DEAF PERCEPTION: HOW BRAIN PLASTICITY

AFFECTS VISUAL SKILLS IN DEAF PERSONS

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DEAF PERCEPTION: HOW BRAIN PLASTICITY AFFECTS VISUAL SKILLS IN DEAF PERSONS

HONORS THESIS

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Abstract

In recent years, numerous scientific endeavors have shown that, despite traditional thinking, the brain has remarkable plasticity. Plasticity is the capability of being molded, receiving shape, or being made to assume a desired form. In other words, the brain is capable of changing itself in response to its needs and stimuli. On this basis the argument could be made that supposed “handicaps,” such as deafness, blindness, or the inability to move certain limbs, may in fact unlock hidden strengths in other areas. The purpose of this study is to investigate whether or not those who are deaf or not hearing-impaired at all, differ in their ability to read words in a variety of forms. The participants will be tested on proficiency in reading original writing, like this abstract, phonetic writing, such as “Da feesh deed sweem”, and tests on word association (quickly associating a picture of a duck with the word “duck”). The hypothesis for this thesis is that those who are born deaf, the portions of their auditory cortex dedicated to sound recognition having never been fully developed, will perform just as well, if not better, in reading regular writing, and perhaps symbolic writing, but will struggle significantly in phonetic writing, in comparison to the other two groups.

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Sincerely,

Zachary Degner

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Introduction

A Brief History of Brain Plasticity: Brain plasticity (or neuroplasticity) refers to the ability of the brain and nervous system in all species to change both in structure and in function as a result of input from the environment. Though the theory has been tossed around since the late 19th century, and perhaps earlier, the idea that the brain, specifically the human brain, can change itself has been a controversial idea since its inception (Mathos 2009). Since the birth of Phrenology (that specific areas of the brain have localized functions), neuroscience has been firmly rooted in the idea that the brain is an unchanging organ with each section having a specific function and purpose. If for example the auditory cortex of a human being were rendered inactive (as is the case in a deaf person), then the brain matter in that area would be cut off and useless to the rest of the brain. Science has shown conclusive evidence in recent times that this is in fact not the case. Take the famous example of the woman who was forced to have half of her entire brain removed due to damage caused by seizures (Mathos 2009). Phrenology and the sciences based on its assumption would expect the areas controlled by that portion of the brain to be forever cut off and unusable, the most obvious of which would be she would at least be paralyzed on an entire side of her body. Though it is true that initially the woman in question was incapable of speaking properly or moving that side of her body easily, over time she has come to move her arms and legs enough to even swim, which if the brain-localization theories were correct, would be far from possible. Using MRI scans and other recent technologies, it's been shown that over time after horrendous accidents, portions of the brain that were damaged will have their “slack picked up” by other portions of the brain, particularly areas nearby. This would explain “cross-wiring”

and other such phenomenon as well. From becoming scientific blasphemy to almost gospel, brain plasticity is quickly being adopted as common knowledge and expanding the horizons of science and people everywhere.

The Importance of Self-Esteem and Self-Actualization: As dictionary.com defines it, self-actualization is “to develop or achieve one's full potential”, whereas self-esteem is “respect for or a favorable opinion of oneself”. The combination of these two, studies have shown, can improve mood and health, encourage workplace performance, help relationships, and a whole number of other benefits, both physical and mental. On the opposite side of the spectrum, if a human being does not have access to a healthy amount of self-esteem and self-actualization there can be serious detriments to both physical and mental health. Whether one looks at dramatic examples of school shootings, or more pervasive problems such as our societies increasing shift towards depression, self-esteem and self-actualization are a valued commodity. Studies have shown that those with mental illnesses or handicaps tend to have lower self-esteem and a lower sense of self-actualization than a typical person, which leads to exacerbated symptoms or depression (Glickman 2007). With that in mind, deaf persons, being a large minority in the world, are likely to have lower self-esteem and self-actualization than most, if only given the nature of their existence. They typically cannot enjoy the benefits of music, spoken conversation, song, or any other sound-based activities we take for granted. In many ways a deaf person's world may feel cut off from a “normal person's” world. As such it is likely that a deaf person might feel isolated or confused, perhaps feeling they have less worth to the world than their fully hearing counterparts. Though obviously there are happy exceptions to the rules, the fact remains people have felt worse for less. One

would thus argue that is important to society and deaf persons in particular, to raise their self of self-esteem and self-actualization by finding activities in which they may excel, things perhaps not properly researched. If my hypothesis is correct, then the knowledge gained to the deaf community would lead to a higher degree of self-esteem and self-actualization than they may otherwise have felt, and as such increasing general happiness and well-being in the long term.

