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Perceptual illusions in brief visual presentations

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ABSTRACT

We often feel that our perceptual experience is richer than what we can express. For instance, when flashed with a large set of letters, we feel that we can see them all, while we can report only a few. However, the nature of this subjective impression remains highly debated: while many favour a dissociation between two forms of consciousness (access vs. phenomenal consciousness), others contend that the richness of phenomenal experience is a mere illusion. Here we addressed this question with a classical partial-report paradigm now modified to include unexpected items in the unreported parts of the stimuli. We show that even in the presence of unexpected pseudo-letters, participants still felt that there were only letters. Additionally, we show that this feeling reflects an illusion whereby participants reconstruct letters using partial letter-like information. We propose that the feeling of seeing emerges from the interplay between partially accessible information and expectations.

1. Introduction

To address the difficult issue of the nature of consciousness, a conceptual advance has been proposed that distinguishes between access and phenomenal consciousness (Block, 1995, 2007). While phenomenal consciousness is meant to capture the quality of first person experience, the particular "what it is like" feeling of each experience, access consciousness relates to the global use of information, its availability for control mechanisms and verbal report. Importantly, phenomenal consciousness is assumed to precede and overflow access, reflecting a rich and detailed experience which cannot be reduced to the information we can report (Block, 2007).

This distinction between two forms of consciousness has raised a great interest among researchers, as it captures much of our intuition about conscious experience. In fact, early experimental psychologists using tachistoscopic presentations had already noted that subjects had the fleeting feeling of seeing a whole complex scene, while they were able to report only a small portion of it (e.g., Dallenbach, 1920). This phenomenon has been famously operationalized by Sperling (1960), who measured the information available in briefly flashed arrays of letters. When participants were asked to report all of the letters in an array of 12 letters (i.e., 3 rows by 4 columns), they could correctly report only between 3 and 4 of them. However, when an auditory cue was introduced at the offset of the array or shortly thereafter, instructing to report specifically one of the three rows in the array (i.e., high tone for upper row, medium tone for middle row, and low tone for lower row), participants could report nearly all 4 items in the cued row. This random sampling technique yields an estimate of the information available for a short period of time after the presentation of the array. It shows that participants have more information than the 3–4 items they can ultimately report. This is in agreement with their subjective feeling. In relation to the phenomenal/access distinction, one is tempted to identify the subjective feeling of seeing a complete array with phenomenal consciousness, while performance in partial report may be considered an index of conscious accessibility.

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However, this dissociative approach has also raised several concerns. In particular, it is difficult to reconcile with studies of change and inattentional blindness showing that observers can miss massive visual events, even in central vision (Levin & Simons, 1997; Mack & Rock, 1998; O'Regan and Noe, 2001; Rensink, O'Regan, & Clark, 1997; Simons & Levin, 1997). Therefore, alternative accounts have described the richness of our phenomenal world as a (well-founded) "illusion of seeing" (Dehaene, Changeux, Naccache, Sackur, & Sergent 2006; O'Regan and Noe, 2001). This cognitive illusion reflects viewers' over-confidence that they see the whole scene because they can at will orient attention to any location and obtain conscious information from it (Dehaene et al., 2006).

Here we propose that participants in the classical Sperling paradigm are misled by a similar type of illusion when they report experiencing a whole array of letters. We reasoned that participants can be induced to feel that they see a whole array of letters, even if one of the items in the array is not a real letter, but a letter-like symbol (Kouider et al., 2007). To test this prediction, we used a modified version of the Sperling paradigm, in which non-cued rows could now occasionally include a "pseudo-letter" (i.e., a rotated letter, see Fig. 1). Besides, although reporting letters of the cued row remained the main task, we sometimes probed participants' perception of the non-attended parts of the array, in particular for pseudo-letters, by using an additional response procedure that we termed "free subjective report" (hereafter, FSR; see Fig. 1). Importantly, we also added a backward mask to the stimulus array, to eliminate possible retinal persistence of the visual information, which is not supposed to constitute phenomenal consciousness, but rather to input the phenomenal level (Block, 2007). Because the introduction of pseudo-letters can lead participants to search for odd items, we also occasionally introduced "catch symbols" on non-cued rows. We predicted that catch symbols should be easily noticed, leading participants into expecting either letters or very different symbols. Further, we predicted that pseudo-letters would be experienced as real letters, as they carry the same low-level geometrical information, yielding to the construction of the same percept.

2. Experiment 1

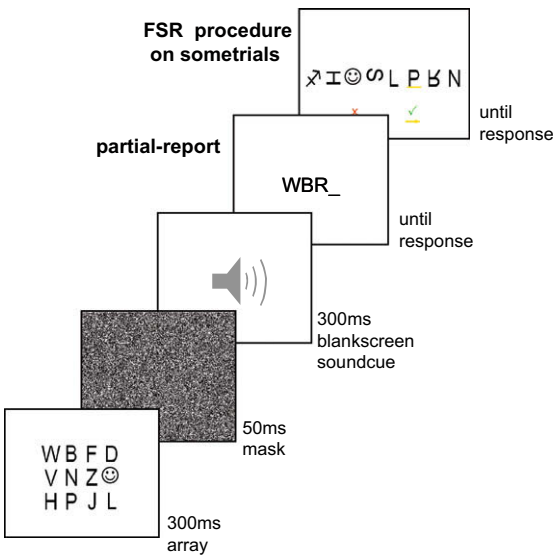
2.1. Methods

2.1.1. Participants

Participants were 24 students (age range: 18–25 years) recruited from Paris universities. They reported normal or corrected to normal vision, and were paid for their participation.

2.1.2. Stimulus

Both experiments were set up and run using the Matlab Cogent Toolbox. The stimuli appeared on a CRT 17" screen viewed at normal distance, such that the array occupied a visual angle of approximately 10°. Letters were only consonants in Arial font (X and Y were excluded). Pseudo-letters were created by randomly rotating (90°, 180° or 270°) and flipping (left-right) letters while ensuring that the result was not identical with an upright letter. For catch items we selected 19 Wingdings symbols. All visual items were coloured in 8 bits grey levels, with foreground and background colour set to 40% and 80% of maximum intensity. We wanted to use reduced contrasts to maintain task pressure on participants.



trial type / FSR	letter trials	catch trials	pseudoletter trials
Part 1: TRAINING			
no FSR	90	0	0
FSR	0	0	0
Part 2: INDUCTION			
no FSR	60	9	0
FSR	12	9	0
Part 3: TEST			
no FSR	48	9	0
FSR	12	9	12
Example	WB F D V N Z G H P J L	WB F D V N Z ☺ H P J L	WB F D V N Z S H P J L

Fig. 1. *Left*: time-course of a trial. *Right*: summary of the design in Experiment 1. Here the numbers indicate the repartition of the trials in each part, according to the stimulation (different types of trials), and to the response procedure (with or without free subjective report – FSR).