Different processing stages in crossmodal influences and multisensory integration

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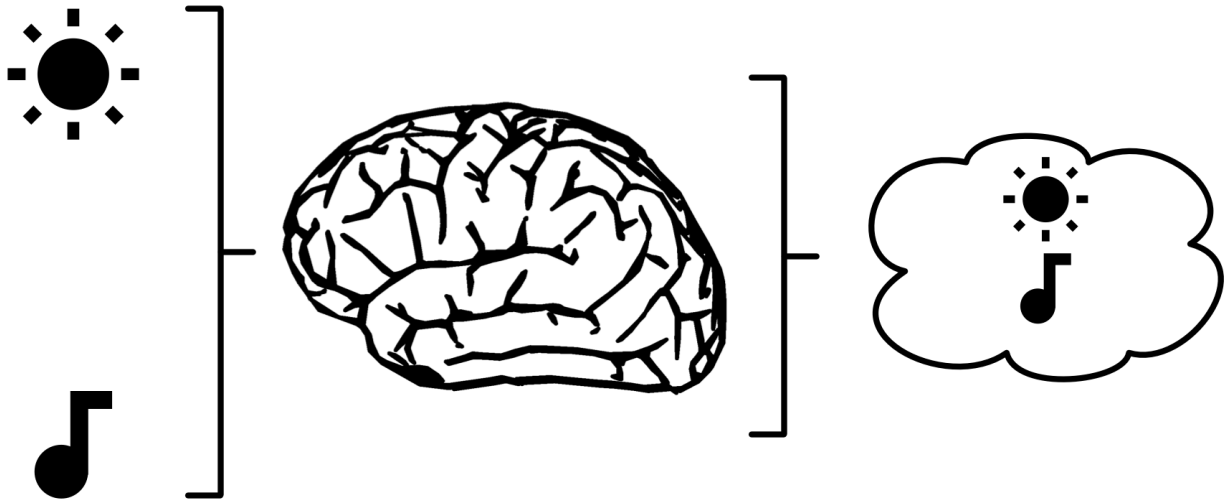

Dr. Julian Keil
Biologische Psychologie
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https://tinyurl.com/Keil-PuG-2020

Multisensory integration can change perception

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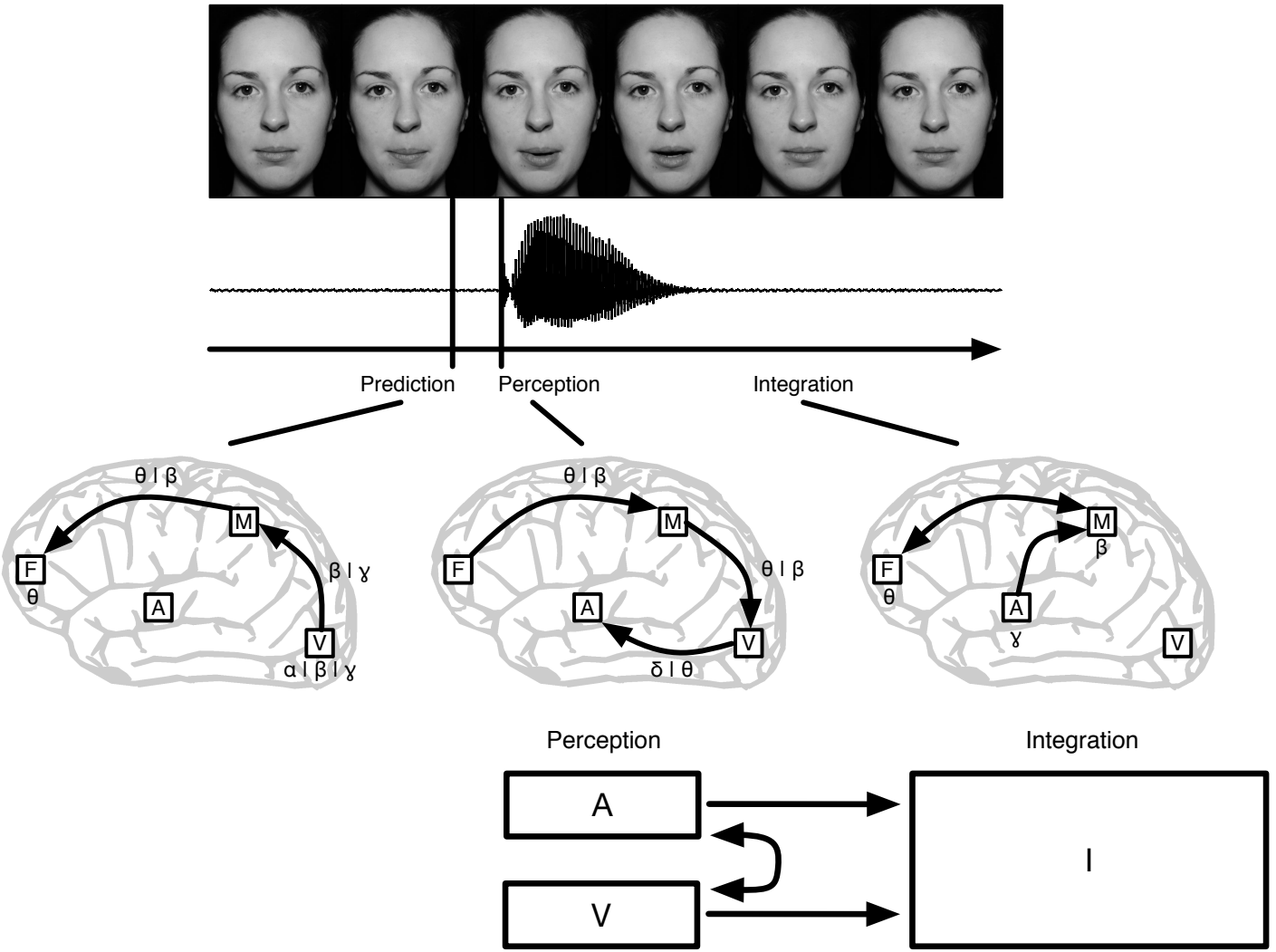

