CLASSIFICATION IMAGES FOR A SIZE ILLUSION

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INTRODUCTION. Perceived size can be strongly influence by context. An example of such a size-context effect is the Ebbinghaus illusion (Fig. 1). In this illusion, a central dot of fixed diameter is placed within the context of surrouding dots of either smaller or lager diameter. The central dot is perceived to be much larger within the context of smaller surrounding dots than larger surrounding dots.

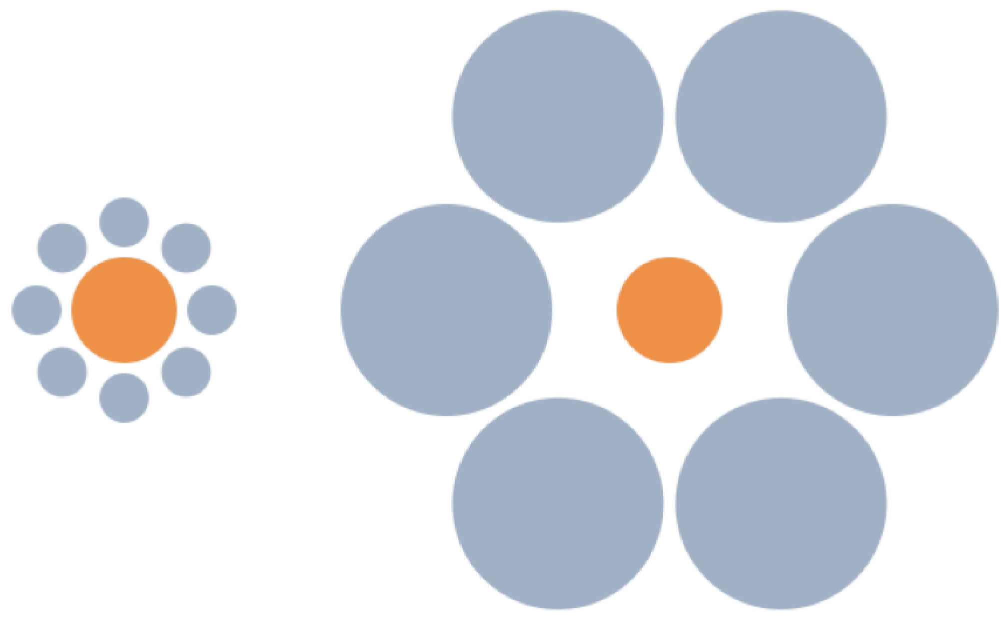

Figure 1: The Ebbinghaus Illusion

We psychophysically measured the effect that this misperception of size has on how visual information is processed in a simple behavioral task (dot detection) using response classification analysis. This technique allowed us to measure how much an observer uses each location in an image by correlating their decisions across trials with noise added to the display. The resulting 'classification image' is a map that shows the relative weighting of spatial positions used by the observer during the task.

TASK, STIMULI & OBSERVERS. Observers detected the presence / absence of a central dot of fixed diameter surrounded by leither arger or smaller dots (Fig. 2). High contrast Gaussian pixel noise was added to the entire stimulus region on each trial (except for the surrounding dots). The contrast of the central dot was set low in order to produce 71% correct performance (contrast thresholds were virtually identical in the two conditions). 3 observers participated in 10,000 trials each.

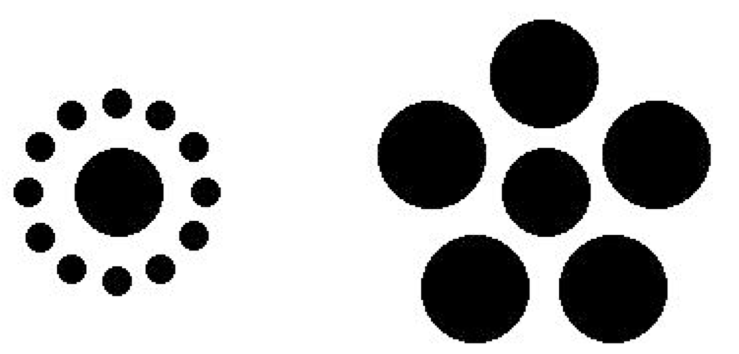

Figure 2: Stimuli used in the Experiment

CLASSIFICAITON IMAGES. Each classification image **C** was calculated by averaging the noise for each stimulus-response combination and combining these means according to

$$\mathbf{C} = (S_{present}R_{absent}+S_{absent}R_{absent}) - (S_{present}R_{present}+S_{absent}R_{present}).$$

Classification images were computed by collapsing the data across observers and are shown in the top panel of Fig. 3. We also generated smoothed versions of these images (convolved with a small kernel; Fig. 3, bottom) and radially averaged versions of each image (Fig. 4; error bars measured by bootstrap simulations).

