Unconscious Processing of Emotion in Crowded Display
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Introduction

The depth of unconscious processing has long been debated, and it remains unclear whether the results obtained so far reflect the true limitations of unconscious cognition or rather methodological restrictions. Here, we present a “gaze-contingent crowding” paradigm (GCC), which is aimed at characterizing unconscious processes in crowded displays. Crowding occurs when nearby flankers impede the identification of a peripheral stimulus.

We argue that taking advantage of this phenomenon, the method we used bypasses limiting factors encountered in other experimental protocols (CFS, masking). In the following study, we prevent conscious access to emotional faces by these three different techniques, and compare their respective unconscious influences on an evaluative judgment of a Chinese pictograph.

We show that static or dynamic upright crowded faces expressing happiness can bias such decisions, while no effect is observed when using other techniques. In addition to offering an alternative probe for the study of unconscious cognition, these results support top-down proposals for the origins of crowding effects, thus suggesting that the information extracted from crowded stimuli is not lost in the visual system but rather not consciously accessed.

Methods

Stimuli
3.2°×3.9° grayscale emotional faces from actor students served as primes, displayed with MATLAB & the Psychophysics Toolbox (Brainard, 1997; Pelli, 1997) on a 22-in. Iiyama Vision master pro 510 monitor, frame rate of 85 Hz and resolution of 1024x768 pixels. Faces were static (pictures) or dynamic (movies). Targets were 3°×3° white Chinese pictographs presented for 150ms.

GCC
Primes were displayed 2500ms (1200ms for Figure 2.2) from fixation point. Primes were surrounded by 2.5°×2.8° flankers (3.1° center to center distance). Eye movements were recorded monocularly with the Eyelink 1000 system (SR research, Toronto, Canada) with a sampling rate of 1000 Hz and a spatial resolution above 1°.

CFS
Primes were presented through a stereoscope for 2500ms in one eye, while a stream of Mondrian appeared in the other eye at a rate of 8Hz. Target were always displayed in the suppressed eye.

Masking
Primes were presented for 33ms, surrounded by a 500ms forward mask and 50ms backward mask.

Conclusion

By developing the Gaze Contingent Crowding paradigm (GCC), we gave three independent proofs of unconscious emotional processing, for both static and dynamic peripheral faces. Noteworthy, the evaluative bias we found with GCC method could not be highlighted with others classical methods like CFS & masking, nor with inverted crowded faces. This is the first demonstration of high level unconscious priming effects arising from crowded stimuli, showing that during crowded perception, information might not be lost due to hard wired limitations (Pelli, 2008) but rather present in the system yet not accessible consciously. Further functional studies (fMRI) will allow contrasting the cerebral processing of static vs. dynamic stimuli rendered subliminal by GCC.

Figure 1 : GCC & oculomotricity

1. Experimental procedure of GCC method. After 2500ms of prime presentation, a valence task occurred unpredictably in 2/3 trials, and a visibility one in 1/3 trials. In the valence task, the subjects were asked to judge a Chinese pictograph “pleasant” or “unpleasant”. The prime was replaced by a filler as soon as the subject’s gaze diverged towards it.

2. Gaze positions during GCC: prime fixation = 1.2% total gaze time.

3. Prime stares across whole exp.

4. Prime stares across trials

Figure 2 : Experimental Results

1. Comparative bias results
Averaged % of “pleasant” responses on the Chinese pictograph, depending on the emotion expressed by angry (black), or happy faces (gray). Results are shown for masking, CFS with static and dynamic faces, GCC with static and dynamic faces, and GCC with static and dynamic emotional faces. Error bars denote one standard error. * denotes a p-value < 0.05.

2. GCC bias with base-line
Averaged % of “pleasant” responses on the Chinese pictograph, depending on the emotion (anger : black, neutral : dark gray, happiness : light gray) expressed by static or dynamic crowded face.

3. Perceptual priming results
Averaged reaction times for related (same target as the prime) and unrelated trials (target is different but expresses the same emotion as the prime), in Masking and CFS.

Figure 2.2