Keil & Senkowski, 2018

Neural correlates of multisensory integration:

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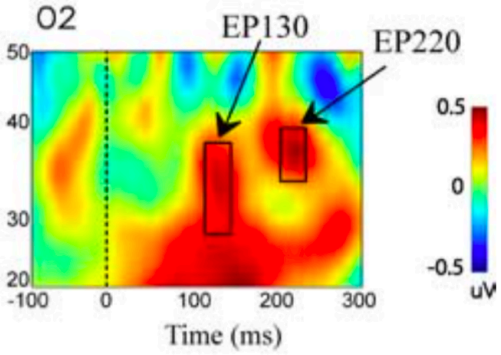
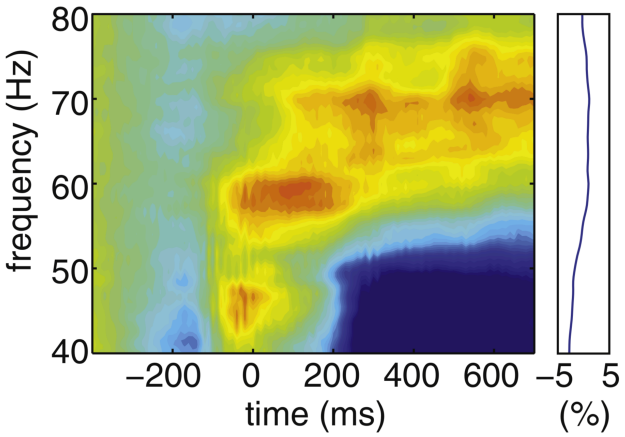
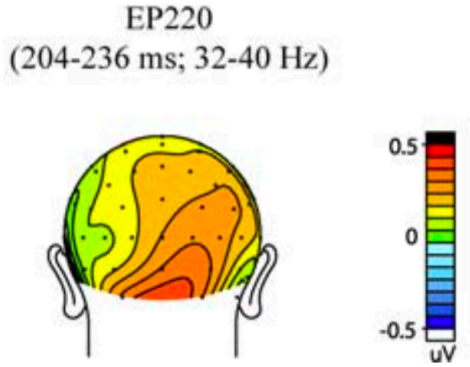
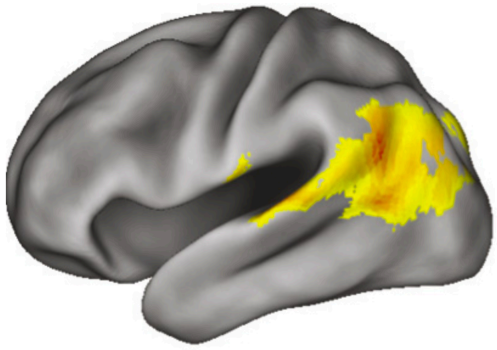
Illusion vs. No Illusion

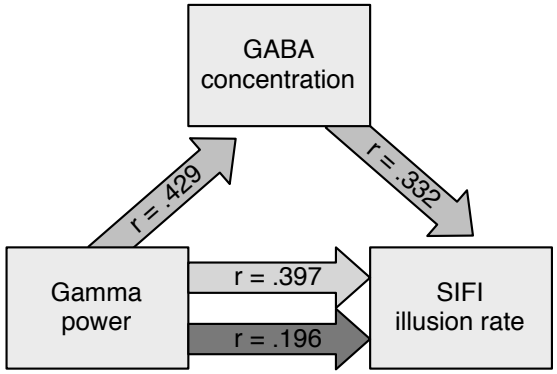


Stimulation vs. Baseline









Mishra et al., 2007; Balz et al., 2016

Neural correlates of multisensory conflict resolution:

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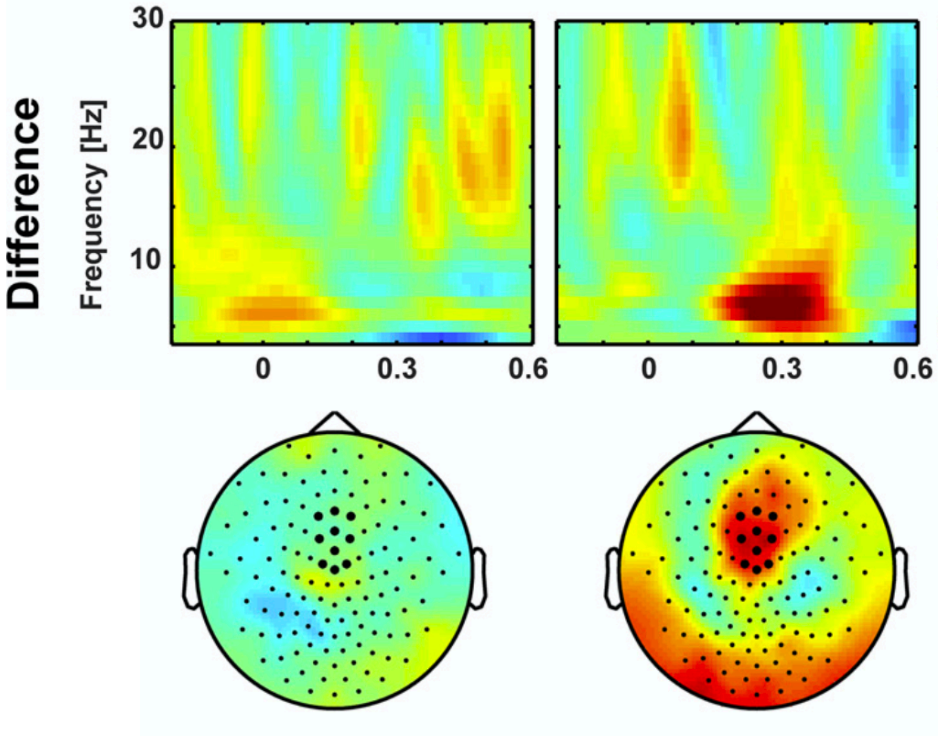
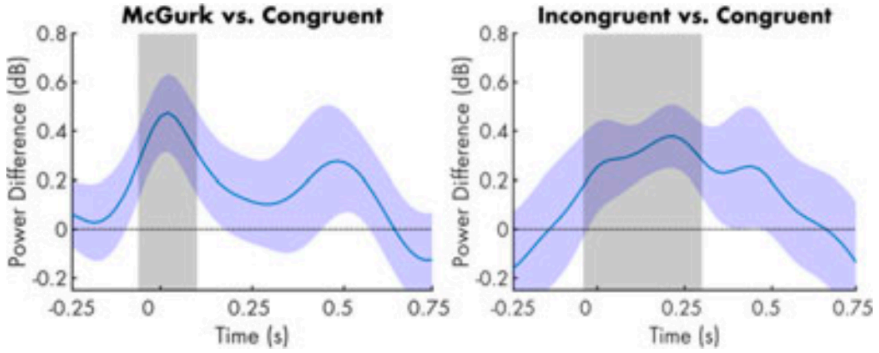
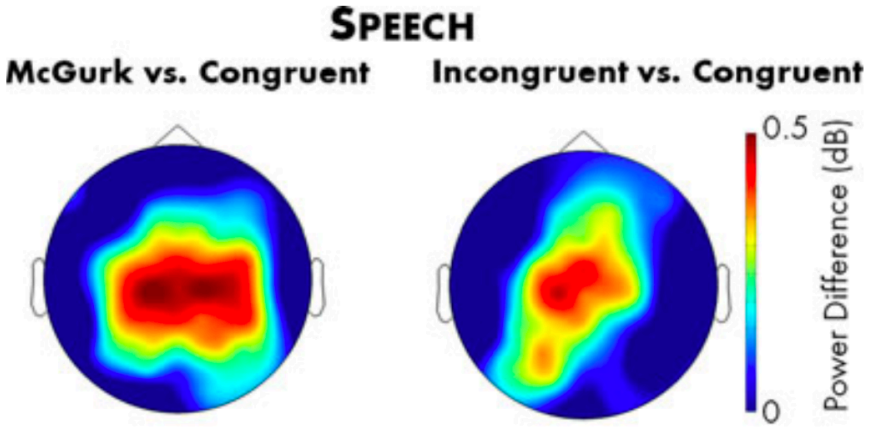
Incongruent vs. Congruent

Low Predictive High Predictive





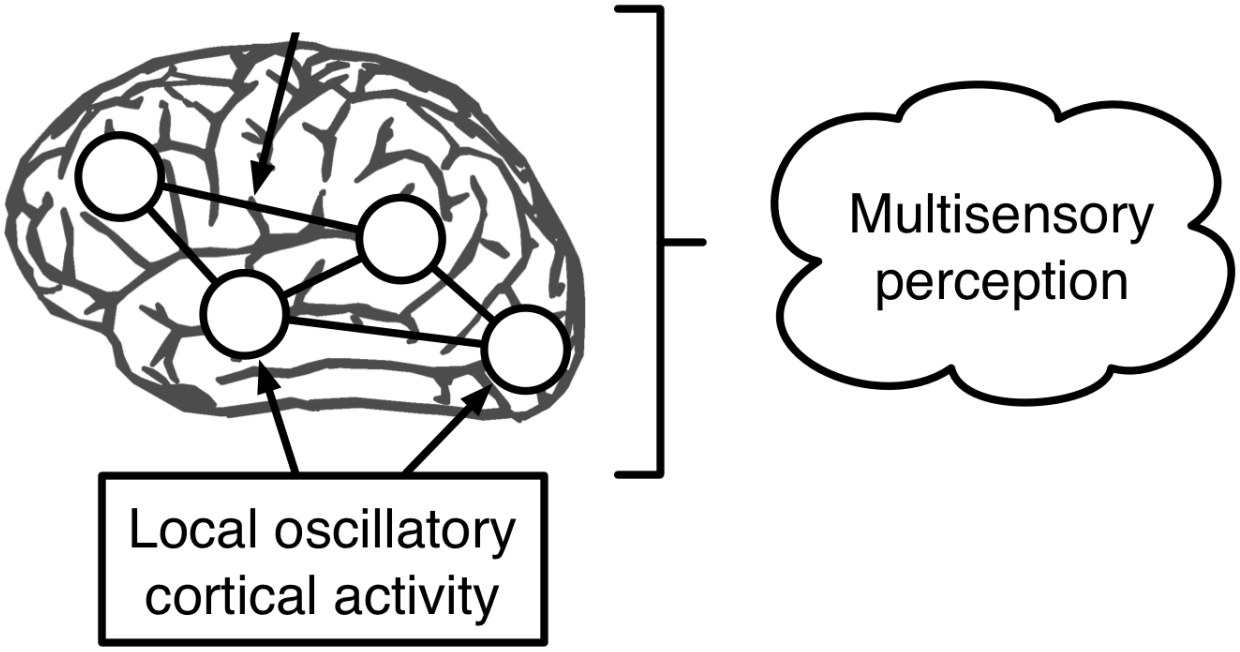


Roa Romero et al., 2016; Morís Fernández et al., 2017

Interim Summary

5

- Multisensory information can change conscious perception
  - Improve perception
  - Induce Illusions
- Multisensory integration relates to increased gamma band power in sensory areas
- Frontal theta power reflects resolution of multisensory conflict



