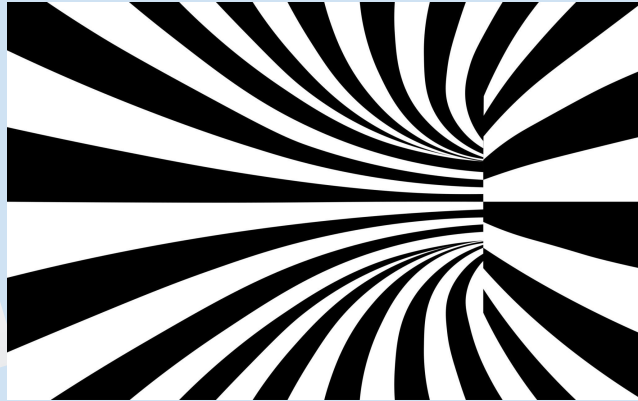


How does a person's age affect
how they perceive optical
illusions?



Background Information

Optical Illusions:

- Optical Illusions can use color, light and patterns to create images that can be deceptive or misleading to our brains.
- The information gathered by the eye is processed by the brain, creating a perception that in reality, does not match the true image.
 - Part of the brain that processes these illusions is the prefrontal cortex, which is responsible for problem solving.
- Optical illusions occur because our brain is trying to interpret what we see and make sense of the world around us. Optical illusions simply trick our brains into seeing things which may or may not be real.

Child Brains:

- At age 7, our brains are 95% of what they are at the adult stage
- During our first years, our brain is rapidly growing and absorbing information, making connections and developing skills
- As we get older, our brain starts refining itself, learning more complex skills and making deeper connections

Teenage Brains:

- During our teenage years, our brain is finishing developing and maturing, though this process isn't complete until our mid-20's (about 25)
- At this stage, our brain is able to quickly adapt and learn in order to respond to challenging situations and activities

Adult Brains:

- By around 25 years old, our brain has finally finished developing and maturing
 - Specifically, our prefrontal cortex, which is responsible for problem and logic solving, is fully developed at this stage. This is the part of the brain that would help solve and understand optical illusions

Background Information

Problems as We Age:

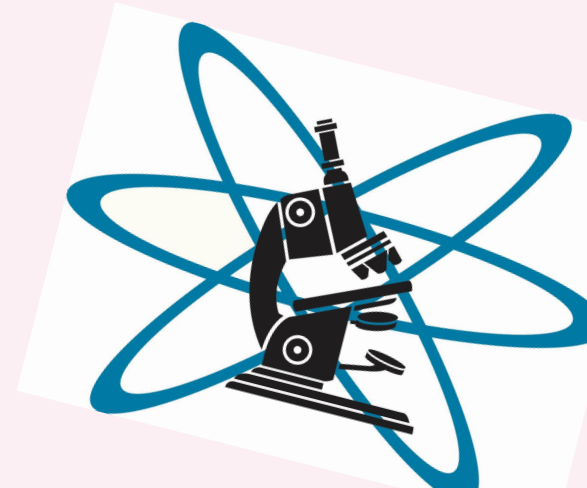
Older adults are slower to find words and recall names, have trouble multitasking and paying attention for long periods of time, in addition to having difficulty perceiving colors, faces, and motion. However, there are some exceptions to these typical aging guidelines. Some older adults in their 80's and 90's can have the brain function of 50 to 60 year olds, though the reason for this has not yet been discovered.

Changes to Our Brains as We Age:

- Certain parts of the brain shrink, such as ones that are important to learning or other complex mental activities
 - Some of the parts shrink more than others such as the frontal lobe, which controls our behaviors and emotions, and the hippocampus, which plays a role in learning and memory
 - The cerebral cortex, the outer layer of the brain that contains cell bodies, also thins with age which can decrease connections and ultimately, cognitive function
- Communication, or flow, between neurons can decrease
- Blood flow can decrease
- Inflammation, which occurs when the body responds to an injury or disease, can also increase
- The brain can begin to produce different levels of chemicals, which can affect neurotransmitters and protein production, ultimately resulting in a decline in cognitive function (mental thinking or processing)
- **All of these changes can make it harder for older adults to complete complex memory challenges, remember words or names, and have decreased attention or ability to multitask**

Hypothesis

Our Hypothesis is that the age group of 20 - 29 (the recorded ages to be considered a young adult) will be the fastest to perceive or make out an illusion. We believe this because we know that the brain is fully developed in this stage, specifically in the prefrontal cortex, which would allow young adults to be able to use their fully developed problem solving and logical thinking skills to perceive and solve the illusions. We also believe that the age group of 70+ will be the slowest at solving the illusions since our brains have started shrinking at this age, specifically the hippocampus, which helps with memory and learning. These changes to the brain can make it harder for older adults to solve illusions, leading us to believe that they will be the slowest.



