1. What is the difference between monocular and binocular rivalry?

Both monocular rivalry and binocular rivalry are examples of bistability, where are two images compete for visual dominance (p. 1). The key difference between them is that in monocular rivalry, the two competing images are superimposed and both eyes are used when viewing the image, whereas in binocular rivalry the two images are presented and viewed one by each eye.

2. Why is binocular rivalry an important psychophysical paradigm for studying the neurobiology of conscious awareness?

With physical stimuli remaining unchanged, the changes of perceptual dominance provide a window for researchers to into the neural dynamics that are associated with the state of consciousness (p. 1; Wilson et al., 2001). Because in a binocular rivalry paradigm changes of perceptual dominance can be overtly reported by participants, researchers can trace the neural activities that are associated with that specific content of consciousness (through time-lock the events to the neural activities).

3. How do stimulus strength, attention, and visual context similarly/differentially modulate the dominance and suppression in binocular rivalry? What does this imply about the underlying neural processes that give rise to binocular rivalry?
Stimulus strength does not modulate the dominance per se. It primarily modulates the amount of suppression experienced by the suppressed target in binocular rivalry (p. 2). In contrast, visual context seems to modulate the dominance phase in that the predominance comes from a lengthened dominance phase rather than a reduced suppression phase of the binocular rivalry (p. 3). Though it’s still under debate, attention seems to work in a similar way that it enhance predominance by extending dominant period (Von Helmholtz, 1866, 1925). However, it seems that dominance phase can only be modulated by endogenous attention while suppressed target can be modulated by both endogenous and exogenous attention (p. 3).

The differential effect implies that stimulus strength, contextual information, and possibly attention, operate differently in modulating visual predominance. Therefore, it is likely they use different neural mechanisms to support these different computations.

4. EEG does not normally have the spatial resolution to resolve the individual competing images presented to the two eyes during binocular rivalry. What clever method was used by Brown & Norcia (1997) to identify the dominance/suppression phases of the competing stimuli in the steady-state visually-evoked potential (a component of the EEG signal)

Brown and Norcia (1997) “tagged” the waveforms that were associated with the competing images from the two eyes by using different flicker rates (i.e. modulating contrast in different rates) for each image, so that signals coming from different eyes can be separated and phased-locked to the reported changes in perceptual dominance (p. 5).

5. (Extra credit) Does binocular rivalry involve competition between the eyes, or competition between images? Reference experimental evidence to support your answer.
The observed perceptual grouping property of binocular rivalry suggests that competition occurs between images/features rather than between the eyes. Even when the features of local rivalry are distributed between the two eyes, binocular rivalry can still give rise to a feature-based coherent perceptual dominance (p. 3). Thus, we can still obtain information from both eyes during binocular rivalry, and competition is not simply between receptive fields.

6. (Extra credit) What has been learned about the neural concomitants of binocular rivalry from visual adaptation experiments?

The tilt aftereffect is thought to arise due to the adaptation of orientation-selective neurons in V1 (Dragoi, Sharma and Sur, 2000). The observation that rivalry suppression has no effect on the tilt aftereffect suggests that the neural concomitants of binocular rivalry are likely to be downstream to V1. In contrast, suppression during binocular rivalry seems to affect aftereffects that are attributable to global motion adaptation (p. 5), which involves the integration of information and is likely to take place in the cortex. Therefore, the neural concomitants of binocular rivalry may reside prior to, or at, sites where information integrates.

7. (Extra credit) Area FFA and PPA's fMRI BOLD responses to dominant-face and dominant-house during binocular rivalry were found to be similar to those evoked by non-rivalrous, alternating presentations of face and house images. What does this imply about the role FFA/PPA play in binocular rivalry? i.e. Is rivalry resolved before, during, or after stimulus information processed through these two areas?

This implies that rivalry is resolved before FFA/PPA (p. 6). By the time information is processed by these areas, the conscious perceptual experience seems to only reflect information
about the dominant image, and information of suppressed image has little access to the consciousness.