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Memory can be broken down into two components: verbal and spatial memories. Verbal memory involves reading, writing, vocabulary and comprehension of texts. Spatial memory, on the other hand, involves the ability to read maps, rotate geometric figures in space, and understand diagrams. Women are thought to have better verbal memories than men, whereas men seem to have better spatial abilities than women. We recruited 28 participants from the Human Subject Pool in order to test this hypothesis. We found that this is not true when we gave the participants memory tasks; there are more differences within a certain gender than differences between the two genders. On the other hand, when participants filled out the questionnaires regarding their memories men did prefer spatial tasks, whereas women leaned towards the verbal tasks.

Gender differences exist from the time we are newborns. Boys are simply raised differently than girls, and girls are raised differently than boys. Boys are associated with the color blue, trucks, and being tough. Girls are associated with pink, dolls, and emotions. Although more can be said of gender differences and all its forms, we were especially curious about gender differences regarding memory. Consequently, we designed an experiment to investigate how memory differs, particularly verbal and spatial memory, between men and women.

Knowing how men and women filter information better can help in high school and college settings. If men have better spatial memory, then they can be given diagrams and/or maps to help with the texts to be read for a class. For women, who are said to have a verbal memory, written instructions can be given, instead of diagrams, to help them to understand schoolwork better.

Many studies have been conducted on gender and the memory differences between the two (Beckman, M., 2005; Caplan, Darby, & Lipman, 1995; Fichner-Rathus, Nevid, & Rathus, 2005; Geiger & Litwiller, 2005; Zinser, Palmer, & Miller, 2004). In order to better understand past research, spatial memory is associated with the ability to place objects mentally, rotate geometric figures in one's head, and the ability to understand diagrams. Conversely, verbal memory reflects one's ability to comprehend sentences in a textbook and the ability to spell words correctly when learning vocabulary.

Geiger and Litwiller (2005) conducted a study on gender differences and memory in the field of science. The study involved fifteen men and forty-eight women who were tested on their verbal and spatial memory abilities. The first session consisted of the verbal working memory span test. The participants were asked to read a set of sentences out loud and then to recall the last words of each sentence. In the spatial working memory span test session, participants saw a set of capitol letters rotated either in a normal manner or as a mirror image. They had to remember how far each letter was rotated. As a result, male participants were found to excel on both verbal and spatial working memory span tests.

According to a study conducted by Zinser et. Al. (2004), memory and gender differences were studied by giving the participants maps of neighborhoods that included geographic site-names. There were 109 participants: 35 were men and 74 were women. Primarily, the participants were given a map of a college campus with the corresponding names for each building as well as a regional map with 12 major cities. After some time, the participants were asked to recall the names of campus sites when shown a representational map of the buildings, and to recall the names of the 12 cities when shown a representational regional map with dots as a city's location. Conclusively, the gender difference for recalling campus buildings was not significant, although men matched more cities than women did.

Beckman (2005) conducted a study to test gender differences in verbal and spatial memories of monkeys. The idea was that male monkeys were born with an innate ability to outperform females spatially, but the researchers found that with a little training, the female monkeys could perform as well as the male monkeys on the spatial memory task. Ninety monkey subjects, of both genders, participated in a game of spatial ability; they were to locate treats under discs in the correct order until they missed one. On average, with training on the spatial memory game, the female monkeys performed just as well as the male monkeys.

To test the idea that female monkeys could perform as well as or better than male monkeys spatially if training was involved, the researchers took twenty-two extra monkeys of both genders and trained them to find the treats. They found that the training did nothing for the young male monkeys, but the female monkeys performed much better

after the training. This seemed to close the 'gender-gap' regarding spatial memory ability; all the female monkeys needed was a little training to do as well as the male monkeys.

