Theme Introduction: Advancing Our Understanding of Hallucinations

Susan L. Rossell*1-3, Neil Thomas1,2, and Flavie Waters4,5

1Faculty of Health, Arts and Design, School of Health Sciences, Swinburne University of Technology, Melbourne, Australia; 2Monash Alfred Psychiatry Research Centre and The Voices Clinic, The Alfred, Melbourne, Australia; 3Psychiatry, St Vincent’s Hospital, Melbourne, Australia; 4Clinical Research Centre, Graylands Hospital, North Metro Health Service Mental Health, Perth, Australia; 5The School of Psychiatry and Clinical Neurosciences, University of Western Australia, Perth, Australia

*To whom correspondence should be addressed; Brain and Psychological Sciences Research Centre, Swinburne University, John St, Burwood Road, Hawthorn, VIC 3122, Australia; tel: 61-3-9214 8173, fax: 61-3-9214 5267, e-mail: srossell@swin.edu.au

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This special theme in Schizophrenia Bulletin on Hallucinations includes three interdisciplinary articles presented at the International Consortium on Hallucination Research (ICHR) meeting in Melbourne, Australia, October 2015. A common theme recapitulated through each of the reports relates to refining and/or improving our conceptualization and understanding of brain mechanisms and dynamics, as well as metabolism, which underlie hallucinations and hallucination-like experiences. The descriptive features of hallucinations associated with schizophrenia, and other psychiatric and neurological conditions, have been of scientific interest for more than 100 years; and the advent of noninvasive neuroimaging technologies in the late 1980s and early 1990s have facilitated the hunt for the neurobiological basis of hallucinations. Although substantial advances in our understanding of this enigma have occurred, we are still a long way from having a complete explanation. Significant developments are being made by exploring the link between different hallucinations presentations/modalities and their underlying brain mechanisms.

The reports in this issue comment on brain functioning and systems during dreams and hypnagogia (fleeting perceptual experiences from sleep to wakefulness) and in the hallucination-prone brain, both at rest (ie, within resting-state networks) and during processes that necessitate inhibitory functions. Common findings highlighted include thalamus and sensory cortical activity during hallucinations (and hallucination-like experiences), as well as molecular, and functional and structural connectivity differences between these regions (and others) during hallucinations and when a hallucination-prone brain is at rest. A summary of other important findings of each of the three reports is further emphasized.

Waters et al.2 explore the intriguing question of whether sleep-related perceptions are similar or different to awake hallucinations. A comprehensive exploration of the phenomenology and the involved brain systems of sleep-related perceptions, the team concluded that they meet the minimum criteria for hallucinations. That is, they are nonveridical perceptions (not elicited from corresponding stimuli) and not under volitional control. There are substantial differences in that sleep-related perceptions only involve a subset of neural networks and are cutoff from reality, which contrasts to hallucinations that are overlaid onto veridical perceptions.

Alderson-Day et al.3 focus on resting-state networks. They summarize connectivity differences within the major resting-state networks and note the difficulty of comparing research findings in this field. The large number of methodological differences create confounds including length of scan, whether eyes are open or closed, whether participants are asked about whether they experienced auditory hallucinations or not during the scan, and differences in methods of data analysis across studies. The authors conclude with recommendations for future studies, including how to make studies more clinically relevant.

Jardri et al.4 review the evidence for an excitatory-to-inhibitory imbalance in hallucinations. Their analyses were completed across multiple levels: from molecular, through neurophysiology and brain mechanisms, to cognition or behavioral inhibition. They present the idea that a Bayesian inference framework offers an efficient method of data integration across the different micro- and macro-levels. Using computational models to explain complex behaviors across multiple levels of explanation is still in its infancy, and this approach represents the potential to make substantial advances in the field. The authors make practical recommendations to ensure that researchers optimize data collection to allow for such
modeling. These authors also emphasize the importance of the metabolic features of hallucinations, and advances in magnetic resonance spectroscopy are presented as novel exploratory method for such a purpose.

As we advance our understanding of hallucinations, a concerted effort is being made to relate the various dimensions of hallucinations to their underlying mechanisms. The syntheses presented here highlight the complexity of this issue. Transdiagnostic research is emphasized as necessary to determine unique and common hallucinations features across disorders and in the non-ill population. The case of Waters et al.\(^2\) gives emphasis to sleep-related hallucinatory phenomena. Anderson-Day et al.\(^3\) and Jardri et al.\(^4\) discuss two areas of hallucination research that have been extensively researched but poorly integrated, resting-state brain imaging, and inhibition/excitatory balance. Their reviews are timely and present computational modeling as an alternative approach to understanding multilevel data. These reviews and concepts further advance our understanding of hallucinations.

ICHR is now in its fifth year and is pleased to support a satellite meeting in Chicago in September 2016, featuring presentations from the researchers, clinicians, and experts by experience. The next ICHR meeting will be held in Lille, France, in Autumn 2017. For further information about meetings, see hallucinationconsortium.org.

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References