Neural oscillations influence multisensory integration: Frequency

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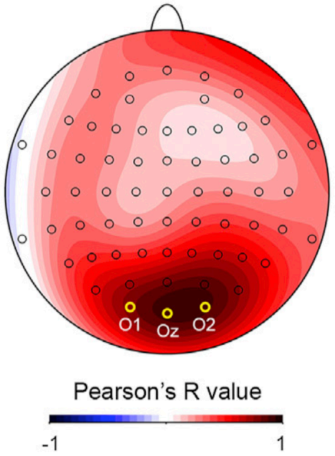

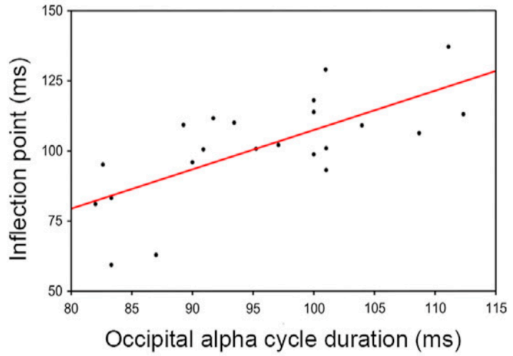

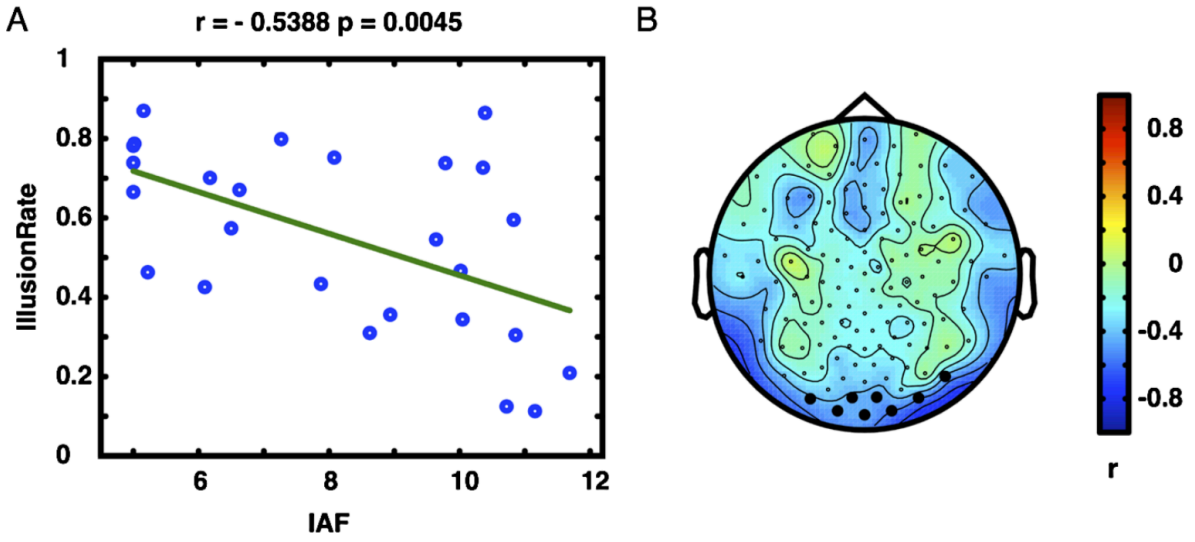

Keil et al., 2017; Cecere et al., 2015

Neural oscillations influence multisensory integration: Power

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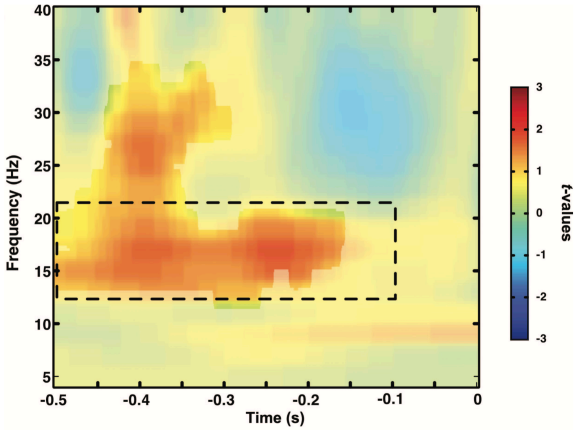
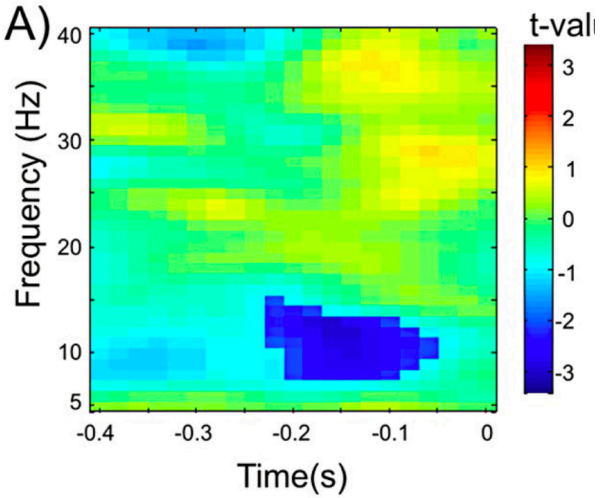
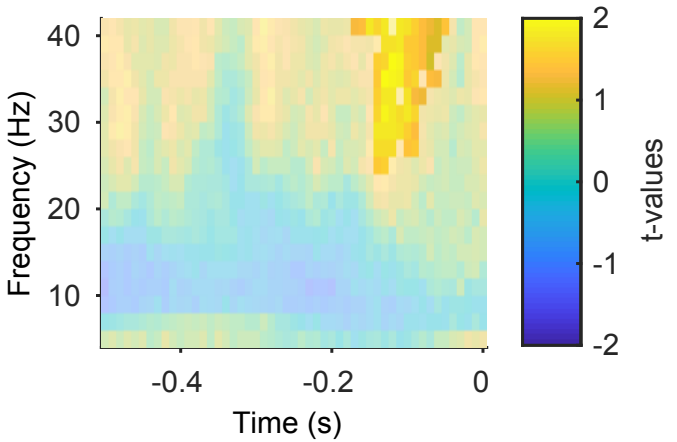
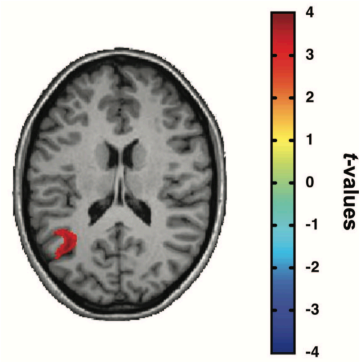
7

