Richard Zhou

Dr.Siefke 1:50

10/24/2022

Homework 2

Blindness is a condition that can be caused by neural deterioration, something with trauma to the pathway, or a condition that has been given since birth. In this research, the condition where blindness is given from birth will be our focus of the article. Where vision is stemmed from is called the occipital lobe, this part of the brain is in the back of the head opposite of the side of the eyes. A main factor for this research is TMS which is transcranial magnetic stimulation, which "impairs the ability of blind people to produce semantically appropriate verbs to heard nouns" (Bedny et al.,2015, as cited in Amedi et al., 2004). The research looks at how language effects blind people before the development of language areas in the prefrontal and temporoparietal cortices. The hypothesis says language and vision compete for similar areas of the brain, if language is present as early or earlier, then the development of the language areas would be different. (Bedny et al., 2015). Other alternative hypothesis is that plasticity would change over time because of how the brain develops at a younger age whereas in adults, this has been tested and given our present-day results. On top of this, another hypothesis is that spoken language gets to the occipital circuits, which is the primary vision area, through the primary auditor areas. (Bedny et al.,2015, as cited in Miller and Vogt, 1984). Lastly, another alternative prediction is that when reading braille in adults, the occipital lobe is active (Bedny et al. 2015, Sadato et al., 1996; Burton er al., 2002; Meraet et al, 2004). This also demonstrates how the occipital lobe is not only responsible for visual stimuli but also with touch.

The experimental design and the control/ test groups are 19 blind children with a mean age of 9.32 years, 6 of which are female; 20 blindfolded sighted children wit ha mean age of 8.66, 13 of which are female; and 20 sighted children with a mean age of 9.09, and 11 of which are female. The control group was the children with sight where the test group was the children without sight. The specific technique used is called a "Does this come next task" which is based off certain inputs and stimuli another would be given after some time and the participant would answer whether it is the appropriate follow-up to the initial stimulus. In this case the stimuli would be recordings of English speakers, music, and foreign languages in Hebrew, Korean, or Russian. To collect the data, fMRI would be used, and it stands for functional Magnetic Resonance Imaging and uses blood flow in the brain to detect where the neuronal activity is most dense. Another special technique that was used was to use a leave-one-run-out analysis because with classical language the sensitivity to language has more parity and to find the most responsive trials, one run would be left out. This would help the researchers pinpoint their data to have better results.

The results were that all the participants were the most accurate in music(93%) and the least accurate in foreign speech(77%) with language(89%) being in the middle(Bedny et al. 2015). In addition, another discovery was that the occipital lobe did respond to spoken language. Another discovery the scientists deduced was that the correlation between how active the

occipital lobe is relative to how old you are is stronger than the connection with braille and age. Also, the correlation is not just with language in the occipital lobe but also with all sounds. There is a significant difference between experimental and control group because, the data shows that blind children have reduced language selectivity in prefrontal cortex relative to sighted children and that in the prefrontal cortex, responses to spoken language are minimal in blind children until 8 years of age. (Bedny et al. 2015). Lastly, sighted but not blind children had a focus of activation in the prefrontal cortex. This could be because, sighted participants had more stimuli than the the blind participants.

To discuss the following results, by 4 years old the occipital cortex responds to more spoken inputs of speech than to music or foreign language in the absence of sight. Firstly, the findings support that early blindness does change how the development of the occipital lobe functions in relation to speech. But in the aspect to having plasticity with braille, the data does not support it where it is completely independent and braille is just linked to the touch and discrimination between dots on paper (Bedny et al. 2015, as cited in Sadato et al, 1996). Another aspect of the hypothesis that is supported is that language does compete with the occipital lobe for space in the brain and this is shown with the data. With the absence of visual input, the regions around the brain become more sensitive in those areas and react in a different manner as shown in the study where the similar areas of occipital lobe are activated with speech and no vision.

Th confounds that were avoided were the disparity in vision and understanding of language which was avoided by ensuring sighted participants had 20/20 vision and all participants were fluent in English. Another confound could be that in addition to vision the unsighted participants also had other neural disorders that could affect the task and that was addressed where a participant with autism failed to report enough data and that was omitted from the data. The relevance of these findings would be that we still do not have a large understanding of blind people given the fact that most of the scientists have sight. Also, there is not a cure for blindness, and this is a step further into the understanding of what blindness is biologically and discover an efficient means of communicating based off which parts of the brain are being stimulated in relation to those with sight. Some of the participants could have grown up with different parental types and this could lead to different personality types and way they perceive the world which would be vastly different. This means that each participant had their own unique tools to discern the task based off their own upbringing.

Lastly, a potential follow-up study that I would be interested in seeing would be to experiment with patients that had vision before going blind. This would allow us to see the difference of how memory affects sight and based on the length of the lose of vision, we would be able to see which parts of the brain are active and maybe understand how to reproduce those images for people who cannot see which would open another dimension for them. I would test this not with language but by using nouns of everyday recognizable objects in the blind from birth and the blind being lost. I would expect to see similar results from the blind from birth people as in this task but in the people who had sight, I would expect a stronger connection with

the occipital lobe and a decrease in encroachment of the occipital like area because it is already being used for memory and previous sight.

Works Cited

Amedi A, Floel A, Knecht S, Zohary E, Cohen LG (2004) Transcranial magnetic stimulation of the occipital pole interferes with verbal processing in blind subjects. Nat Neurosci 7:1266 –1270. CrossRef Medline

Bedny, M., Richardson, H., & Saxe, R. (2015). "visual" cortex responds to spoken language in Blind Children. *The Journal of Neuroscience*, *35*(33), 11674–11681. https://doi.org/10.1523/jneurosci.0634-15.2015

Clavagnier S, Falchier A, Kennedy H (2004) Long-distance feedback projections to area V1: implications for multisensory integration, spatial awareness, and visual consciousness. Cogn Affect Behav Neurosci 4:117–126. CrossRef Medline

Merabet L, Thut G, Murray B, Andrews J, Hsiao S, Pascual-Leone A (2004) Feeling by sight or seeing by touch? Neuron 42:173–179. CrossRef Medline

Miller MW, Vogt BA (1984) Direct connections of rat visual cortex with sensory, motor, and association cortices. J Comp Neurol 226:184 –202. CrossRef Medline
Reich L, Szwed M, Cohen L, Amedi A (2011) A ventral visual stream reading center independent of visual experience. Curr Biol 21:363–368. CrossRef Medline

Sadato N (2005) How the blind "see" Braille: lessons from functional mag netic resonance imaging. Neuroscientist 11:577–582. CrossRef Medline

Sadato N, Pascual-Leone A, Grafman J, Iban˜ez V, Deiber MP, Dold G, Hallett M (1996) Activation of the primary visual cortex by Braille reading in blind subjects. Nature 380:526 –528. CrossRef Medline