Purpose of the Study and Methodology: The purpose of this study was to find whether there is a statistically significant difference between deaf-persons and non-deaf persons in visual perception, sentence recognition, and phonetic awareness-based skills. My hypothesis was, based on the concepts of brain plasticity that areas unused or damaged in the brain can be "taken over" by other portions, is that deaf persons would excel in their very nature in visual perceptual skills as well as in sentence recognition. The reason this is important to research is due to the statistically lower sense of self-actualization and self-esteem that deaf persons are likely to have, and as such the detriments such lacking would have in both mental health and physical well-being. I accomplished this task by measuring these three skills through three, short tests that measure both speed and accuracy of visual-based skills. Then, using an independent samples t-test, I will attempt to find if there is a statistically significant difference between scores of deaf persons and non-deaf persons in regards to visual perception skills.

Literature Review

Twenty two out of every thousand people have a severe hearing impairment or are deaf in the United States (Mitchell 2005). It has been shown that deaf persons or those with hearing impairments have difficulty communicating and relating to the outside world (Kleim, 2001). In this study, I attempted to show that deaf persons have hidden skills in visual perception which could help resolve their communication difficulties, or in the very least, increase their sense of self-efficacy and esteem, thereby improving their well-being in the long run.

Bryck (2001) stated that "the positive effects of such neural plasticity include enhanced functioning in specific cognitive domains and shifts in cortical representation following naturally occurring cases of sensory deprivation" thus emphasizing that those with deprived senses (such as deaf persons) could have enhanced functioning in other cognitive areas, such as visual perception. Researchers examined enriched rearing environments in animals, revealing the potential for promoting positive brain plasticity, popularizing methods for training one's brain to reverse early brain deficits, or even increasing cognitive functioning. In the article, two classes of empirically based methods of brain training in children are critiqued: laboratory-based, mental process training paradigms and ecological interventions based upon neurocognitive conceptual models. Special attention is paid to training programs that emphasize executive function enhancement, such as programs involving creating detailed stories about persons presented in pictures. The study also addresses a third approach to brain training, aimed at tapping into compensatory processes. The study's results (given the statistically significant increase in testing scores given the training treatment groups) showed the

effectiveness of this strategy in the field of neuro-rehabilitation and in terms of naturally occurring compensatory processing in human aging lend credence to the potential of this approach. Thus with the article's analysis of various methods towards increasing brain plasticity, it is apparent that if the hypothesis that deaf persons were better at various visual-based skills, it would likely be due to brain plasticity.

Davis (2011), stated that "it is well known that the adult brain is capable of profound plasticity", further indicating that "much of our understanding of the mechanisms underlying injury-induced changes in the brain is based on animal models". This could emphasize a profound reasoning, even a need, to look based animal-based models and attempt to gain further understanding of plasticity through human-based research. She further described the development of sophisticated noninvasive neuroimaging techniques over the past decades that provide a unique opportunity to examine brain plasticity in humans, further encouraging the new possibilities of human-based plasticity research. In this article, the author examined the consequences of nerve injury and surgical repair on peripheral nerve degeneration and regeneration, as well as review classic animal literature that laid the foundation of injury-induced plasticity research. She proceeded to relate these concepts to recent findings of functional and structural changes in the human brain following peripheral nerve injury. Finally, they then present a working theoretical model that links behavioral outcomes of nerve injury with functional and structural brain plasticity and personality. Her findings show a working theoretical model linking brain plasticity and personality, which relates to my hypothesis by showing that fostering brain plasticity in deaf persons could have a dramatic and effective positive influence on that person's personality.

