Temporal Dynamics of Learning Center

NSF Highlights 2012-2013

Learning to read may trigger right-left hemisphere difference for face recognition

Outcome:
Whereas, in this study, adults showed the expected left and right visual field superiority for face and word discrimination, respectively, the young adolescents demonstrated only the right field superiority for words and no field superiority for faces. Although the children's overall accuracy was lower than that of the older groups, like the young adolescents, they exhibited a right visual field superiority for words but no field superiority for faces. Interestingly, the emergence of face lateralization was correlated with reading competence, measured on an independent standardized test, after regressing out age, quantitative reasoning scores and face discrimination accuracy.

Impact/benefit:
These findings suggest that the hemispheric organization of face and word recognition do not develop independently, and that word lateralization, which emerges earlier, may drive later face lateralization. These findings are consistent with a theoretical account, which argues that both word and face recognition rely on fine-grained visual representations. However, by virtue of pressure to couple visual and language areas and to keep connection length short, the left hemisphere becomes more finely tuned for word recognition and, consequently, the right hemisphere becomes more finely tuned for face recognition. These behavioral studies are being followed up at present and evoked response potentials are being collected from observers, across a wide age span, to elucidate further the neural mechanisms that underlie the emergence of hemispheric specialization over the course of development.

Future Predictions: These findings lead to many predictions, some of which are currently being examined in the Behrmann lab. One prediction is that individuals who have less strongly left-lateralized word representations should also have less strongly right-lateralized face representations. First, many left-handed individuals have a more bilateral language organization, which would be expected to lead to more bilateral orthographic word representations. Second, non-alphabetic orthographic scripts, such as Chinese, are less closely tied to phonology and hence have a more bilateral organization. As a result, we predict that both left-handed individuals and native readers of Chinese should have less strongly right-lateralized face processing (as compared to right-handed English readers).

Background/explanation:
The question addressed by the research study conducted in the lab of Dr Marlene Behrmann (member of the Perceptual Expertise Network) at Carnegie Mellon University is how the pattern of mature hemispheric specialization emerges over the course of development. We know that, in adulthood, the left hemisphere is more tuned to word recognition whereas the right hemisphere is more tuned to face recognition. The current study examines the hemispheric superiority for faces and words in children, young adolescents and adults in a discrimination task in which stimuli are presented briefly in either hemifield.

This research is conducted by Marlene Behrmann (below left) in collaboration with Eva Dundas (below middle), a graduate student in the Department of Psychology at Carnegie Mellon University, and with Dr David Plaut (below right), Professor of Psychology at Carnegie Mellon University.

Computer-Based Cognitive and Literacy Skills Training Improves Students' Writing Skills

Outcome:
A study conducted at Rutgers University finds that cognitive and literacy skills training improves college students' basic writing skills.

Impact/Benefit:
Basic writing skills are among the most important skills in today's information-driven society. According to Our Nation's Report Card, 76% of 12th graders are writing at the basic or below basic level (Saluhu-Din, Persky, & Miller, 2008). Using computer-based instruction, standardizes the content, its presentation, and can be scaled with efficiency for an unlimited number of learners.

Explanation:
In order to write a sentence, a writer must be able to switch back and forth between working memory and long-term memory as ideas are being formed and rules of grammar are being recalled with a level of automaticity. Writing requires the writer's full attention as the writer sorts the relevant from the irrelevant. Words must be sequenced with proper subject-verb agreement and rules of grammar—from capitulation to punctuation and usage—must be processed quickly so the writer can keep up with her thoughts or the person to whom s/he is attending. The computer-based cognitive and literacy skills training that students received was based on neuroplasticity research which finds the brain to be capable of new learning at any age. Saluhu-Din, D., Persky, H., & Miller, J. (2008). *The nation's report card: Writing 2007*. (NCES 2008-468). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, DC. Retrieved from
http://nces.ed.gov/nationsreportcard/pdf/main2007/2008468.pdf

A screenshot from a sample exercise used in the training. In this exercise, the student hears the sentence: "Rubin is helping Maria put on her coat." The student is to click on the picture that represents the correct verb tense used. In the example, the correct answer is the middle picture. The picture to the left, "Rubin will help…", and the picture on the right, "Rubin helped…" are incorrect responses. This series of exercises was designed to explicitly train students in every rule of English grammar. In addition, the student must attend to the sentences, hold them in working memory and understand the conventions being tested. Picture used with permission from Scientific Learning Corp.
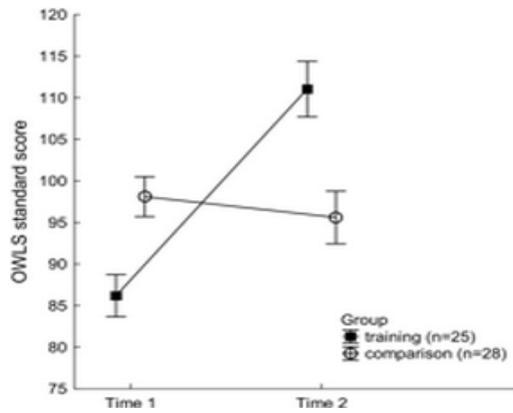
FIGURE 2 | Written Expression Scale standard scores of the Oral and Written Language Scales (OWLS) for the two participant groups at Time 1 and Time 2.