An experiment by Caplan and Lipman (1995) was conducted to study gender differences when participants were asked to remember a route through a neighborhood. Participants either received no map-aid, a map-aid labeled "map", or a map-aid labeled "diagram". The aids either did or did not include marked landmarks. It was hypothesized that men would outperform women when the aid was labeled "map" rather than "diagram" due to their advantage in spatial memory. The term "map" was considered a more spatial label than "diagram". Men were also hypothesized to outperform women if they were given landmarks (scene-spatial memory), since they do not usually process information this way. With the help of landmarks that are normally not used to find locations by men, it was thought that these cues would be used to their advantage because they were paired with maps that men are more able to read. On the other hand, women who were given configured information, such as how far a location was from another, (layout-spatial memory), would benefit more due to the lack of spatial memory they have in this category.

The researchers found that their hypotheses were partially supported by the results. Men did outperform women when using map-aids labeled "maps"; each of these conditions was shown to be less useful for women though. One reason found true was that if women had had bad luck reading maps previously, they were more apt to not perform well now with map-aids labeled "maps" due to the negative stigma they had

attached to maps. Men, on the other hand, are more spatial and do not become discouraged the same way women do when attempting to read a map.

The hypothesis that was fully supported was that map reading ability depended more on individual past experiences than their actual ability, such as the women whom had performed poorly after reading maps previously in life, which kind of spatial memory was being tested (scene or layout), if landmarks were used, and gender. It was found that there may be more differences within a gender instead of between the two genders, but more research needs to be conducted in order to show this.

Research by Rathus, Nevid, and Fichner-Rathus (2005) showed insignificant sex differences in cognitive ability, but found more significant results between the genders concerning spatial and verbal memory. It was thought that there were more differences within the genders rather than between the two. Nevertheless, research found that men tend to be superior to women in visual spatial abilities, the sort used in math, science and reading maps. On the other hand, females tend to perform better than males in verbal tasks, such as reading comprehending words found in sentences. These are overall differences because there will always be spatially-oriented women and verbally-fluent men in each group.

After reviewing the former research, we were interested to see how women and men would perform in a memory task that contained both verbal and spatial memory tasks. Our hypothesis was that male participants would better remember the placement of objects in a room (spatial memory), whereas female participants would better recall a list of the objects in the exact same placement in the same room (verbal memory). Neither

the male nor female participants were told that the objects on the table were to be remembered. We used 28 undergraduate students from the Human Subject Pool at Lindenwood University. The participants sat at a table with 12 objects strategically placed in front of them. The participants had two minutes alone at the table as we, the experimenters, left the room to "set up the experiment room".

Following the two minutes, we led the participants into another room, where they were given 5 minutes to recall the objects that they could remember on the table in both list and diagram form. Subsequently, after having collected the data and dismissing them, we counted the total items recalled from both the list and diagram to see if there were true gender differences in memory.

Method

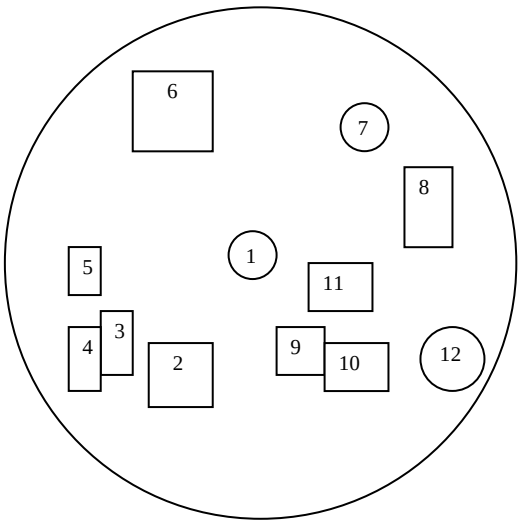
Participants

Twenty-eight undergraduate students, seventeen men and eleven women, were recruited from Lindenwood University located in St. Charles, Missouri. The students were entry-level psychology, sociology and undergraduates. The participants were recruited through the Human Subject Pool, whose purpose is to bring together experimenters and participants while ensuring the safety of the participants. Participants received bonus points in their psychology, sociology or anthropology classes. Participants were given the experiment on first come first serve basis.