Cawthon (2010), stated that “many students with learning disabilities participate in standardized assessments using test accommodations such as extended time, having the test items read aloud, or taking the test in a separate setting”. However she goes on to point out that the test items themselves, the language demand in particular, may have aspects that contribute to the effects of said accommodations. The study entailed an analysis of “linguistic complexity (LC) and accommodation use for SLD in grade four on 2005 National Assessment of Educational Progress (NAEP) reading and mathematics items”. The purpose of the study was to investigate the effects of test item “LC” on reading and mathematics item difficulties for those students with learning disabilities; (b) the impact of accommodations (presentation, response, setting, or timing) on estimates of student ability, after controlling for LC effects; and (c) the impact of “differential facet functioning (DFF), a person–by-item-descriptor interaction, on estimates of student ability, after controlling for LC and accommodations' effects”. The study found that for both reading and mathematics, the higher an item's linguistic complexity, the more difficult it was for a student with a learning disability. After the study controlled for differences due to accommodations, LC was not a significant predictor of mathematics items' difficulties, but it remained a significant predictor for reading items. The study found no effect of accommodations on mathematics item performance, but for reading items, students “who received presentation and setting accommodations scored lower than those who did not”. No significant language-complexity-by-accommodation interactions were found for either subject area, indicating that the effect of LC “did not depend on the type of accommodation received”. Though this study doesn’t directly relate to deaf persons, it shows that in those with difficulty with language complexity

(such as might be emphasized with phonetic awareness, a key feature in understanding literature) is not necessarily affected by the accommodations set forth. Thus in the very least the study may show that the accommodations one might make for a deaf person may not help them in their ability to comprehend and use language (as well as communicate), and indeed may only serve to lower their self-esteem and actualization.

In an article by Smit, (2010), the author of the article rehearses the past reasoning for his study, citing the case in which “concerned calls from the South African community led to a survey during 1976-1978 that included research into the psycho-socioeconomic situation of Deaf persons”. He goes on to mention that among the most commonly mentioned circumstances were feelings of “rejection, loneliness, lack of human dignity, vulnerability, lack of skills development, and lack of belongingness”. In order to meet the needs of these deaf South Africans, the “South African National Council for the Deaf was founded”. The deaf persons and their families could consult this organization about challenges in regard to “unemployment, family relationships, adjustment problems, and substance abuse”. The author states that the service assisted many deaf persons and their families in overcoming some of these difficulties. Such organizations were tasked with the dissemination and exchange of knowledge and skills between Deaf communities and service providers, “in order to improve the quality of life of Deaf persons and their families in Africa”. The author stated that he hoped that this effort can be perfected and eventually duplicated to “meet the cultural, religious, and socioeconomic challenges that face Deaf and hard of hearing people who live in other regions of South Africa and elsewhere in Africa”. Though obviously the lessons the author learned by researching the history of these organizations could very well be

applied in our own society, the study in the very least shows that the mental suffering deaf person's may go through with their feelings of isolation and the difficulties in communication that stem from it, is not a national problem, it is a global one. Finding a way to increase the sense of self-efficacy and self-esteem deaf persons have would certainly be the author's priority.

The final article to be reviewed, by Doucet, Bergeron, Lassonde, Ferron, and Lepore (2006) goes about underlining the recent work suggesting that once the auditory cortex of deaf persons has been reorganized by cross-modal plasticity, "it can no longer respond to signals from a cochlear implant (CI) installed subsequently". The article attempts to further examine this issue, by comparing the evoked potentials involved in the processing of visual stimuli between CI users and hearing controls. The stimuli used were concentric circles replaced by a "different overlapping shape, inducing a shape transformation, known to activate the ventral visual pathway in human adults". All the CI users involved had their device implanted for less than one year, but obtained "different levels of auditory performance following training to establish language comprehension". Seven of the thirteen patients showed good capacities for speech recognition with the CI (good performers) while the six others demonstrated "poor speech recognition abilities (poor performers)". The evoked potentials of all patients showed larger amplitudes, with "different distributions of scalp activations between the two groups". Their results suggested the existence of a profound "cross-modal reorganization" in the poor performers and an "intramodal reorganization" in the good performers. They interpreted the data on the basis of "enhanced audiovisual coupling as the key to a long-term functional improvement" in speech discrimination in CI users. In spite of the technical

jargon involved, these results indicate that brain plasticity not only very clearly affects how the brain is organized and responds to stimuli, but also the tools involved with it. By working with plasticity at an early age and attempting to use it to a deaf persons benefit, it would be possible to organize in their brain in ways much different from non-deaf persons, and perhaps for the better.

