Journal of Experimental Social Psychology 79 (2018) 181–187

Contents lists available at ScienceDirect

Journal of Experimental Social Psychology

journal homepage: www.elsevier.com/locate/jesp

Conscious awareness is necessary for affective faces to influence social judgments

Ian R. Kleckner[a,b,*], Eric C. Anderson[a,c,d], Nicole J. Betz[a], Jolie B. Wormwood[a], Rhea T. Eskew Jr[a], Lisa Feldman Barrett[a,e]

[a] Department of Psychology, Northeastern University, Boston, MA, United States of America
[b] University of Rochester Medical Center, Rochester, NY, United States of America
[c] Center for Outcomes Research and Evaluation, Maine Medical Center, Portland, ME, United States of America
[d] Tufts University School of Medicine, Boston, MA, United State of America
[e] Department of Psychiatry and the Martinos Center for Biomedical Imaging, Harvard Medical School, Massachusetts General Hospital, Boston, MA, United States of America

ARTICLE INFO

Handling editor: Ursula Hess

Keywords:
Consciousness
Emotions
Social perception
Individual differences
Perception

ABSTRACT

A growing body of research claims that stimuli presented outside conscious awareness can influence affect, speech perception, decision-making, eating behavior, and social judgments. However, research has shown that conscious awareness is a continuous phenomenon. Using a continuous flash suppression (CFS) paradigm to suppress awareness of affective faces (smiling and scowling), we demonstrate that some awareness of suppressed stimuli is required for the stimuli to influence social judgments. We discovered this using a rigorous within-participants psychophysics method that allowed us to assess awareness at very low levels, which is difficult using traditional methods. Our findings place boundary conditions on claims (made previously by us and others) that stimuli presented completely outside conscious awareness influence judgments. This work contributes to the literature highlighting the need to study conscious awareness as a continuous phenomenon and provides a framework for researchers to ask and answer questions regarding conscious awareness and its relation to judgment and behavior.

1. Introduction

Many researchers (including us) have claimed that stimuli presented outside conscious awareness can influence diverse phenomena such as affect (Li, Zinbarg, Boehm, & Paller, 2008), speech perception (Plass, Guzman-Martinez, Ortega, Grabowecky, & Suzuki, 2014), decision-making (Vlassova, Donkin, & Pearson, 2014), eating behavior (Winkielman & Berridge, 2004), and social judgments (Anderson, Siegel, White, & Barrett, 2012). However, several barriers limit the interpretability of experiments claiming to measure the effects of stimuli presented outside conscious awareness (for a review, see Yang, Brascamp, Kang, & Blake, 2014). For example, studies are often underpowered to measure very low levels of awareness, and individual differences in perceptual abilities are rarely considered. Therefore, group-level effects might depend on a small number of participants who have non-zero awareness that goes undetected. In addition, most studies dichotomize perceivers as "aware" or "unaware" which is overly simplistic because conscious awareness is better described as a continuous phenomenon (e.g., Pessoa, Japee, & Ungerleider, 2005; Rouder & Morey, 2009; Tamietto et al., 2015). Thus, although research in this area typically asks: *Can a stimulus influence a phenomenon of interest even when people have no awareness of the stimulus?*, two more productive questions are: (1) *How does the influence of a stimulus on a phenomenon of interest vary with changes in an individual's awareness of the stimulus?*, and (2) *Are there individual differences in the relationship between stimulus intensity and the phenomenon of interest?*

To address these questions, we combined a social judgment task that we have previously used (Anderson et al., 2012; Siegel, Wormwood, Quigley, & Barrett, 2018) with a rigorous idiographic psychometric curve fitting approach adapted from vision science in which each participant completes hundreds of trials across a wide range of stimulus intensities (here, image contrast level) (e.g., Sandberg, Bibby, Timmermans, Cleeremans, & Overgaard, 2011). This approach provides sufficiently powered within-person data to treat awareness and social

* Corresponding author at: Department of Surgery, University of Rochester Medical Center, 265 Crittenden Blvd., Box CU 420658, Rochester, NY 14642, United States of America.
E-mail address: Ian_Kleckner@URMC.Rochester.edu (I.R. Kleckner).

https://doi.org/10.1016/j.jesp.2018.07.013
Received 22 December 2017; Received in revised form 27 July 2018; Accepted 27 July 2018
0022-1031/