Materials

We used loose-leaf paper, two pens, and two rooms in close proximity with two chairs and a table, a lamp or overhead light fixture, and a stopwatch. A questionnaire (see Appendix A) was constructed in order to see whether the subjects were right- or left-handed, male or female, and if they learned better using their verbal or spatial memories (see Appendix A for a copy of the questionnaire used). In addition, the 12 specific items were placed on a table before the participants entered the room. These items included a candle, a psychology textbook, a pencil, a highlighter, a stapler, a box of Kleenex, a CD, a hairbrush, a pocket-sized dictionary, a calculator, a glass paperweight and a water bottle (see Figure 1). We also provided the participants with two pieces of loose-leaf paper, which the participants used after we gave instructions to draw a diagram and make a list of the former objects on the table (see Appendix B).

FIGURE 1. Map of the items



1. candle
2. book
3. pencil
4. highlighter
5. stapler
6. box of Kleenex
7. CD
8. hairbrush
9. dictionary
10. calculator
11. glass paper weight
12. water bottle

Procedure

When the participants entered the first room for the study, they signed the appropriate forms including the informed consent, questionnaire, the participant receipts, and the sign-in sheet. This exact setup was crucial so that each individual was tested under the same condition and, hence, were graded according to the standard diagram setup. After the participants finished the paperwork, we informed them that we had to leave the room for a couple of minutes to set up the experiment. We left the participants in the room alone for two minutes. When we returned, we told them to follow us to the "experiment room". Subsequently, we led them into the second room. The participants were never told what the memory experiment consisted of. They walked into the second room with no idea that the items on the table in the initial room were the items to be recalled for the memory task. We used deception because this was when the experiment actually started. Deception was necessary in order to get an accurate account of the participants' memories. Knowing in advance that they would be recalling the items would have skewed our results because every participant would have recalled all, or nearly all, 12 items. Therefore, the results would have been the same across the board.

In the second room, we asked the participants to recall the items they remembered seeing on the table in the initial room. Each was to recall the items in two fashions: a drawn out diagram and a simple listing of the objects. They were given 5 minutes to do both tasks, in either order, and were asked to recall the items to the best of their abilities. We left the room as the participants performed the memory tasks. When the time had lapsed, we collected both papers from the participant, asked if they had any questions,

and handed out the feedback letters with a full debriefing. Lastly, we thanked them for participating and they were dismissed.

Results

Three independent t-tests were computed. The first t-test was conducted in order to assess whether there were any sex differences in questionnaire response. Overall, there was statistical significance in that male participants are more spatially-oriented than the female participants (M =1.82 for men versus M = 1.00 for women). Hence, the means differed reliably in the predicted direction, $t(25) = 2.180$, p =.039. With regards to the other two t-tests, which were based on how many items were correctly drawn and how many items were correctly listed from each participant, they both were not statistically significant. Men had a lower mean than the women on how many items were drawn correctly in the diagram (M = 33.82 versus M = 42.50). Consequently, the results were surprisingly in the wrong direction, $t(25) = -.865$, p >.05, without statistical significance. Although the last t-test result was also not statistically significant, the female participants did have a greater mean (M = 48.14 versus M =35.78) on how many items were listed correctly, pointing in the predicted direction, $t(25) = 1.353$, p >.05. For these last two t-tests the individual scores were calculated by dividing the number of correctly drawn or listed items by 12. Then we found the mean of the men's scores as well as the women's.

Discussion

The results of the present study did not reveal sex differences in memory based on whether the recall task involved spatial or verbal memory. What was actually found was that women drew better diagrams and produced better lists than men. The overall recall for women was better for both dependent variables (the diagram and the list).

One question that came to mind after seeing the results was if any of the participants were tipped off to the deception we used in the study. We told every participant to not to let the other prospective participants know about the nature of the study, but who is to say they still did not tell his/her friends? This is a question we will never have answered, but two female participants' results looked a little fishy. They recalled a very high number on each memory task, but we do not know if they are just attentive to their surroundings or if they knew what was going to be asked of them.