Taking this research together, it becomes apparent that deaf persons can and do suffer from many signs of mental suffering caused by their condition, that brain plasticity can mold and shape the brain in constructive and novel fashions that non-deaf persons may not be able to experience as readily, that human research in regards to brain plasticity is newly available given advances in technology, and that our current methods of dealing with deaf persons may not only fail to improve their abilities in language, communication, and other areas, it may very well serve only to lower their already compromised self-esteem. It can be assumed with these literature reviews that it would be beneficial to determine how and in what ways a deaf persons brain plasticity could be used to their advantage, if not to improve their sense of self-esteem and self-efficacy, then in the very least improve their ability to interact and function in their day-to-day world.

Methods

Participants: The participants in the study were a total of 59 participants (n = 16 deaf participants) from *Texas State University* at San Marcos, Texas. Both groups will be given the three anonymous tests online and voluntarily. No participants were granted compensation for their participation. All participants will be given an online consent form at the beginning of the testing so they are aware of their rights and their ability to leave at any time.

Instrumentation: The test itself was sixty three questions, with twenty questions allocated to each testing subject, and three questions (one after each test) allocated to basic personal information (what classification are you, are you a deaf or non-deaf participant, etc.). For example, the first test section the participant would complete is intended to measure basic visual perception, specifically by measuring how quickly the participant could visually identify a picture and answers a multiple choice identification-based question. I.e. if shown a picture of a duck, the participant would then be asked which word most correctly describes the picture: Duck, Bird, Dinosaur, Lemon, or Cow. These questions are obviously not intended to be difficult, but this test measures the hypothesis that a deaf person would have faster and more accurate visual perception skills compared to their non-deaf counterparts. The second test section would measure reading comprehension and speed in much the same way, in that a participant would be presented a simple sentence such as “John goes to the store and buys three gallons of milk”, and then asked a question in regards to the question, such as “How many gallons of milk did John buy?”. Once again this test would be far from difficult, but it is important to measure deaf persons on two measures of visual perceptual skills to

compensate for outliers. The third test section, as a control measure, would measure phonetic awareness, meaning how well the participant could identify a word phonetically. For example, the participant would be shown the word “phish” and given a multiple choice question asking which word is the closest approximation. This, according to the hypothesis, would most likely be more challenging for a deaf person than a non-deaf person, and demonstrate why a deaf person would need to be stronger in visual skills more than auditory-based language.

Data Quantification: It is important to note that question 48, asking the phonetic equivalent to “cuhp” was thrown out in regards to data for that question since there was no right answer, which gives the third test an even 20 questions like the others. For calculating average total time taken for the surveys, four points of data were not included: a person who took 18 hours as well as a person who took 54 minutes (most likely by keeping their browser window open), and two person who took 1 minute (and did not answer any question).

Procedures: Since the tests would be taken online and be identical for each participant, there is no chance on the presentation of the tests being a confounding variable across participants, given each survey would in its nature be identical across participants.

Results

Table 1:	Deaf		Non-Deaf	
	Mean Score	Standard Deviation	Mean Score	Standard Deviation
Visual Identification	0.979	0.0294	0.9825	0.0245
Sentence Comprehension	0.9965	0.0157	0.992	0.0358
Phonetic Awareness	0.8135	0.1737	0.931	0.1285
Average Total Time	692.87 seconds, or 11.55 min.		540.6 seconds, or 9.01 minutes	

The table above displays the mean scores and standard deviations between deaf and non-deaf persons in tests of visual identification, sentence comprehension, and phonetic awareness. The table also includes the mean time taken for the entire survey for both deaf and non-deaf participants.

Hypothesis—

H0: H0: $\mu1-\mu2=0$ ($\mu1=\mu2$)

H1: $\mu1-\mu2\neq0$ ($\mu1 \neq\mu2$)

Visual Identification: An independent samples t-test was conducted on the number of correct answers on the visual-identification test. There was no significant difference on the mean score $t(19) = -.409$, the critical value being +/- 1.6859, $p > .01$. Deaf and non-deaf persons had similar visual perception skills as demonstrated on the visual-identification task. (See table 1 for means and SDs).

Sentence Comprehension: An independent samples t-test was conducted on the number of correct answers on the sentence comprehension test. There was no significant difference on the mean score $t(19) = .514$, the critical value being +/- 1.6859, $p > .01$.