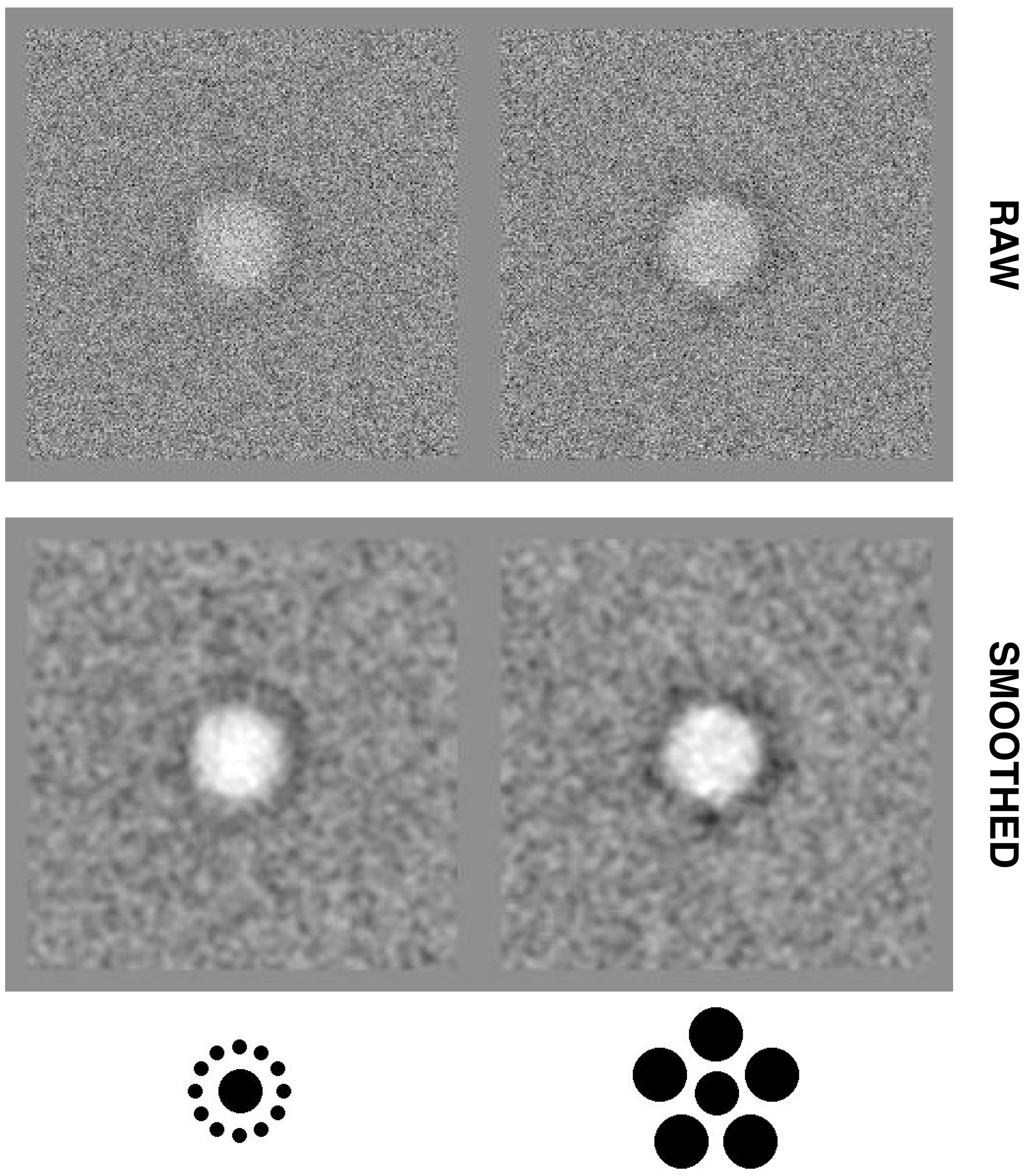

Figure 3: Classification Images

RESULTS. The presence of small and large surrounding spots had different effects on the weight observers placed on the inside and surrouding areas of the central spot region. In both cases, observers negatively weighted noise falling in the surround and positively weighted noise falling in the center (typical of detection tasks). However, observers placed more weight on the center and less on the surround in the presence of small surrounding spots.