A statistically significant sex difference was found in the participant's responses on the questionnaire. There were three questions tapping into verbal and spatial memory: drawing a diagram (spatial) or giving written instructions (verbal); following written directions (verbal) or following a map (spatial); taking a drawing class (spatial) or a reading/writing class (verbal) at school. Men, on average, would rather use diagrams, maps, and take a drawing class at school than women; the women, on the other hand, preferred giving written instructions, following written directions, and taking a reading/writing class.

We ran into many different limitations while conducting our experiment. The most obvious was the fact that it is nearly impossible to get exactly half male and half-

female participants when recruiting from the HSP. The sign-up sheets were on a first come, first serve basis, and we could not be biased by stating we needed more females at the end of experimenting. There were also distractions in the library; other students were looking for books, the participant's cell phones were ringing, and some participants brought other homework to do before the experiment began. Since we could not tell them to concentrate on the table they were sitting at, we had to let them be distracted the entire time.

Some participants also misunderstood the instructions they were given. We told them, "recall the objects on the table", yet some participants recalled chairs, book bags, and other objects not sitting directly on the table they sat at. They also tended to draw and list the informed consent sheets we had them fill out before running the memory experiment. Those were not on our diagram, but the participants left them lying on the table when we took them to the second room. We wanted the objects we placed on the table ourselves recalled, not what each individual left on the table.

If this study were to be replicated, the overall number of participants needs to be increased due to the fact that it was truly up to fate if we were to get exactly half men and half women for an experiment like this. The more participants overall, the better chance there is of finding statistical significance.

Instead of giving the instructions verbally, we could have written them down for the participants to clarify more thoroughly. The participants who did not seem to be paying attention were the ones who drew the windows and chairs in their diagrams; perhaps that was because they could not recall any of the objects placed on the table. It

would have seemed odd if we would have told the participants to put their informed consent sheets in their book bags just so they did not draw them on the diagrams. It did not skew the results, however since we crossed out anything that was not included in our twelve listed objects on the table.

The study conducted by Caplan and Lipman(1995) supported our significant findings regarding gender differences and memory. From their research, it was concluded that there were more differences within a gender (woman A verse woman B) rather than between the genders (woman A verse man A). Our participants did not vary significantly on the verbal and spatial memory tasks, even though women preferred the verbal choices, and men the spatial choices, on the questionnaire.

Rathus et al (2005) also had findings that coincided with the results of our experiment. They also found more difference within a gender than between the two. We found this to be true due to the fact that humans are innately born with better verbal or spatial memories depending on gender, but these differences tend to even out over the lifespan. This may be a reason why our results were not significant; our participants were at least eighteen years of age or older.

Knowing this fact also connects to the study conducted by Beckman (2005) regarding the monkeys. He found the male monkeys were born with a tendency to be more spatially oriented than female monkeys, but with training, the female monkeys could perform just as well. Over the lifespan, women can learn how to better their spatial abilities, and thus, catch up to men eventually.

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Appendix A

Questionnaire

1. Are you MALE or FEMALE?

2. When explaining a new idea to someone, would you rather

DRAW A DIAGRAM or GIVE A WRITTEN DESCRIPTION?

3. Are you LEFT or RIGHT -handed?

4. When traveling to a new place, would you rather

FOLLOW WRITTEN DIRECTIONS or FOLLOW A MAP?

5. In college, would you rather take a

DRAWING CLASS or READING/WRITING CLASS?

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Appendix B

Instructions

Instructions given to the participants after being placed in the second room for the memory tasks are as follows:

> "Do you remember the table you were just sitting at in the other room? I am going to ask you to make a list of the objects you remember seeing on the table on one sheet of paper, and to draw a diagram of where the objects were placed on the table on the other sheet of paper. You have five minutes, good luck!"