Deaf and non-deaf persons had similar visual perception skills as demonstrated on the sentence comprehension task. (See table 1 for means and SDs).

Phonetic Awareness: An independent samples t-test was conducted on the number of correct answers on the phonetic awareness test. There was a significant difference on the mean score $t(19) = -2.432$, the critical value being +/- 1.6859, $p > .01$. Deaf and non-deaf persons had differing visual perception skills as demonstrated on the phonetic awareness task. (See table 1 for means and SDs).

Discussion

There is no significant difference between deaf and non-deaf person's scores in visual identification and sentence comprehension. There was a significant difference between deaf and non-deaf person's scores in phonetic awareness. This was most likely caused by a statistically small sample size, as well as the inability to measure whether there was a statistically significant difference in time taken for each individual test.

Limitations

In conclusion, although not significant, the data shows there are at least a minor positive difference in favor of deaf persons in regards to visual identification, and a slight negative difference in regards to sentence comprehension. The only aspect of the study that was statistically significantly validated was the idea that deaf person's would not do as well in tests of a phonetic nature, which has already been confirmed in other studies. It is important to note however that throughout the testing period we were limited in both time and sample size, having to rely on a convenience sampling of students at Texas State University. In future studies one would obviously like a larger number of deaf participants, as well as a way to measure how long it took each person to do each particular section, perhaps by dividing the survey into three different surveys.

It would also be prudent to have a more diverse and larger group of participants as to compensate for educational levels, socio-economic status, age, and perhaps gender. This being said, the fact that all students came from the same campus dictates that most of the students would have similar age, education, and socio-economic status, so confounds were considered and kept to a minimum. Another confounding variable may have been the size of the test, as twenty of testing may not be enough to make statistically viable conclusions that would be generalizable to the general public. Primarily, in future studies of this nature, it would be important to measure the time it takes deaf versus non-deaf person's to complete the questions. However given what we can see of the data, the difference in average time between deaf and non-deaf person's appears to be in the non-deaf person's favor, though this could be due to deaf person's having difficulty and requiring more time on the phonetic portion of the test, which their scores would indicate

is likely.

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Appendix

Test Format: Visual Perception Questionnaire

Disclaimer Please complete this questionnaire as quickly and accurately as you can. There is no scoring or penalties so please answer all the questions. There is no penalty for stopping at any time.

1 Which of the following words best describes the image?

- ❍ Fruit
- ❍ Apple
- ❍ Sun
- ❍ Planet
- ❍ Orange

2 Which of the following words best describes the image?

- ❍ Egg
- ❍ Oval
- ❍ Circle
- ❍ Chicken
- ❍ Ball

3 Which of the following words best describes the image?

- ❍ Baseball
- ❍ Football
- ❍ Soccerball
- ❍ Basketball
- ❍ Tennisball

4 Which of the following words best describes the image?

- ❍ Firetruck
- ❍ Taxi
- ❍ Police Car
- ❍ Garbage Truck
- ❍ Ambulance

5 Which of the following words best describes the image?

- ❍ Book
- ❍ Folder
- ❍ Shelf
- ❍ Paper
- ❍ Notepad

6 Which of the following words best describes the image?

- ❍ Golfclub
- ❍ Baseball Bat
- ❍ Tennis Racket
- ❍ Needlenose Pliers
- ❍ Plunger