Research Question

How does a person's age affect how they perceive optical illusions?

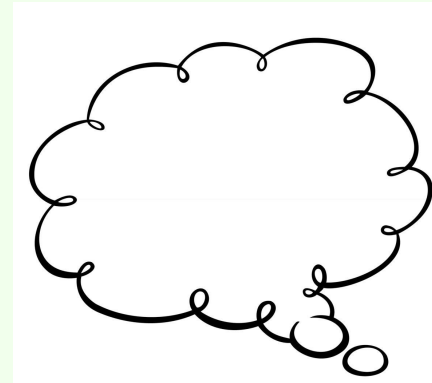
Age Groups We Will Test:

- Child: 1 - 9
- Adolescent: 10 - 19
- Young Adult: 20 - 29
- Adult: 31 - 49
- Older Adult: 50 - 69
- Elderly: 70 +

We will test 2 participants per age group, making a total of 12 participants

Optical Illusions that we will use:

- 2 Hidden Number Illusions
- 2 Hidden Picture Illusions
- 1 Stroop Effect Illusion

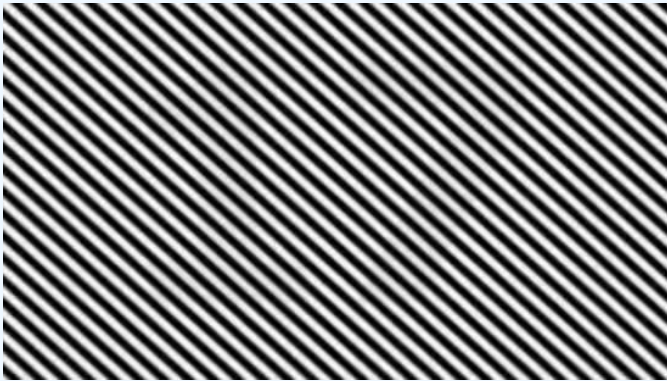


Investigative Methods or Procedure

(number illusions)

Our plan is to test the various age groups on several different optical illusions. Our first test will be on the hidden number illusions pictured below, where we will...

1. Show the participant (of whatever age group) the number optical illusion on a chromebook
2. We will then start the timer to record the time it takes for them to solve it
 - a. We will give no hints as to ensure that everyone receives the same experience
 - b. If the participant does not solve the illusion within 10 minutes, we will record their time as 10 minutes
3. Record this data in seconds and move on to the the next illusion set



Investigative Methods or Procedure

(picture illusions)

Our second test will be on the hidden image illusions pictured below, where we will...

1. Show the participant (of whatever age group) the hidden image optical illusion on a chromebook
2. We will then start the timer to record the time it takes for them to solve it
 - a. We will give no hints as to ensure that everyone receives the same experience
 - b. If participant does not solve the illusion within 10 minutes, we will record their time as 10 minutes
3. Record this data in seconds and move on to the next illusion



Investigative Methods or Procedure

(stroop effect)

Our final test will be on a single stroop effect illusion (pictured below), where we will...

1. Explain to the participant (of whatever age group) that for this illusion, they have as many tries as needed to successfully complete it, and if they mess up, they will just restart
2. Show the participant the stroop effect optical illusion (an illusion where color words are colored differently than what they read) on a chromebook
3. We will then start the timer to record the time it takes for them to successfully read through the words
 - a. When timing the participants, we will not stop the timer until they complete the entire illusion successfully, regardless of mistakes or number of tries
4. Record this data in seconds

Once all tests are complete, we will...

