Priming and Anchoring Effects in Visualization

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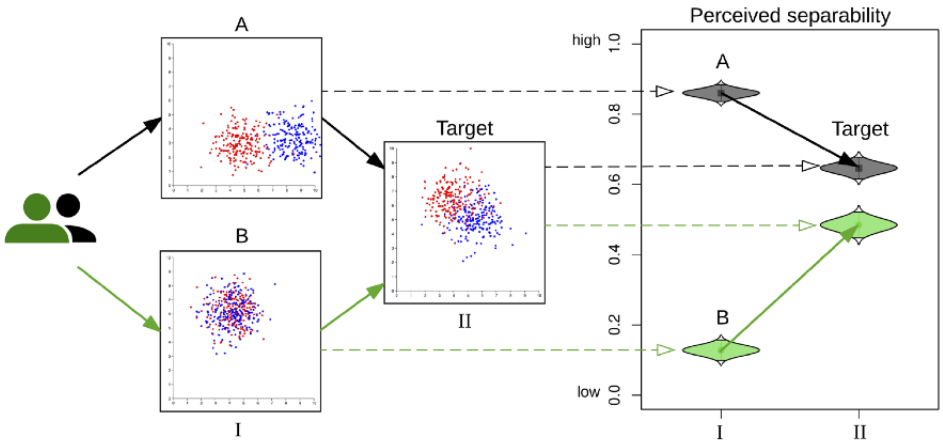

Fig. 1. The exposure to a different stimulus changes the subsequent judgment of separability in a scatterplot target. Means and 95% confidence intervals of judgments depicted as catseye plots (data from study 4 in this article).

Abstract— We investigate priming and anchoring effects on perceptual tasks in visualization. Priming or anchoring effects depict the phenomena that a stimulus might influence subsequent human judgments on a perceptual level, or on a cognitive level by providing a frame of reference. Using visual class separability in scatterplots as an example task, we performed a set of five studies to investigate the potential existence of priming and anchoring effects. Our findings show that—under certain circumstances—such effects indeed exist. In other words, humans judge class separability of the same scatterplot differently depending on the scatterplot(s) they have seen before. These findings inform future work on better understanding and more accurately modeling human perception of visual patterns.

Index Terms—Perception, Anchoring, Bias, Scatterplots, Visualization, MTurk Study

1 Introduction

Visual perception is the main epistemic source of information for understanding our environment. One assumption of visualization is the consistency of visual perception. Given the same stimulus and the same person, one should 'see' the same thing every time. However, visual perception is both a top-down and bottom-up process or, as phrased by Kinchla, a 'middle-out' process [30]. Both higher- and lower-order aspects of visualization affect perception, and prior stimuli might bias perception and change what is seen.

Human biases play a major role in psychology research. The goal is to understand the underlying mechanisms that shape 'irrational' behavior and if necessary provide means to counteract these biases. Many biases are shaped by heuristic cognitive processes and their inherent flaws [60]. Humans, for instance, are known to overestimate the risk of becoming a victim of violent crime if they have been exposed to violent shows on television [48]. This mechanism is caused by the availability heuristic: 'because I remember crime easily, it must be prevalent often'. Similar effects are present in other judgments and can be attributed to the effort to handle noisy input signals [26]. Since visualizations are increasingly used in decision making, it is necessary to understand how cognitive biases might distort decisions from visualizations.

In this work, we focus on priming and anchoring effects, and the question of how far such effects might play a role in visualization. Priming effects describe phenomena in which human responses are influenced by a preceding perceptual stimulus [36]. For instance, participants who are asked to complete the word 'so_p' are more likely to pick the word soap, when they see a picture of a shower before. In contrast, participants, who see a picture of bread and butter, are more likely to fill it with 'soup'. Anchoring effects, on the other hand, describe the phenomenon that a previous stimulus provides a frame of reference, that is, an anchor. This anchor aids judgments, even if the stimulus is completely unrelated. For example, asking someone the amount of calories of a carrot, anchors later judgment on the amount of calories of ice-cream [40]. People then underestimate the latter. Or even more odd, telling someone the birth year of Mark Twain can affect their estimation of the length of the Mississippi [42, 65]. Priming is based on neural pre-activation, that means similar stimuli are recognized more easily, because their neural correlates are already 'warmed up'. Anchoring is (presumably) based on priming and describes the mere effect that judgments might be biased, or 'anchored', towards a preceding stimulus. Based on this line of research in psychology, we

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