7 Which of the following words best describes the image?

- ❍ Toilet Brush
- ❍ Plunger
- ❍ Tooth Brush
- ❍ Medicine
- ❍ Sword

8 Which of the following words best describes the image?

- ❍ Triangle
- ❍ Square
- ❍ Circle
- ❍ Hexagon
- ❍ Line

9 Which of the following words best describes the image?

- ❍ Lemon
- ❍ Lime
- ❍ Orange
- ❍ Egg
- ❍ Apple

10 Which of the following words best describes the image?

- ❍ Hand
- ❍ Turkey
- ❍ Pink
- ❍ Thumb
- ❍ Shake

11 Which of the following words best describes the image?

- ❍ Woman
- ❍ Man
- ❍ Hair
- ❍ Eyes
- ❍ Face

12 Which of the following words best describes the image?

- ❍ Feather
- ❍ Line
- ❍ Direction
- ❍ Light
- ❍ Arrow

13 Which of the following words best describes the image?

- ❍ Lion
- ❍ Dog
- ❍ Cat
- ❍ Mouse
- ❍ Lizard

14 Which of the following words best describes the image?

- ❍ Jaguar
- ❍ Puma
- ❍ Elephant
- ❍ Tiger
- ❍ Bear

15 Which of the following words best describes the image?

- ❍ Computer
- ❍ Television
- ❍ Radio
- ❍ Cellphone
- ❍ Microwave

16 Which of the following words best describes the image?

- ❍ Lightbulb
- ❍ Fan
- ❍ Cord
- ❍ Lamp
- ❍ Vacuum

17 Which of the following words best describes the image?

- ❍ Wolf
- ❍ Antelope
- ❍ Shark
- ❍ Bear
- ❍ Alligator

18 Which of the following words best describes the image?

- ❍ Lobster
- ❍ Spider
- ❍ Crab
- ❍ Snake
- ❍ Fish

19 Which of the following words best describes the image?

- ❍ Cat
- ❍ Bat
- ❍ Mat
- ❍ Hat
- ❍ Flat

20 Which of the following words best describes the image?

- ❍ Unicorn
- ❍ Leprechaun
- ❍ Minotaur
- ❍ Dragon
- ❍ Kraken

21 Are you a deaf or non-deaf participant?

- ❍ Deaf
- ❍ Non-deaf

22 John went to the store and bought three eggs, how many eggs did John buy?

- ❍ One egg
- ❍ Two eggs
- ❍ Three eggs
- ❍ Four Eggs
- ❍ Five Eggs

23 The building is seven feet tall. The man next to the building is five feet tall. How tall is the building?

- ❍ Three feet
- ❍ Twelve feet
- ❍ Nine Feet
- ❍ Seven Feet
- ❍ Five Feet

24 What color is the sky at day time?

- ❍ Green
- ❍ Blue
- ❍ Yellow
- ❍ Red
- ❍ Black

25 There is eight fish in a school. Four fish swim away from the school. How many fish swam away?

- ❍ Six
- ❍ Eight
- ❍ Two
- ❍ Twelve
- ❍ Four

26 A man sees a red firetruck drive past him in a hurry, what color is the fire truck?

- ❍ Blue
- ❍ Yellow
- ❍ Red
- ❍ Purple
- ❍ White

27 Jack carries four red apples , what color are the apples?

- ❍ Green
- ❍ Yellow
- ❍ Grey
- ❍ Red
- ❍ Purple

28 There are three colors of play goop. The goop to the left is blue, the goop in the middle is green, and the goop to the right is purple. What color is the goop to the left?

- ❍ Blue
- ❍ Green
- ❍ Red
- ❍ Purple
- ❍ Orange

29 A mermaid picks up two blue seashells, how many seashells did she pick up?

- ❍ One
- ❍ Two
- ❍ Six
- ❍ Four
- ❍ None

30 There are three colored blocks stacked on top of each other. At the bottom of the stack is a green block. On top of the green block, in the middle of the stack, is a white

block. At the top of the stack is a blue block. What colored block is at the bottom of the stack?

- ❍ White
- ❍ Purple
- ❍ Green
- ❍ Blue
- ❍ Yellow

31 The first guitarist strummed a chord. The second guitarist strummed a note. The third guitarist broke a string. What did the first guitarist do?

- ❍ Played a lullaby
- ❍ Strummed a chord
- ❍ Broke a string
- ❍ Strummed a note
- ❍ Strummed two chords

32 There's a yellow mother duck and five baby black ducks follow behind her. What color is the mother duck?

- ❍ Black
- ❍ White
- ❍ Green
- ❍ Brown
- ❍ Yellow

33 A martian makes plans to fly towards Mars. He makes a wrong turn and ends up at Earth. Where did the martian make plans to fly to?

- ❍ Venus
- ❍ Pluto
- ❍ Mars
- ❍ Earth
- ❍ The Sun

34 The snail comes in first place, the tiger comes in second place, and the rabbit comes in third place. Which animal came in second place?

- ❍ Tiger
- ❍ Moose
- ❍ Snail
- ❍ Rabbit
- ❍ Dolphin

35 A man with a beard parks his van. A short woman parallel parks her truck. A man with a moustache parks his bike on two parking spaces. Which car does the man with the beard park?