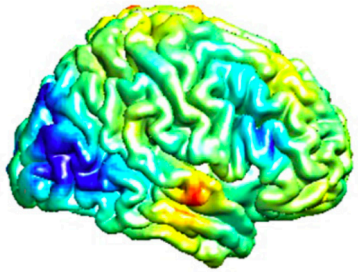
Illusion vs. No Illusion

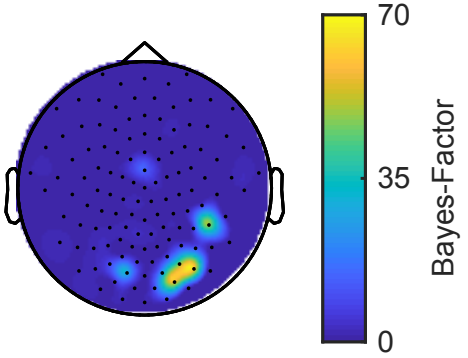












Keil et al., 2014; Lange et al., 2013; Kaiser et al., 2019

Cognitive influences on multisensory integration

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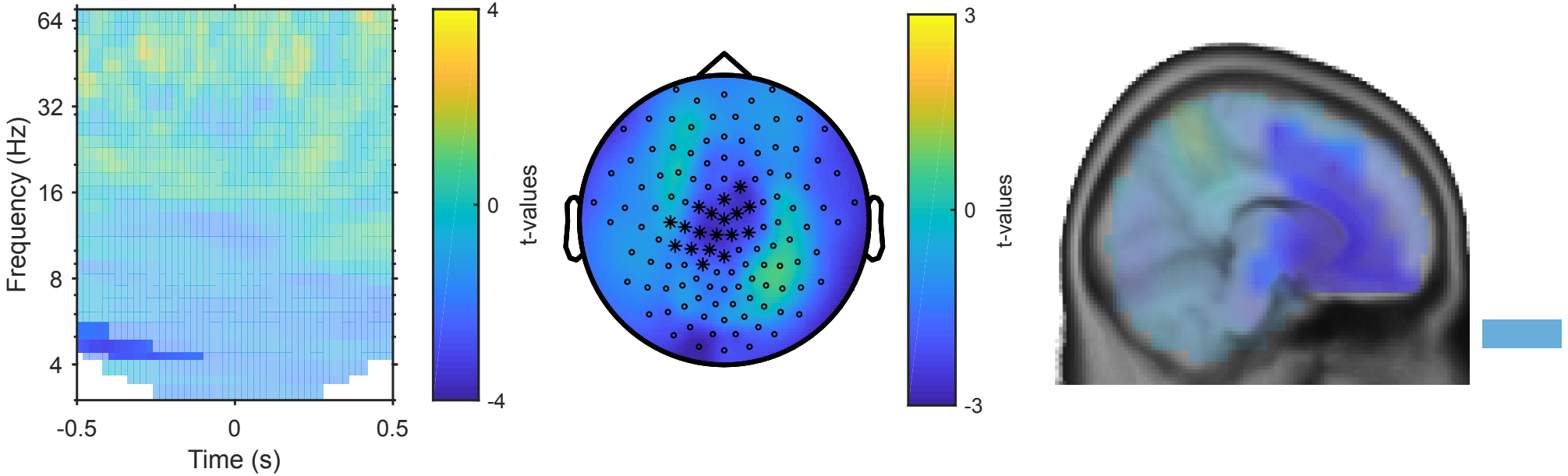
Illusion vs. No Illusion

