1. Binocular rivalry is an important psychophysical paradigm for studying the neurobiology of conscious awareness because it describes a phenomenon by which alternating visual percepts dominate awareness, providing an opportunity to understand more about awareness by studying these fluctuating neural states. Though the stimulus is unchanged, the dominant percept switches after being held for several seconds, and is then suppressed during dominance of the other percept. Studying the mechanisms that mediate this “dissociation between unchanging visual stimulation and fluctuating conscious awareness” (1) is important to learning the neural correlates of conscious visual awareness.

2. Stimulus strength, attention, and visual context affect the dominance and suppression involved in binocular rivalry. Stimulus strength primarily modulates the suppression phase of a target, with little effect on its dominance phase; a stronger stimulus has a shorter period of suppression than a weaker stimulus, and consequently has higher “overall predominance, as indexed by the percentage of total viewing time for which it is dominant” (2). Top-down attentional influences appear to modulate rivalry by “boosting the effective strength of stimulus during dominance” (2) – it is important to note that this voluntary attention works only during dominance, while involuntary attention continues to work during suppression. And unlike stimulus strength, the visual context of stimulus modulates a target during dominance and not during suppression. A target embedded in a congruent, meaningful context has greater predominance than the same target embedded in an incongruent context.

Taken together, these findings imply that “dominance and suppression rely on distinct neural processes” (3). The bottom-up perceptual characteristics of a target (contrast, brightness, motion, density of contours) modulate the suppression of a target, whereas the top-down effects of voluntary attention and context are not engaged during suppression, and instead amplify salience during dominance.

3. Brown & Norcia (1997) identified the dominance and suppression phases of competing stimuli by tagging the VER (visually evoked response) waveforms associated with each stimulus. Because the stimuli were gratings moving at different rates, and the waveforms associated with each rate could be identified. The tagged waveforms were shown to inversely change in magnitude, consistent with the phases during which subjects reported dominance and suppression (5).

4. The finding that area FFA and PPA’s fMRI BOLD responses to dominant-face and dominant-house percepts during binocular rivalry were found to be similar to the non-rivalrous alternating face and house images implies that rivalry is resolved before stimulus information is processed through these areas. The FFA and PPA respond preferentially to faces and scenes, respectively, and report nearly identical activity in the rivalrous and non-rivalrous conditions, suggesting that rivalry has already been resolved before signals reach this stage of processing (6).
5. The question of whether binocular rivalry involves competition between the images or the eyes is unresolved, with experimental evidence to support both hypotheses. Switching targets between the eyes will cause a switch in dominance (the previously suppressed stimulus, placed in the eye of whose region was dominant before, will then become dominant). However, if the switching occurs several times a second, a rival stimulus can remain suppressed (9), and other evidence demonstrates interocular grouping, suggesting that dominance is distributed and not isolated to one eye at a time.

(Gold & Shadlen, 2007)

1. According to Gold & Shadlen, the five elements of a decision are the prior, evidence, value, decision variable, and decision rule. The prior is the probability that the hypothesis is true without receiving any evidence. In a perceptual task, this can correspond to the predicted probability of viewing a stimulus, given or inferred from “its relative frequency of occurrence on previous trials” (2). Evidence is information that can support a hypothesis, for example the “neural activity that represents immediate or remembered attributes of a sensory stimulus” (2). Value is the subjective costs and benefits of each outcome; value can encompass factors like feedback, reward, time, and effort. The decision variable, or DV, is the “accrual of all sources of priors, evidence, and value into a quantity that is interpreted by the decision rule to produce a choice” (4), an example of which could be a weighted sum of the evidence accumulated so far in time. Finally, the decision rule is a criterion value on the decision variable, such as a threshold on how much evidence has to be observed before choosing a hypothesis.

2. If accuracy became more important than speed, you would expect the decision bounds A and –A to shift farther apart, towards positive infinity and zero respectively, in order to increase the ratio of evidence for one hypothesis over the other. On the other hand, if speed became more important than accuracy, you would expect the distance between the decision bounds to decrease, as the accumulation of evidence for one hypothesis over the other will reach a less extreme threshold in a shorter amount of time.

3. Figure 5c suggests that LIP neurons do not only respond to the sensory properties of the motion stimuli, but also reflect something of the final perceptual decision. Even when the stimulus has zero coherence, the firing rate differentiates in pattern between trials in which the monkey selects Tin (firing rate increases) and those in which it selects Tout (firing rate meanders or decreases). Furthermore, the firing rates on trials in which the monkey selects Tin reach the same threshold before saccade initiation, a level of activity that is analogous to the decision rule that terminates the decision process (14).

4. Likelihood ratio: \( l(e) = \frac{P(e|h_1)}{P(e|h_2)} \)

Log likelihood ratio: \( \log\left(\frac{P(e|h_1)}{P(e|h_2)}\right) \)

Likelihood and log likelihood are monotonically related because if \( x \leq y \), \( \log(x) \leq \log(y) \), for \( x, y \geq 0 \). (Condition holds because \( 0 \leq P(e|h_1), P(e|h_2) \leq 1 \).)
Posterior: \( P(h_1|e), P(h_2|e) \)
Increase in \( P(e|h_1) \) increases \( P(h_1|e) \), and increases the likelihood ratio and moves the DV towards the threshold for \( h_1 \).
Increase in \( P(e|h_2) \) increases \( P(h_2|e) \), and decreases the likelihood ratio and moves the DV towards the threshold for \( h_2 \).

Log posterior: \( \log(P(h_1|e)), \log(P(h_2|e)) \)
There exists the same monotonic relationship as for the posterior, because if \( x \leq y \), \( \log(x) \leq \log(y) \), for \( x, y \geq 0 \). (Condition holds because \( 0 \leq P(h_1|e), P(h_2|e) \leq 1 \).)

The monotonic relationship of the likelihood ratio to the log likelihood ratio, posterior, and log posterior, implies that the decision variable can be represented in many different equivalent ways because the priors, evidence, and values are not constrained except that they interact in a certain way (5), which can be captured by assuming any of the above quantities for the DV and scaling the decision rule. It is thus difficult to find the neural correlate for representing the decision value because it requires finding how the other elements of the decision process are represented individually.