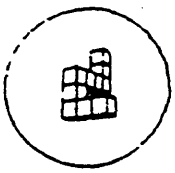
3. 

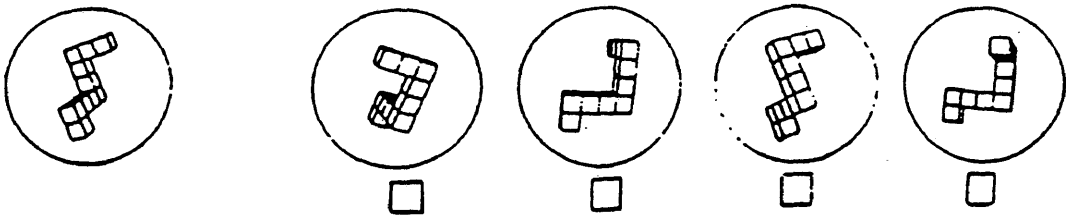





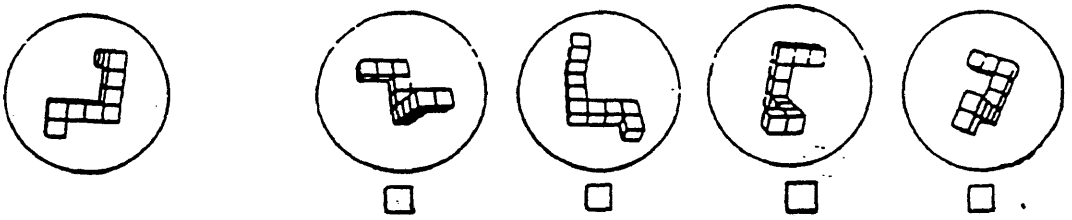
4. 

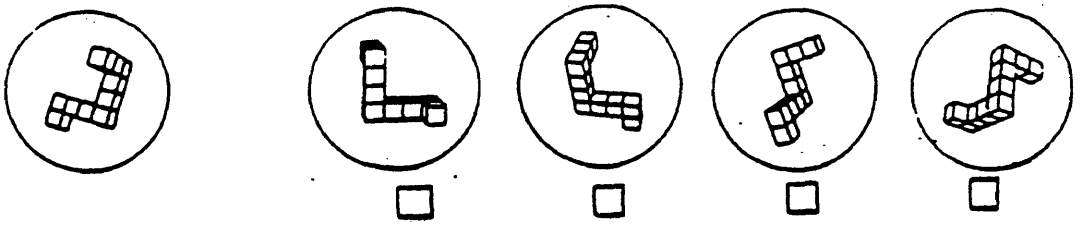





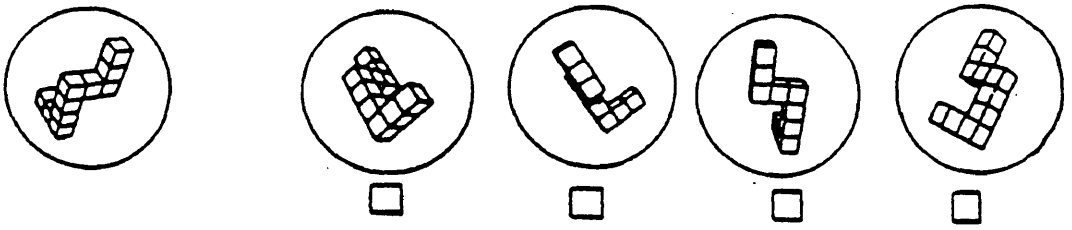
18. 

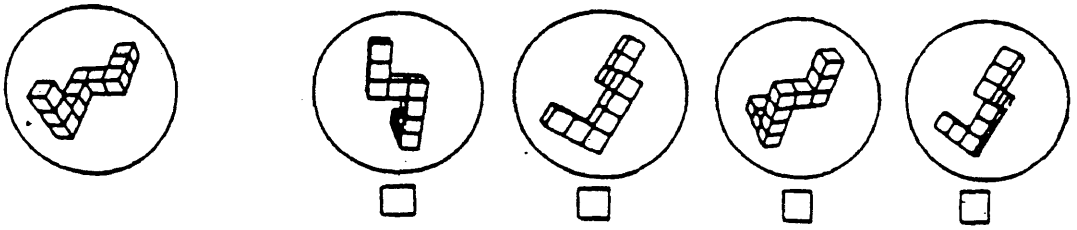





6. 

7. 

8. 

13. 

14. 

Finish: _____

Appendix F

Analogy Pre-Test

1. WALK:LIMP::TALK:(A. pronunciation, B. stammer, C. crutch, D. speech)

2. COUNTERFEIT:REAL::MATURE:(A. spotted, B. rotten, C. unripe, D. grown)

3. LAMP:LIGHT::CHAIR:(A. stool, B. table, C. back, D. seat)

4. INGREDIENT:RECIPE::YELLOW:(A. yolk, B. green, C. liver, D. age)

5. RIVER:STREAM::MOUNTAIN:(A. cliff, B. hill, C. canyon, D. peak)

6. ELECTRICITY:CURRENT::WATER:(A. wet, B. juice, C. stream, D. present)

7. THREAD:FABRIC::(A. cell, B. molecule, C. skin, D. life):ORGANISM

8. (A. inoculation, B. disease, C. medicine, D. doctor):VACCINATION::RISK:INSURANCE