- I. Gather all data from previous tests together to evaluate
- II. Average out the overall time it took for each age group to solve all 5 illusions

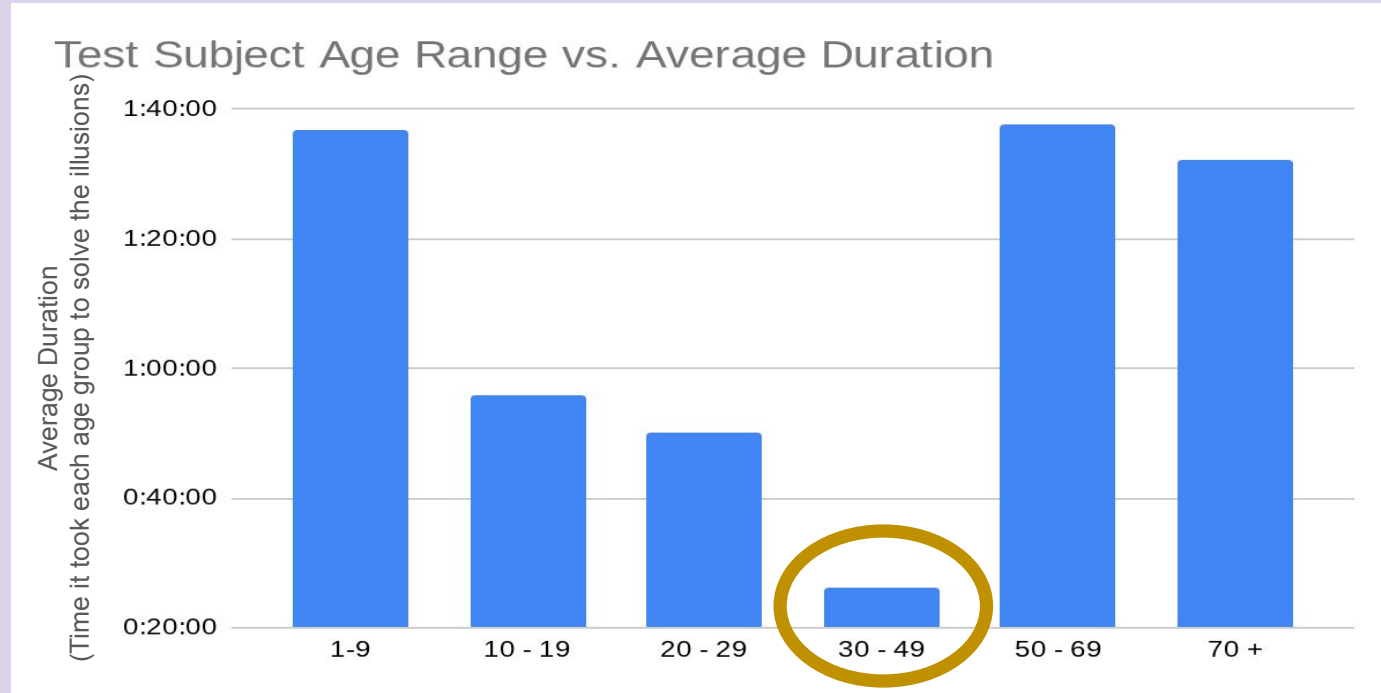


Results and Data Visualization

Number Illusion 1	1-9		10 - 19		20 - 29		30 - 49		50 - 69		70 +	
Number Illusion 2	3:53.03	2:06.32	1:58.56	00:51.62	00:08.35	00:03.15	00:03.38	00:02.79	01:11.41	00:01.61	00:00.36	00:08.08
Image Illusion 1	0:06.09	00:09.10	0:03.58	01:58.03	00:08.95	00:25.10	00:08.35	00:06.51	00:05.91	00:10.30	01:39.21	00:14.85
Image Illusion 2	04:00.04	03:59.44	1:57.49	01:15.66	00:37.42	04:30.82	01:48.01	00:23.53	03:15.83	10:00.00	10:00:00	00:25.92
Stroop Effect	00:18.81	00:20.10	00:07.39	00:14.32	00:25.52	01:00.25	00:23.48	00:13.49	00:36.39	00:08.08	00:20.01	01:20.21
Individual Averages	00:31.71	00:40.53	00:21.38	00:32.11	00:28.86	00:28.63	00:46.18	00:25.68	00:29.35	00:15.34	00:31.16	00:41.45
	01:45.94	01:27.10	00:52.68	00:58.35	00:21.82	1:17.59	00:37.88	00:14.40	01:07.78	02:07.06	02:30.17	00:34.12
						Had seen #1	Had seen #4	Has Glasses	Has Glasses	Has Reading Glasses	Has Glasses	

