Published in final edited form as:

Anesthesiology. 2013 September ; 119(3): 728–729. doi:10.1097/ALN.0b013e31829e6d29.

In Reply

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The questions about the duality and hemispheric functional specializations of the human brain have occupied interested scientists for decades. Experimental findings from split-brain and binocular rivalry research strongly suggest that the two hemispheres of the brain are both actively engaged in constructing and representing different aspects of the content of human consciousness. The seminal research by Sperry¹ and Gazzaniga² in the 1960s on split-brain patients led to a novel understanding of functional lateralization of the brain. It is well known that under special circumstances, the two hemispheres can show an amazing amount of autonomy and cognitive functions associated with different contents of internal and external realities. In binocular rivalry experiments with normal participants, visual perception of each eye alternates to become the content of consciousness, which is mediated primarily by one of the hemispheres. Although evidence for functional lateralization is measurable, broad generalization of lateral dominance has yet to be treated carefully. Evidence from various cognitive experiments collectively suggests that hemispheric dominance is related to task,³ rather than to handedness or the sites for representation of conscious contents. For example, as in the majority of population, when we are speaking and reading, the left brain privileged in language and verbal reporting is dominant, but when we are navigating or appreciating music or an artwork, the right brain is dominant.

The handedness of our study participants was unfortunately not recorded at the time when the experiments were conducted.⁴ Nonetheless, we know that the left hemisphere is dominant for speech in approximately 95% of right-handed people and in approximately 70% of left-handed people.⁵ This raises the question whether handedness can be regarded as a reliable, authentic representation of hemispherical functional specialization. Moreover, working memory and semantics have been reported to involve mainly left-lateralized brain networks.^{6,7} This may explain why in our experiments the task-induced brain activity and connectivity patterns showed pronounced lateralization to the left in the wakeful baseline condition and the absence of this lateralization during deep sedation.⁸ In our experiments, there was no motor action performed during imaging scan; behavioral evaluations were conducted only during the interval between scans to assess the level of sedation. However, auditory stimuli were continuously presented during scanning. Thus, it is conceivable that during deep sedation, nonspecific thalamocortical connectivity had to be more suppressed in the left than in the right hemisphere, preventing the incoming stimuli to become the dominant content of consciousness. In other situations, where the nature of task demands a predominant involvement of the right hemisphere, the results could be dramatically different (e.g., a prominent suppression of right hemisphere activity or connectivity). Thus, we consider our observations of more pronounced suppression of nonspecific thalamocortical connectivity in the left hemisphere, as reported in our publication, to be task related. We

thank Dr. Derakhshan for commenting on our work and offering interesting interpretations of the results.

Acknowledgments

Research reported in this publication was supported by the National Institutes of Health (Bethesda, Maryland) under Award Numbers P01-MH51358, R01-MH57836, M01-RR00058, R01-GM056398, National Institutes of Health AG20279, and the W. M. Keck Foundation (Los Angeles, California). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or of the Keck Foundation.

References

1. Sperry R. Consciousness, personal identity and the divided brain. *Neuropsychologia*. 1984; 22:661–73. [PubMed: 6084824]
2. Gazzaniga MS. Cerebral specialization and interhemispheric communication: Does the corpus callosum enable the human condition? *Brain*. 2000; 123(Pt 7):1293–1326. [PubMed: 10869045]
3. Liu X, Lauer KK, Ward BD, Li SJ, Hudetz AG. Differential effects of deep sedation with propofol on the specific and nonspecific thalamocortical systems: A functional magnetic resonance imaging study. *ANESTHESIOLOGY*. 2013; 118:59–9. [PubMed: 23221862]
4. Corballis, MC., Sala, SD. Tall Tales About the Mind and Brain: Separating Fact from Fiction. New York: Oxford; 2007. The dual-brain myth.
5. Knecht S, Dräger B, Deppe M, Bobe L, Lohmann H, Flöel A, Ringelstein EB, Henningsen H. Handedness and hemispheric language dominance in healthy humans. *Brain*. 2000; 123(Pt 12): 2512–8. [PubMed: 11099452]
6. Binder JR, Desai RH, Graves WW, Conant LL. Where is the semantic system? A critical review and meta-analysis of 120 functional neuroimaging studies. *Cereb Cortex*. 2009; 19:2767–96. [PubMed: 19329570]
7. Curtis CE, D’Esposito M. Persistent activity in the prefrontal cortex during working memory. *Trends Cogn Sci*. 2003; 7:415–23. [PubMed: 12963473]
8. Liu X, Lauer KK, Ward BD, Rao SM, Li SJ, Hudetz AG. Propofol disrupts functional interactions between sensory and high-order processing of auditory verbal memory. *Hum Brain Mapp*. 2012; 33:2487–98. [PubMed: 21932265]