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The Roelofs and induced Roelofs effects

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ABSTRACT

The visual image provides important cues for an observer's sense of location and orientation within the world. Occasionally, though, these cues can be misleading, resulting in illusions. In the Roelofs and induced Roelofs effects, for example, a large illuminated frame, offset from the observer's midline in otherwise complete darkness, tends to bias the observer's judgment of straight ahead, causing the position of the frame, and anything contained within it, to be misperceived. Studies of these illusions have provided much insight into the processes that establish an observer's egocentric reference frame, and the manner in which object locations are encoded relative to this frame for perception and action.

1. Preface

In 2012–2013, Ben Lester and I had the pleasure of working with Bruce Bridgeman to write a review of the visual illusions known as the Roelofs and induced Roelofs effects. The review was originally intended as a book chapter, but due to a miscommunication with the editors, it was mistakenly left out of the final publication. While frustrating and disappointing at the time, that miscommunication created the scenario that allows us to share a slightly expanded version of that review[1] in this special issue of *Consciousness and Cognition* dedicated to Bruce's life and works. We are honored once again to serve as coauthors with Bruce, even as we are deeply saddened by the circumstances.

For many years, I have shared with my students the story of how my collaboration with Bruce began, because it is a shining example of Bruce as a scientist, putting data before ego, and as a person, kind and thoughtful. One of my first extended interactions with Bruce occurred at the 2001 meeting of the Cognitive Science Association for Interdisciplinary Learning (CSAIL). In the years before, Bruce had published several papers describing a dissociation in the way perceptual judgments and sensorimotor actions were affected by the induced Roelofs effect, which seemed to provide support for the existence of separate maps of visual space for cognition and action. I was a new assistant professor, and my talk at the conference contained some preliminary data that had led me to a new interpretation of the Roelofs dissociation that directly contradicted Bruce's, so I was a somewhat nervous knowing that he was in the audience. After my talk, Bruce approached me and said something like, "You know, I never thought about it that way," and we agreed to meet that evening to have a deeper discussion. By the time we met later that day, Bruce had already started developing a paradigm that would provide a direct test of the two interpretations. After we smoothed out the details of an experiment, Bruce proposed that we each do the experiment separately (he in his lab with pointing movements as the motor response, me in my lab with eye movements), with a plan to write up the results in a single manuscript, and the order of authorship determined by whichever interpretation was correct. The results of that collaboration were eventually published in *Vision Research* (Dassonville, Bridgeman,

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[1] This review has been expanded slightly to include studies that either did not fit within the space constraints of the original manuscript (Walter & Dassonville, 2008; Walter, Dassonville & Bochsler, 2009), or were published after the original manuscript was submitted (Lester & Dassonville, 2014; Dassonville & Reed, 2015).

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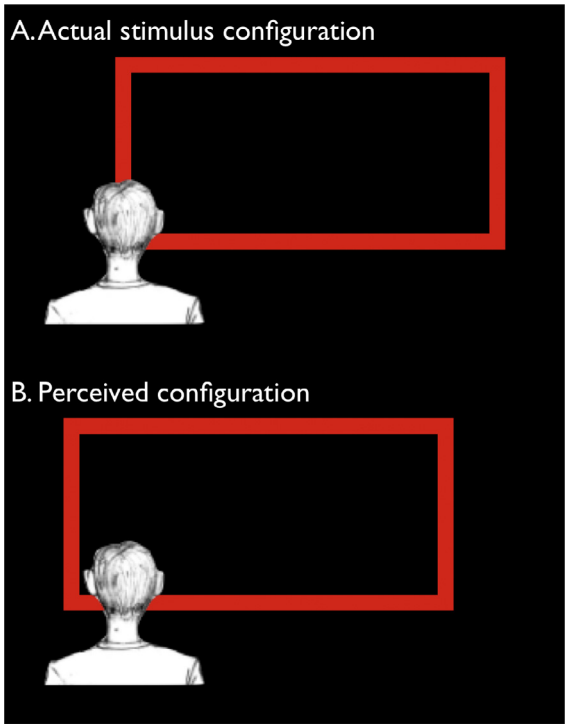

Fig. 1. The Roelofs effect. (A) A static illuminated frame is positioned so that one edge is aligned with the observer's median plane. (B) The typical observer underestimates the frame's offset, such that the perceived location of the edge is not straight ahead.

Bala, Thiem, & Sampanes, 2004).

My CSAIL presentation could have provoked many reactions in a lesser person—a decision to ignore inconvenient findings, an urge to go back to the lab to find evidence to contradict my interpretation and reinforce his own, a plan to keep for himself the new ideas for follow up experiments that my presentation prompted, etc. Instead, Bruce enthusiastically embraced the challenge and forged a new collaboration to resolve the discrepancies, gladly following the data no matter where it led. In doing so, he provided a striking example of the way science, and scientists, should work, and I'll always be grateful to him for that. Bruce was bright and interesting, fun to talk with, and generous in spirit—he is missed.

–Paul Dassonville

2. Introduction

In the Roelofs effect (Roelofs, 1936[2]), an observer in otherwise complete darkness is presented a static illuminated rectangular frame positioned so that one edge is aligned with the observer's median plane (Fig. 1A). However, the observer typically reports that the frame has a reduced offset; for example, with the frame shifted rightward so that the left edge is straight ahead, the observer reports that the edge appears to lie to the left of straight ahead (Fig. 1B). Alternatively, if the observer is asked to position the frame so that one edge lies straight ahead, he or she will typically position the frame with an exaggerated offset in order to compensate for the effects of the illusion.

In a related phenomenon, a static offset frame can also induce the mislocalization of an enclosed target (Bridgeman, Peery & Anand, 1997). In this *induced* Roelofs effect, an observer is asked to report the location of the target (for example, by judging its location with respect to the median plane; Fig. 2A). However, the presence of the offset frame typically generates a bias in the reported location of the target, with the target perceived to be offset in a direction opposite that of the frame (that is, a right-shifted frame causes the target to be perceived as being offset to the observer's left; Fig. 2B).

3. History

Interest in how an observer determines the locations of objects in the world, 'how the eye knows where the world is', is as old as psychophysics. In the 19th century, Lotze formed the basis for subsequent work on localization with his theory of local signs, which proposed that the location of an image on the retina signals the presence of an object in the corresponding place in the world. It

[2] This is often cited as Roelofs, 1935. However, the copy of the paper in our possession, originating from the Bayerische Staats-Bibliothek München, has the bibliographic notation "München Verlag von J. F. Bergmann 1936".