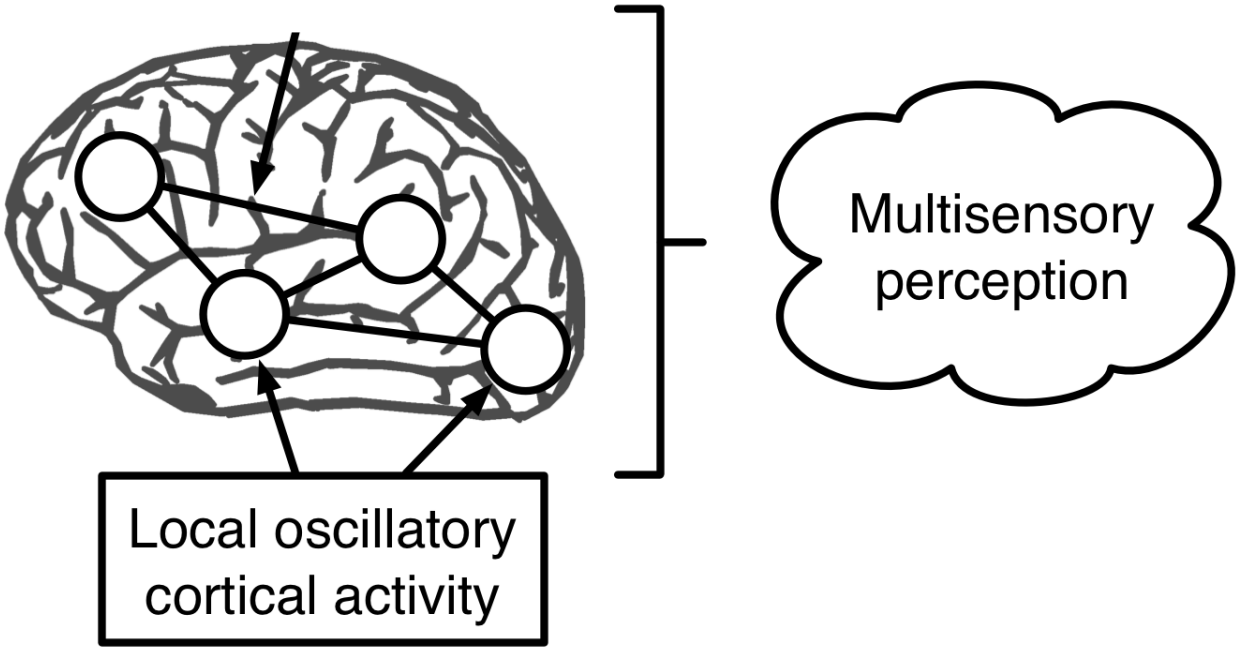


Kaiser et al., under review

Interim Summary

9

- Ongoing neural oscillations influence perception
  - Temporal window of integration
  - Local excitability
- Frontal theta power reflects cognitive control
  - Integration depends on cognitive resources



Challenging cognitive resources affects multisensory integration

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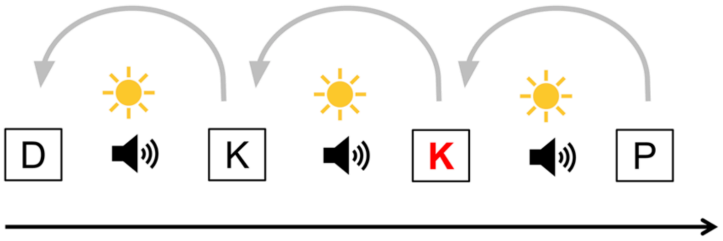
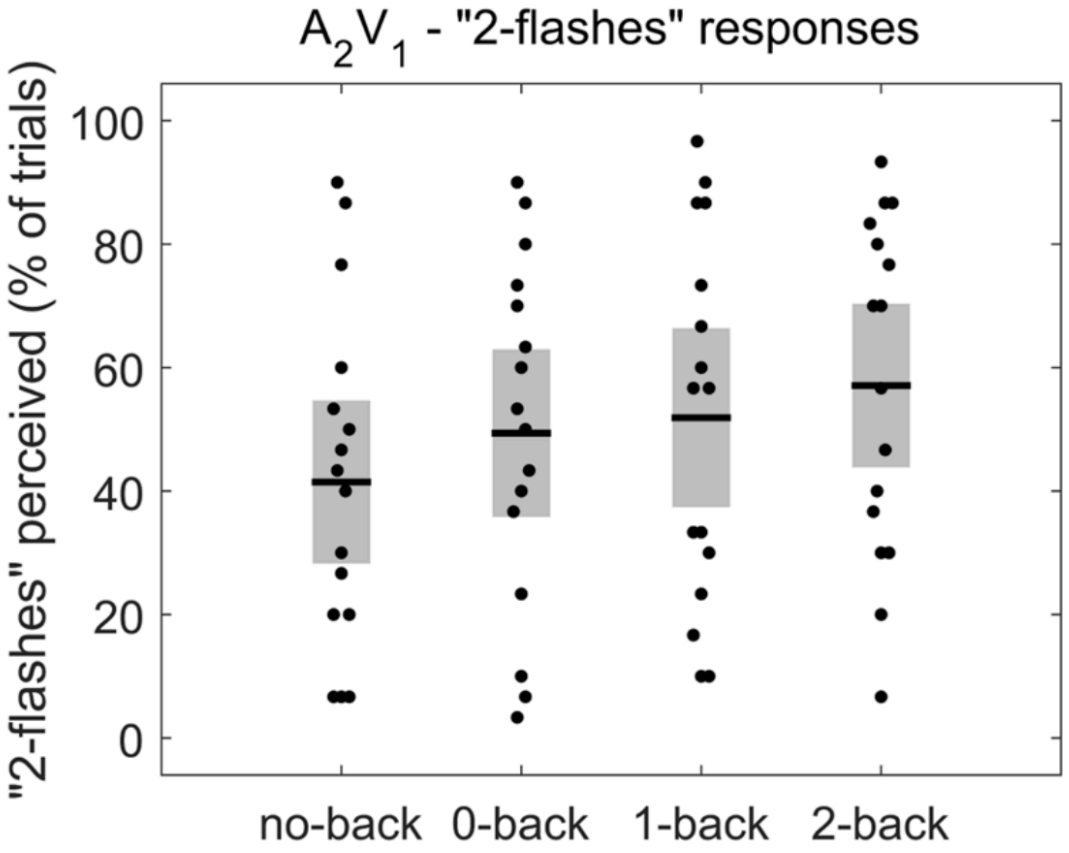
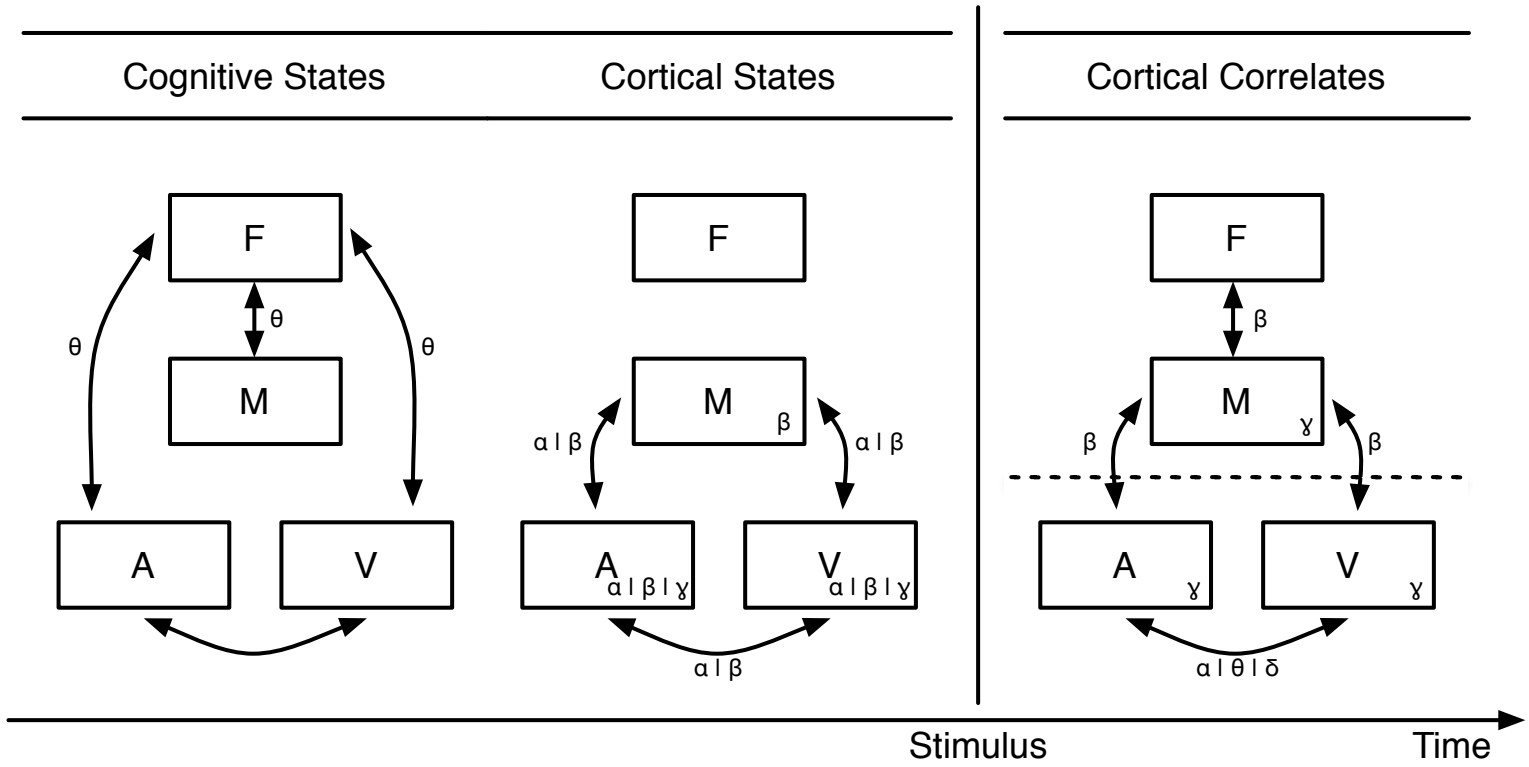