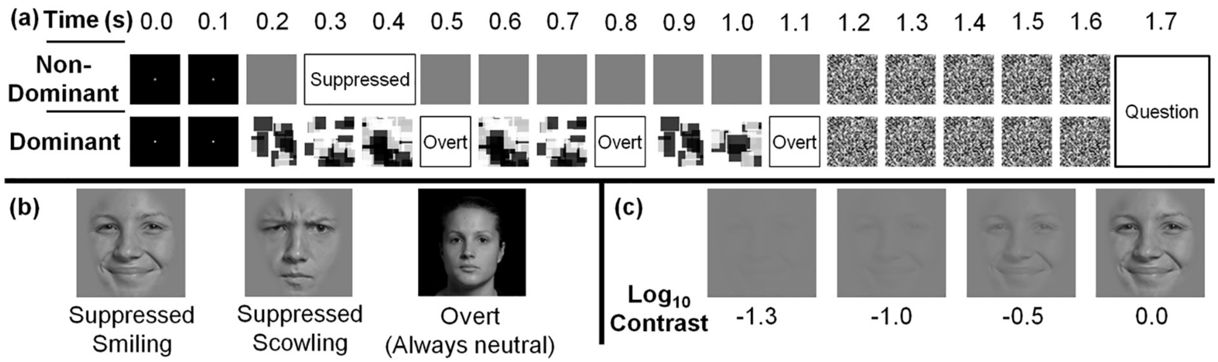

Fig. 1. Each CFS trial presented a sequence of images to each eye wherein the face images had a particular expression and contrast level. (a) Different images were shown to the dominant and non-dominant eyes. The images included a fixation dot, a gray square, Mondrian style patterns, a suppressed face, an overt face, random white noise images for backwards masking, and a question (e.g., asking whether the participant saw the suppressed face: yes/no). For the Face Detection task, a "No CFS" condition presented the suppressed face at maximum contrast to both eyes from 0.3 to 0.5 s. (b) The suppressed face was a close-up face with a smiling or scowling expression and the overt face had a neutral expression. The tasks used fifty different identities (25 male, 25 female; but only one identity is shown here). The suppressed and overt face always had the same identity. (c) The suppressed face spanned $\log_{10}$ contrast levels from −1.3 to 0, wherein −1.3 is nearly invisible and 0 is maximum contrast.

judgment (our phenomenon of interest) as continuous variables. Moreover, this approach can map relationships among these variables by comparing changes in each variable along a single, shared dimension: stimulus intensity. A major advantage of this idiographic psychometric curve fitting approach is that it allows us to extrapolate results to very low levels of awareness that are difficult to manipulate and measure directly.

In each of two tasks, we reduced awareness of visual stimuli using continuous flash suppression (CFS; Tsuchiya & Koch, 2005), wherein rapidly changing high-contrast images are presented to one eye to suppress awareness of a single, image presented simultaneously to the other eye (e.g., Fig. 1a). Specifically, we presented overt neutral faces—which participants consciously saw—amid a series of high-contrast patterned images to the participants' dominant eye while simultaneously presenting smiling or scowling faces of varying contrast levels—which were suppressed from awareness to varying extents—to the non-dominant eye. In the first task, participants reported whether they detected each suppressed face (yes/no; *a binary rating of awareness*) and rated how clearly they saw the face (*a continuous rating of awareness*). In the second task, participants reported their willingness to approach or avoid each overt neutral face (*a measure of social judgment*). We analyzed each participant's relatively large dataset using psychometric curve fitting. To our knowledge, this is the first study to employ such a rigorous approach to examine continuous relationships between awareness of affective social stimuli and their influence on social judgments. By establishing this method within the context of CFS and a social judgment task for which our group already has expertise, future work can continue this line of work to address more specific and nuanced scientific questions and other tasks besides social judgment.

2. Materials and methods

2.1. Participants

Because this project was the first of its kind, it was not possible to use traditional power analyses to determine sample size. Therefore, sample size was determined by our resources (5–10 participants per semester for two years) and we performed one interim analysis that did not influence the sample size. We reasoned that running 20–40 participants would provide ample power considering that parametric studies in vision science often employ very few participants (e.g., $N = 18$ from (Mudrik, Breska, Lamy, & Deouell, 2011), $N = 11$ from (Pessoa et al., 2005), $N = 1$ from Tamietto et al., 2015). Fortunately, using effect size estimates from the current project, future studies can use traditional *a priori* power analyses to determine the number of participants, trials, contrast levels, etc.

Thirty-nine participants (31 females; age range 19–29 years) were recruited from the Interdisciplinary Affective Science Lab at Northeastern University, United States. Laboratory members were recruited because they were more willing and able to complete this lengthy study compared to a typical student or community sample. Of these 39 participants, 25 participants completed the entire study (attrition was caused by personnel turnover in the lab). We removed data from two additional participants from all analyses: one due to an error in stimulus presentation, and one because all the stimulus intensities were too low for detection. Thus, the final dataset consisted of 23 participants (17 females, 19–25 years old), all of whom were blind to the study's hypotheses.

With 23 participants, sensitivity analyses ($\alpha = 0.05$ two-tailed, and $1\text{-}\beta = 0.8$) indicate that we can detect across-participant effects as small as Cohen's $d = 0.61$ using a paired t-test (Faul, Erdfelder, Lang, & Buchner, 2007) (e.g., compare average awareness levels at two different contrasts across participants, compare average judgment ratings for smiling vs. scowling faces across participants). Thus, we are sufficiently powered to detect effects smaller than were found in a prior study using a similar task comparing social judgments of neutral faces when paired with suppressed smiling vs. scowling faces (Study 3, Trustworthiness ratings, Cohen's $d = 1.06$; Anderson et al., 2012).

2.2. Experimental tasks

In these studies, we report all measures, manipulations and exclusions. Participants completed two separate tasks, a Face Detection task and a Social Judgment task. Both tasks used the same stimuli and timing described herein (Fig. 1). To reduce awareness of certain visual stimuli, we utilized an established suppression paradigm, CFS (Tsuchiya & Koch, 2005), wherein rapidly changing high-contrast images are presented to a participant's dominant eye in order to partially suppress awareness of a single image presented simultaneously to the participant's non-dominant eye. For simplicity hereafter, we use the term *suppressed face* to refer to stimuli that we attempted to suppress using CFS. As our results indicate, CFS either partially or completely suppressed the faces to varying extents, depending on the contrast of the suppressed face. For each trial of both tasks, participants were presented with a neutral face embedded in a series of high-contrast Mondrian images to their dominant eye, such that participants could consciously see the neutral face (which we call the overt face). Also on each trial, an affective face (smiling or scowling) was presented to the non-dominant eye slightly preceding the overt face. The affective face was partially suppressed from awareness using CFS (i.e., the stimulus timing