Mean values of 25 training group participants (filled squares) and 28 comparison participants (open circles) are shown. Vertical bars indicate standard errors of mean. While the training group students were outperformed by the comparison group at Time 1, their considerable spurt in writing following intervention, led to a reversed performance pattern at Time 2, with lower standard scores in the non-trained students.
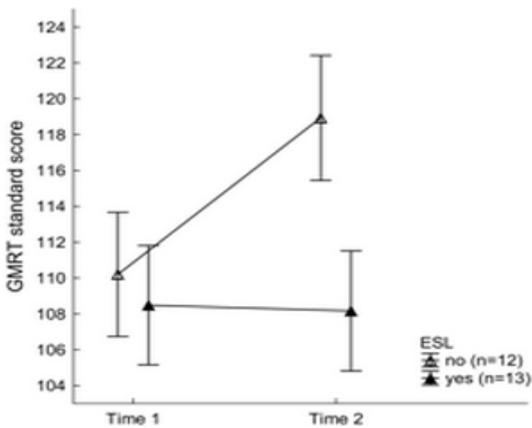

FIGURE 3 | Gates MacGinitie ReadingTest (GMRT) standard scores for the training group as a function of speaking English as a second language (ESL) at Time 1 and Time 2. Mean values of 12 non-ESL (open triangles) and 13 ESL students (filled triangles) are shown. Vertical bars represent standard errors of mean. Non-ESL training participants improved significantly across time and outperformed the ESL students after completion of the intervention protocol.

Rogowsky, B., Papamichalis, P., Villa, L., Heim, S., Tallal, P. (2013) Neuroplasticity-based Cognitive and Linguistic Skills Training Improves Reading and Writing Skills in College Students. Frontiers in Educational Psychology. 4 (article 137), pp 1-11. doi: 10.3389/fpsyg.2013.00137

Paula Tallal   Beth Rogowsky

Micro-valences: perceiving affective valence in everyday objects
Sophie Lebrecht, Moshe Bar, Lisa Feldman Barrett, and Michael J. Tarr

Outcome:
New research from Carnegie Mellon University's Center for the Neural Basis of Cognition (CNBC) shows that the brain's visual perception system automatically and unconsciously guides decision-making through something called valence perception. Valence — defined as "the positive or negative information automatically perceived in the majority of visual information" — is a process that allows our brains to quickly make choices between similar objects. The researchers conclude that "everyday objects carry subtle affective valences – 'micro-valences' – which are intrinsic to their perceptual representation."

Impact/benefit:
The findings of this research (Published in the journal *Frontiers in Psychology*), offer important insights into consumer behavior. Instead of using traditional consumer marketing focus groups, companies can utilize brain research to understand how visual perception unconsciously affects preferences.

The CMU research team hopes to transfer the research's scientific application to the online video market, with the support of The National Science Foundation (NSF) Innovation Corps (I-Corps), NSF established I-Corps to "assess the readiness of transitioning new scientific opportunities into valuable products through a public-private partnership." The CMU team is founding the startup company **Neon**, one of the first companies to use cognitive neuroscience to increase audience engagement for online video publishers. For example, the Neon team is developing a Web-based software service that automatically selects the most visually appealing frame from a stream of video to be used as the thumbnail. Initial pilot test results show that a thumbnail chosen by Neon significantly increased online clicks compared to a randomly selected thumbnail or even one hand-selected by a Web designer.

Background/explanation:
Michael Tarr, co-director of the CNBC and TDLC member, explains that basic research in the cognitive and brain sciences has many applications: "In Neon's case, a better understanding of the role of unconscious visual processing in choice behavior may have implications in both the educational and commercial domains."

Sophie Lebrecht, lead author of the study and the entrepreneurial lead for the I-Corps grant, continues: "Everything you see, you automatically dislike or like, prefer or don't prefer, in part, because of valence perception. Valence links what we see in the world to how we make decisions … Talking with companies such as YouTube and Hulu, we realized that they are looking for ways to keep users on their sites longer by clicking to watch more videos. Thumbnails are a huge problem for any online video publisher, and our research fits perfectly with this problem. Our approach streamlines the process and chooses the screenshot that is the ost visually appealing based on science, which will in the end result in more user clicks."

Michael Tarr, co-Director of CNBC, Sophie Lebrecht, Neon co-founder
Neon co-founder and senior technical adviser.