Michail & Keil, 2018; Michail et al., under review

Summary

- Perception is influenced by
  - Concurrent sensory stimulation
  - Task setting
  - Brain state
  - Cognitive Processes
- Neural Oscillations orchestrate perception across multiple stages
  - Reflect local processing
  - Influence crossmodal integration
  - Indicate top-down influences



Thank you!

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Deutsche Forschungsgemeinschaft

KE1828/2-1 (2014-2016)
KE1828/4-1 (2016-2020)
KE1828/4-2 (?)

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References

Balz, J., Keil, J., Romero, Y. R., Mekle, R., Schubert, F., Aydin, S., et al. (2016). GABA concentration in superior temporal sulcus predicts gamma power and perception in the sound-induced flash illusion. NeuroImage, 125(C), 724–730. http://doi.org/10.1016/j.neuroimage.2015.10.087

Cecere, R., Rees, G., & Romei, V. (2015). Individual differences in alpha frequency drive crossmodal illusory perception. Current Biology : CB, 25(2), 231–235. http://doi.org/10.1016/j.cub.2014.11.034

Kaiser, M., Senkowski, D., Busch, N. A., Balz, J., & Keil, J. (2019). Single trial prestimulus oscillations predict perception of the sound-induced flash illusion. Scientific Reports, 9(1), 5983. http://doi.org/10.1038/s41598-019-42380-x

Keil, J., Müller, N., Hartmann, T., & Weisz, N. (2014). Prestimulus beta power and phase synchrony influence the sound-induced flash illusion. Cerebral Cortex, 24(5), 1278–1288. http://doi.org/10.1093/cercor/bhs409

Keil, J., & Senkowski, D. (2017). Individual alpha frequency relates to the sound-induced flash illusion. Multisensory Research, 30(6), 565–578. http://doi.org/10.1163/22134808-00002572

Keil, J., & Senkowski, D. (2018). Neural Oscillations Orchestrate Multisensory Processing. The Neuroscientist, 83, 1073858418755352. http://doi.org/10.1177/1073858418755352

Keil, J. (2020). Double flash illusions: current findings and future directions. https://www.frontiersin.org/articles/10.3389/fnins.2020.00298/abstract

Lange, J., Oostenveld, R., & Fries, P. (2013). Reduced Occipital Alpha Power Indexes Enhanced Excitability Rather than Improved Visual Perception, 33(7), 3212–3220. http://doi.org/10.1523/JNEUROSCI.3755-12.2013

Michail, G., & Keil, J. (2018). High cognitive load enhances the susceptibility to non-speech audiovisual illusions. Scientific Reports, 8(1), 11530. http://doi.org/10.1038/s41598-018-30007-6