- ❍ A truck
- ❍ A convertable
- ❍ A van
- ❍ A bike
- ❍ A bus

36 In the first jack in the box a fox pops out. In the second jack in the box a clown pops out. In the third jack in the box a sock puppet pops out. What pops out of the third jack in the box?

- ❍ A pumpkin
- ❍ A clown
- ❍ A sock puppet
- ❍ A fox
- ❍ A monkey

37 You are driving a yellow school bus. At the first stop you pick up three children. At the second stop, you pick up five children. At the third stop, you pick up two children. What color is the bus?

- ❍ Blue
- ❍ Red
- ❍ Black
- ❍ Orange
- ❍ Yellow

38 The taxi's first customer is in a hurry. The taxi's second customer is in a rush. The taxi's third customer is already late. What is the second customer?

- In a hurry.
- Already late.
- On the move.
- Busy as a beaver.
- In a rush.

39 Woodchuck one tosses five planks of wood. Woodchuck two tossed six planks of wood. Woodchuck three tossed nine chucks of wood. Which woodchuck tossed the least wood?

- Woodchuck One
- Woodchuck Two
- Woodchuck Three
- Woodchuck One and Three tied
- Woodchuck Two and Three tied

40 Jon always lies. Jim always tells the truth. Joseph could go either way. Which letter is at the beginning of all their names?

- K
- A
- E
- U
- J

41 A boy is sitting in a green room. He is eating four red apples. His mother walks in. His brother in the next room is purple. What color are the apples?

- Blue
- Four
- Purple
- Green
- Red

42 What is your college-level identification?
- ❍ Freshman
- ❍ Sophomore
- ❍ Junior
- ❍ Senior
- ❍ Graduate

43 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Phish"
- ❍ Dish
- ❍ Wish
- ❍ Cliche
- ❍ Niche
- ❍ Fish

44 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Ellahfant"
- ❍ Jello feet
- ❍ Hello fat
- ❍ Hell of bat
- ❍ Elephant
- ❍ Yellow hat

45 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Stawr"
- ❍ Star
- ❍ Stair
- ❍ Straw
- ❍ Saw
- ❍ Sour

46 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Blaynk"
- ❍ Black
- ❍ Blank
- ❍ Bleed
- ❍ Blonde
- ❍ Bank

47 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Lihk"

- Stick
- Sick
- Whick
- Lick
- Link

48 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Cuhp"

- Pup
- Hup
- Stop
- Pup
- Sup

49 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Saigh"

- Lie
- Bye
- Wine
- Hind
- Sigh

50 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Ahld"

- Lawd
- Old
- Stove
- Bald
- Hold

51 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Vue"

- View
- Ewe
- Too
- Blue
- Hue

52 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "mawn"

- Girl
- Hurl
- Plan
- Man
- Stand

53 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "wurd"

- Bird
- Stirred
- Word
- Learned
- Pretty

54 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Jawkit"

- Jacket
- Pocket
- Hockey
- Sock-it
- Bop it

55 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Yuhs"

- ❍ No
- ❍ Maybe
- ❍ Yes
- ❍ Definitely
- ❍ Not

56 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Tahcoh"

- ❍ Burrito
- ❍ Taco
- ❍ Chalupo
- ❍ Tac
- ❍ Stack

57 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Deyem"

- ❍ Dame
- ❍ Doom
- ❍ Doubt
- ❍ Dime
- ❍ Dear

58 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Leyem"

- ❍ Lemon
- ❍ Light
- ❍ Loose
- ❍ Livid
- ❍ Lime

59 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Uhnder"

- ❍ Under
- ❍ Uber
- ❍ Wonder
- ❍ Walker
- ❍ Udder

60 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Lihp"

- ❍ Light
- ❍ Lip
- ❍ Lap
- ❍ Lost
- ❍ Lying

61 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Drehs"

- ❍ Dross
- ❍ Cross
- ❍ Loss
- ❍ Mess
- ❍ Dress

62 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: "Pluhm"

- ❍ Dumb
- ❍ Sum
- ❍ Plum
- ❍ Hum
- ❍ Plus

63 Please identify the word that most likely matches the meaning of the following phonetically-spelled word: Cauw

- How
- Now
- Brown
- Cow
- Tow