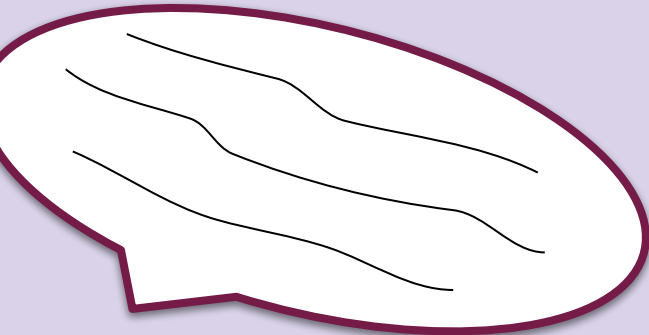
Test Subject Age Range	1-9	10 - 19	20 - 29	30 - 49	50 - 69	70 +
Average Duration	1:36:52	0:55:52	0:50:11	0:26:14	1:37:42	1:32:14

Results and Data Visualization



Discussion and Interpretation

On the first data slide, the top table is a representation of each participant's individual times from every test. The table below this represents the average time it took for each age group to solve the illusions. Those calculated averages are fully represented in the bar graph on the next slide. Using the main bar graph, we are able to determine what age group was able to solve the optical illusions the fastest by seeing which bar is the lowest. In this case, it was the age group of 30-49, with an average time of 26.14 seconds. We were also able to conclude that the 50-69 age group took the longest to solve the optical illusions with an average solving time of 1 minute and 37.42 seconds. Furthermore, we can see that there was a relationship as the participants' age group increased. From the young age group (1-9) to the middle adult group (30-49), the average time it took for the participants to solve the illusions decreased. The times then increased drastically for the 50-69 age group and stayed about the same for the 70+ age group. All of this data proves the answer to our question: that age does affect how the mind perceives optical illusions.



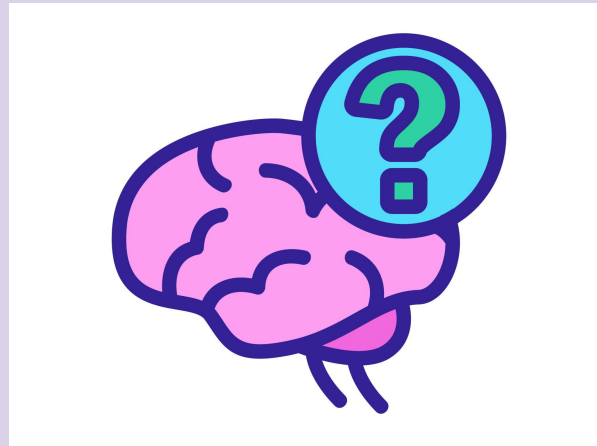
Conclusions

Our hypothesis was not correct, as the 30-49 age group was the fastest, while we believed that it would be the 20-29 age group. Our other estimate that the 70+ age group would be the slowest at solving the illusions was also incorrect as the 50-69 age group was the slowest. Overall, we were able to conclude that age does affect how the mind perceives optical illusions. These conclusions make sense compared to the background information that we discovered regarding the topic. According to the National Institute of Mental Health, “The brain finishes developing and maturing in the mid-to-late 20s.” [journeystocollege.mo.gov](https://www.journeystocollege.mo.gov) also stated that the brain isn’t fully developed until age 25. This means that half of the participants in the 20-29 age group would have undeveloped brains, while everyone in the 30-49 age group would have fully developed brains. This explains why the middle aged adults were able to solve the illusions the fastest. Furthermore, columbia.edu states, “Then, in our 30s and 40s, the brain starts to shrink, with the shrinkage rate increasing even more by age 60...While brain volume decreases overall with age, the frontal lobe and hippocampus - specific areas of the brain responsible for cognitive functions - shrink more than other areas.” This data seems to point towards the 70+ age group being the slowest to solve the illusions, since the oldest participants would have the most shrinkage in their brains. However, the 50-69 age group was the slowest, leading us to believe that there are other factors that can impact how fast someone can solve illusions. For example, the National Institute of Aging states, “Some people in their 80s, 90s, and beyond defy the common assumption that cognitive decline goes hand in hand with aging. These people, called cognitive super agers, have memory performance comparable to people 20 to 30 years younger.” This evidence proves that we could have tested a cognitive super ager, which would have ultimately strewed the data in the 70+ age group. We also know that whether people wear glasses or not, the fact that some people have less familiarity with illusions, or just that some people may not understand them could also have affected our data.

Ideas for Future Research

For future research, we would recommend to test more people or widen the range of data contained in each age group. This would lessen the effect of outliers in the data, ultimately providing more accurate information.

Additionally, testing participants on more illusions would allow us a chance to explore different illusions that play to people's strengths rather than certain categories with strict guidelines on what is tested. These various illusions could possibly give us a deeper understanding of what parts of the brain change as we age since certain illusions are solved with different parts of the brain.



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