Introduction

Attention and consciousness are closely related. James (1890), Posner (1994), yet recent empirical and theoretical work indicates that they do not share identical underlying neural processes (Koch & Tsuchiya, 2004; Lamme, 2003; Woolf and Luck, 2003). Among theories of visual attention, a stimulus may be necessary for their conscious registration, yet we know it is not sufficient, since space-based as well as feature-based attention can occur independently of processes such as awareness during object-substitution masking


Brain processes.


To this end we exploit a modified version of Eriksen’s (1974) response-competition paradigm. We use a gradient model (Cave & Bichot, 1999) to account for choice RTs to the probe will be significantly slower in the probe (response-incompatible flankers). We expect that choice RTs to the probe followed the flankers; in the flanker-visible condition only the probe followed the flankers, in the flanker-invisible condition, the probe was accompanied by two flankers that were presented at two different locations that were progressively farther from the attentional focus (Posner, 1980; Lamme, 1995).

Relying on this trend, we compare the spatial specificity of stimulus interactions at nonconscious levels of processing to those at conscious levels. To this end we exploit a modified version of Eriksen and Eriksen’s (1974) response-competition paradigm. We use a central probe surrounded by flankers to which is assigned either the same discriminative response as to the probe (response-compatible flankers) or a different response that competes with that to the probe (response-incompatible flankers). We expect that choice reaction times (RTs) to the probe will be significantly slower in the response-compatible condition than in the response-incompatible condition. This is possible if the flankers fall within the spatial gradient of attention centered at the probe location. Specifically, based on the Eriksen and Eriksen’s (1974) results, this difference ought to decrease as the flankers are presented farther from the attended probe location.

In the Eriksen and Eriksen (1974) study all stimuli had registered in visual consciousness that they were clearly visible. Here, we compare effects of spatial attention located at conscious levels to effects of spatial attention located at nonconscious levels of processing. As expected, the effect of response compatibility between flankers and probe was highly significant (RT, 113±53, p<.001). This is reflected in the higher RTs obtained with incompatible than with compatible flankers. Effects of the probe-flanker separation were also significant (F(2,22)=12.59, p<.005), as seen in the progression of choice RTs as separation increases. The two-way interaction between compatibility and flanker-probe separation was additionally significant (F(2,22)=4.45, p=.033).

While the visibility of the flankers did not produce a significant effect (F(1,11)=28, p>.77), the two-way interaction between visibility and flanker-probe separation approached significance (F(2,22)=3.27, p=.07). The visible flankers tend to produce larger decreases of overall RT as probe-flanker separation increases than the invisible flankers. The significant two-way interactions between compatibility and probe-flanker separation can be seen by inspection of the incompatibility effects shown in the figures below.

2. Incompatibility Effects:

The results show that: 1) response-competition/incompatibility effects can be obtained with invisible (masked) flankers as well as with visible (unmasked) flankers, and 2) these effects decrease as probe-flanker separation and probe increase.

In line with Eriksen and Eriksen’s (1974) interpretation of similar results, the latter trend, consistent with attention having a spatially limited temporal window, suggests that attention is also nonconsciously processed ones. It follows that this characteristic of processing in conscious as well as nonconscious levels of processing. One possible limitation to this interpretation is that the spatial gradient found in the present study are not due to characteristics of the task such as calling to core magnification factor. This probe was presented slightly above fixation and therefore the flankers at progressively greater distance from the probe were seen in fewer cortical neurons than the near probe. Such weaker activation may have contributed also to a weaker response incompatibility effect. This possible contribution of cortical magnification must be investigated before one can unequivocally conclude that attention directed nonconcious levels of processing is characterized by a spatial gradient found at a conscious level.