9. DIAMOND:(A. brilliance, B. size, C. carat, D. color):LIGHTBULB::WATT

10. INFANT:ADULT::KITTEN:(A. dog, B. cat, C. pig, D. giraffe)

Time Finished:_____

Rotations Pre-Test

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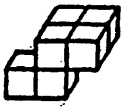

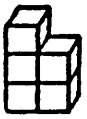

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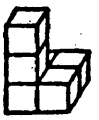

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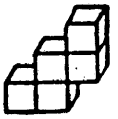

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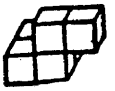

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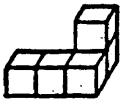

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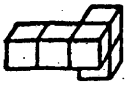

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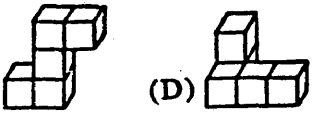

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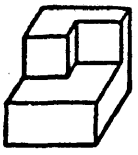

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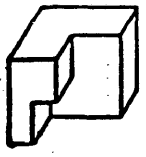

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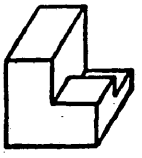

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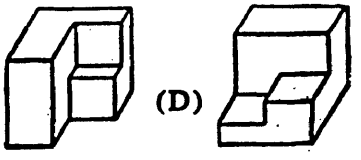

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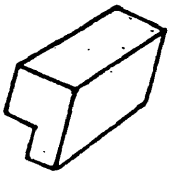

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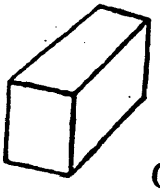

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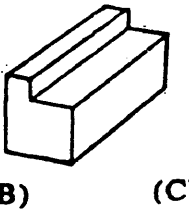

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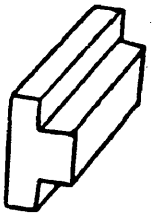

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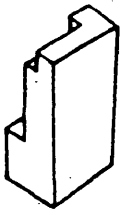

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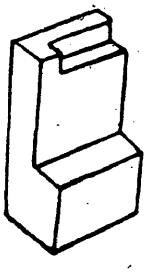

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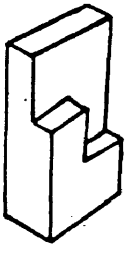

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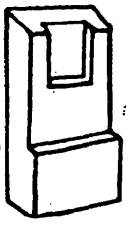

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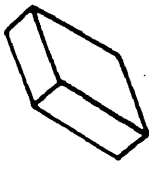

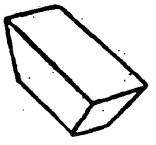

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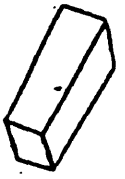

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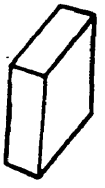

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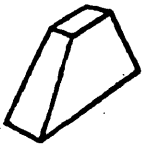
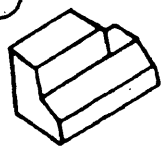
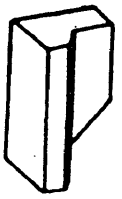


(D)

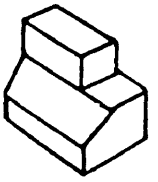
7



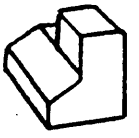


(A)

(B)

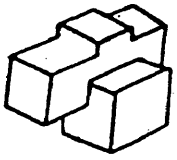


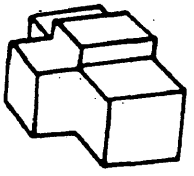
(C)



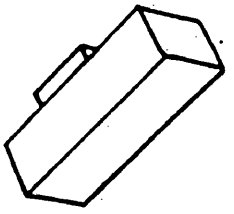
(D)

8





(A)



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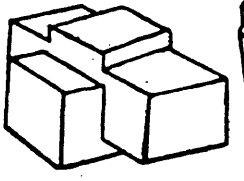

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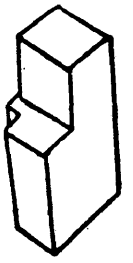
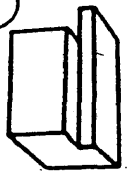
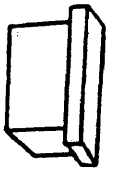


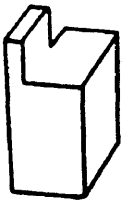
(D)

9





(A)



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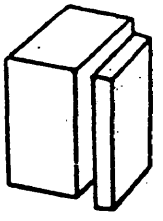

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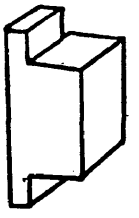
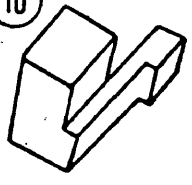
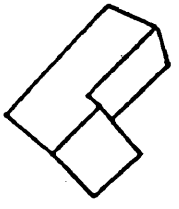


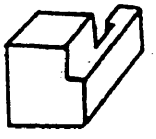
(D)

10





(A)



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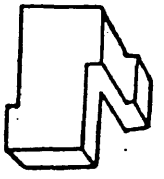

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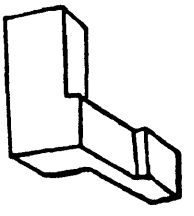

(D)

Finish: _____

VITA

Heather Gail Belanger

The author was born in Caribou, Maine on November 10, 1969. She graduated from Colby College in 1992. She completed her master's degree in experimental psychology at the College of William and Mary in 1994. In all likelihood, the author is currently unemployed.