Mishra, J., Martinez, A., Sejnowski, T. J., & Hillyard, S. A. (2007). Early cross-modal interactions in auditory and visual cortex underlie a sound-induced visual illusion., 27(15), 4120–4131. http://doi.org/10.1523/JNEUROSCI.4912-06.2007

Morís Fernández, L., Torralba Cuello, M., & Soto-Faraco, S. (2017). Theta oscillations reflect conflict processing in the perception of the McGurk illusion. The European Journal of Neuroscience. http://doi.org/10.1111/ejn.13804

Roa Romero, Y., Keil, J., Balz, J., Gallinat, J., & Senkowski, D. (2016). Reduced frontal theta oscillations indicate altered crossmodal prediction error processing in schizophrenia. Journal of Neurophysiology, 116(3), 1396–1407. http://doi.org/10.1152/jn.00096.2016

Neural Oscillations as Time Window of Integration

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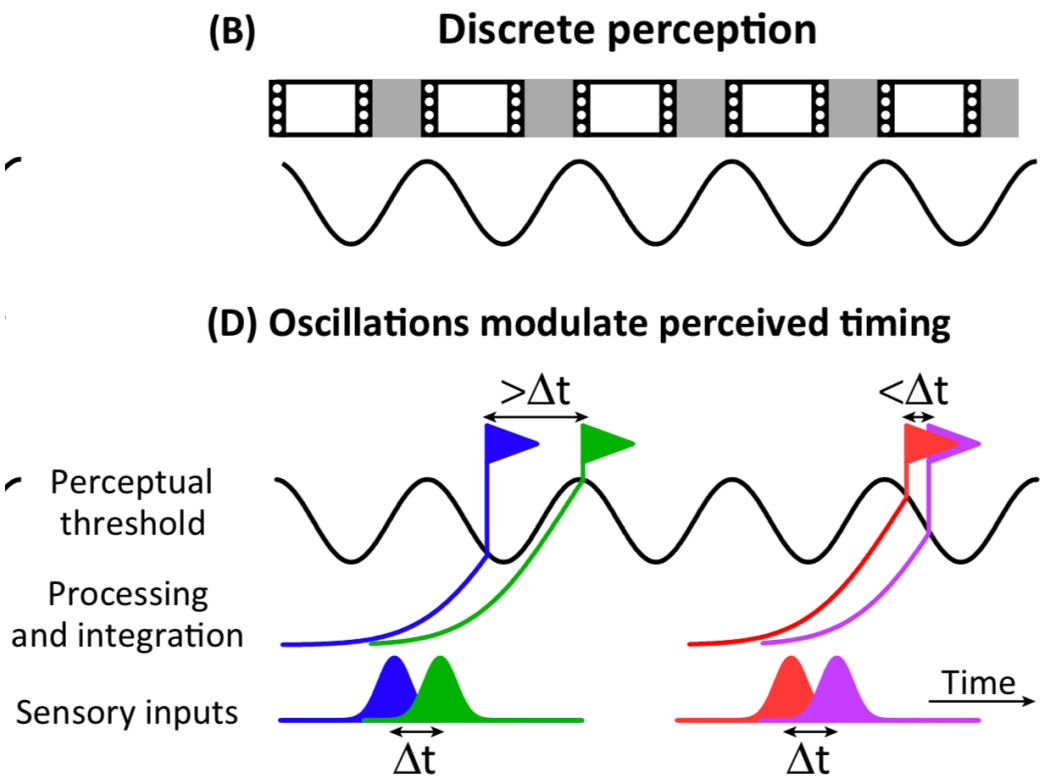

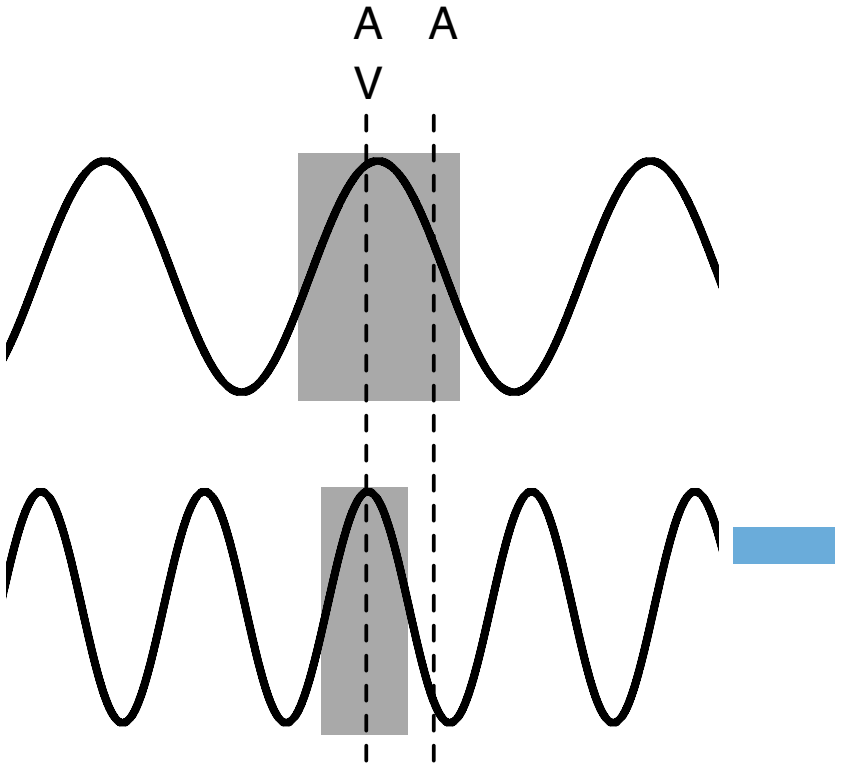

Van Rullen 2016, TICS