INTERPRETATION. Our results clearly demonstrate that the presence of context has an effect on how information is processed in these Ebbinghaus figures. However, it remains unclear why this difference in weighting results in (or perhaps is the result of) a phenomenological difference in perceived size of the central spot.

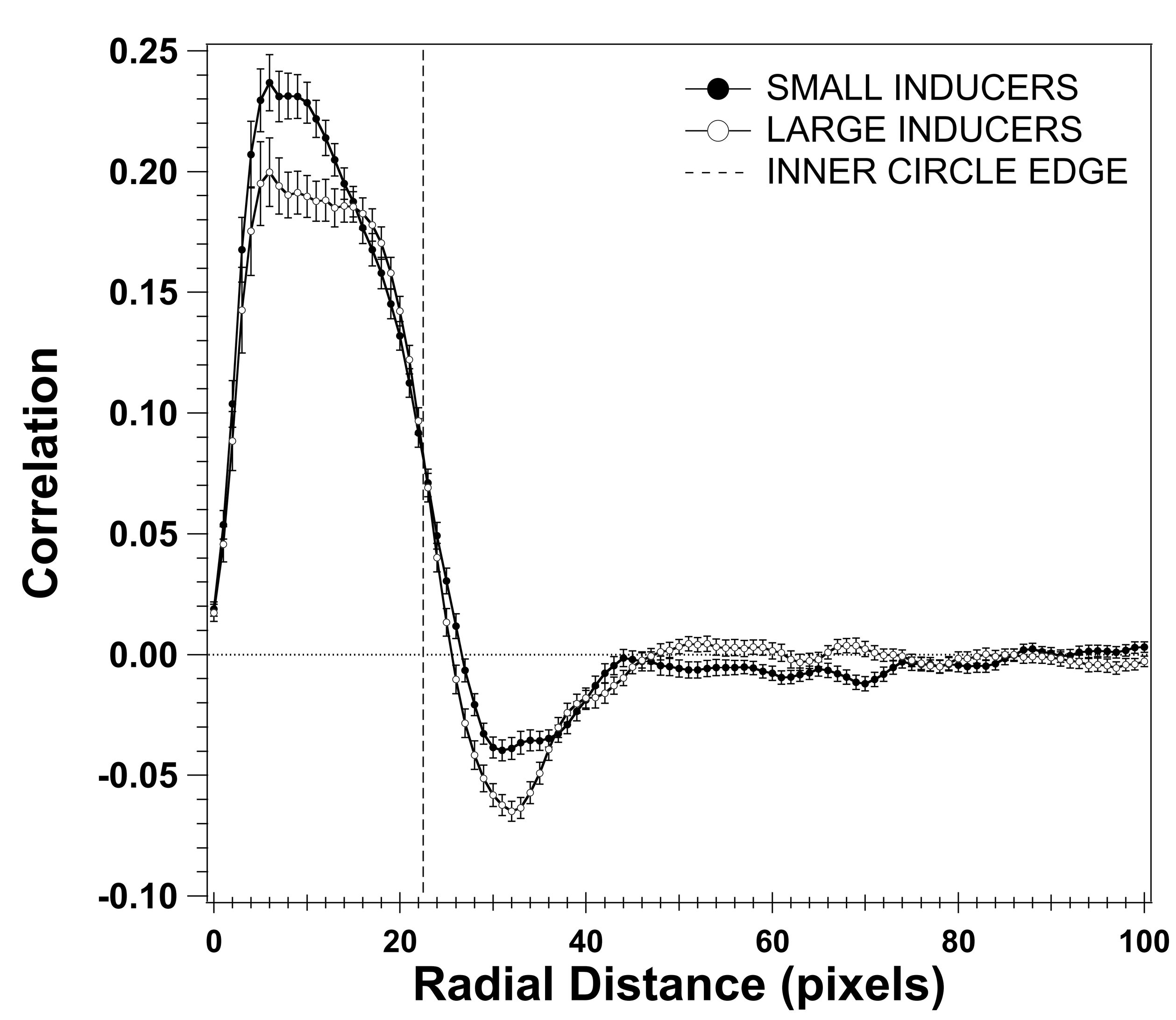

Figure 4: Radially Averaged Classification Images

FUTURE DIRECTIONS. We are currently measuring classification images in the absence of surrounding spots, as a neutral condition for comparison. We are also implementing a simple Bayesian model of early visual processing (up to and including V1) to explore whether our classification image results can be accounted for by pre-neural mechanisms (e.g., optics, receptor sampling) and/or the receptive field properties of V1 simple cells.