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Last but not least

The multiple-faces phenomenon: some investigative studies

We have observed a new and peculiar phenomenon involving face perception. When a familiar face measuring about 12 – 14 cm is placed in such a way that its nose coincides with the blind spot, we create the best conditions for observing a series of interpolation events, including the multiple-faces phenomenon. During observation of this phenomenon subjects can report events like a few subtle changes in the facial expressions relative to the printed face as well as events where a countless number of different faces appear in place of the original one. These faces may be recognised or not. We started by informally investigating it with twenty-five mixed-sex subjects with ages extending from 7 to 77 years. Twenty-one (ie 84%) of these subjects described the phenomenon. We then proceeded to a more formal experimental setting with twenty-five naïve subjects where we used either audio (fourteen subjects) or video (eleven subjects) recording. As we noticed that it is much easier to observe the phenomenon with a face that is very familiar to the subject, we asked each subject to provide a photograph of a familiar face (parents, brothers, sisters, etc). We digitised each photograph (generally from passport size or from a 3 cm × 4 cm photo) and enlarged to the appropriate size (to about 12 – 14 cm) in black-and-white. We used computer printouts. Our method consisted of placing a solid black circle over the nose and marking two fixation spots to either side for viewing at about 25 – 30 cm (refer to figure 1). The subject was instructed to close one of the eyes and fixate the right or left point (accordingly) and move the face printout forward or backward until the black circle on the nose disappeared. Subjects were asked to describe any changes they were seeing while maintaining steady fixation. The same procedure was used for each eye. Subjects were also told that events could be happening very fast. Subjects typically describe random disappearance of the nose, either or both eyes, mouth, hair, of either half-face, etc. Increases in the size of the eyes or the mouth are often mentioned. All those events may occur in the absence of the multiple-faces phenomenon. This phenomenon is often preceded by some noticeable emotional expression such as a smile, an exclamation, a laugh, and a reaction of surprise. The time to observe the effect varies widely from subject to subject as well as from trial to trial, and depends on whether the subject has seen the effect before or not. From our twenty-five subjects, eighteen (ie 72%) produced accounts consistent with the experience of the multiple-faces phenomenon. Encouraged by those results, we extended the sample to thirty-seven subjects (ages 14 – 36 years; thirty-three females, four males). This time we asked specifically for photos of parents (if possible, both). Subjects who brought photos of both parents were counted as one.

We developed a system of four categories to classify all thirty-seven reports registered on video: (i) disappearance/darkening/whitening of the eyes, nose, mouth, face, nasal face, temporal face, or hair; (ii) variation in size of these face parts; (iii) movement, or change in facial expression of the eyes, mouth, face, or eyebrows; (iv) perception of different characteristics or of other faces: 3-D, face upside down, the subject's own face, younger, older, seeing teeth, moustache, beard, hair changes, seeing profile, seeing other faces. The first category, which does not reveal the presence of the phenomenon is likely to be related to the Troxler fading effect (Troxler 1804, as cited by Mennemeir et al 1994) where disappearances may occur in the periphery while staring takes place.

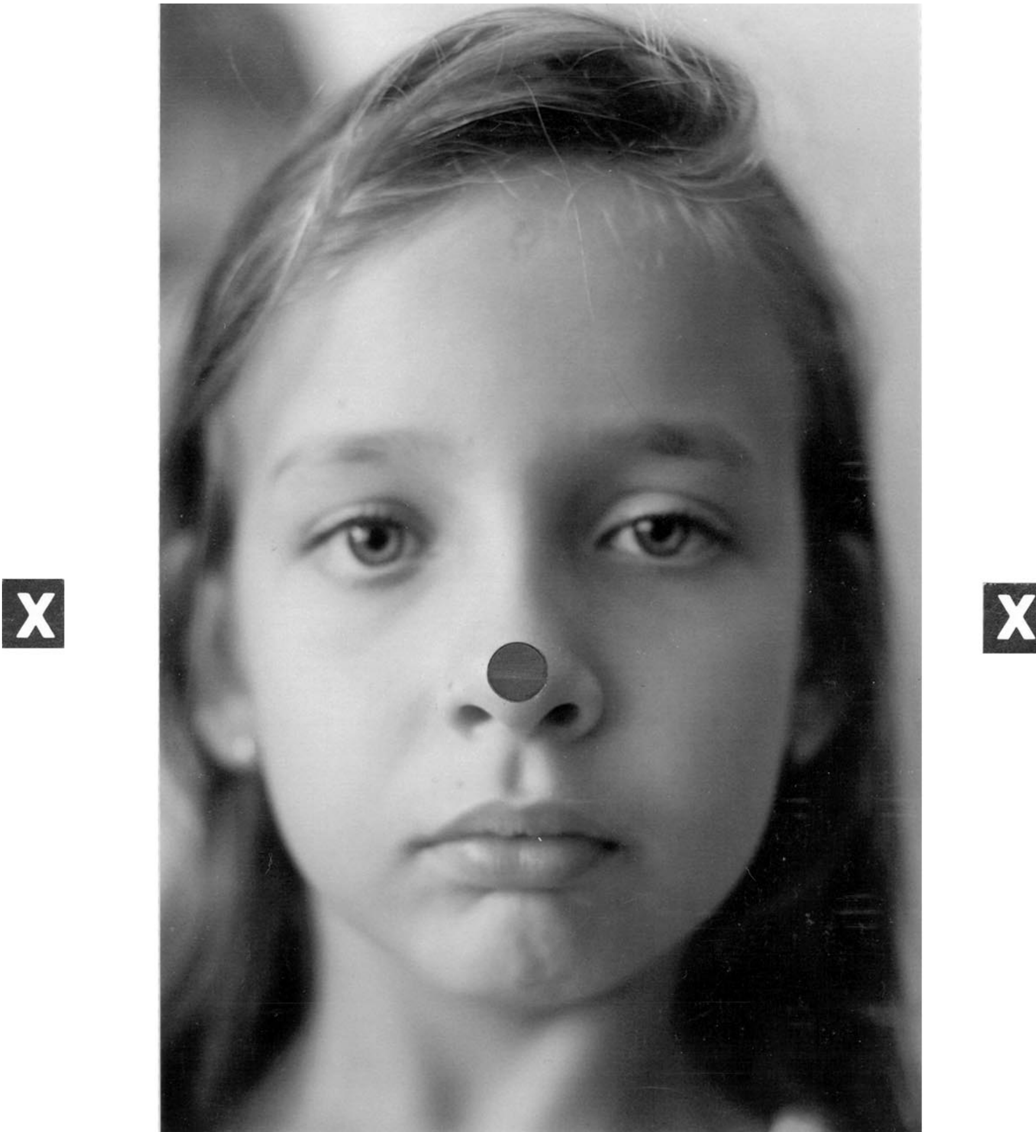

Figure 1. Example of photo to observe the phenomenon. To fit the format of the periodical it is somewhat reduced from the actual sizes we used. Although it is not so easy to observe the phenomenon with unfamiliar faces, some subjects can observe it even in these conditions. To start, the reader should close the right eye (not pressing it) and focus the left eye on the right 'X'. Then, move the picture forward or backward until the black circle on the nose disappears. When this happens, the reader should keep looking at the 'X' mark while observing what happens to the image and counting slowly to about 60 (or 150, if necessary). Try with the other eye, reversing the focused 'X'. And, finally, if the reader cannot observe the phenomenon it is worth testing with a familiar face.

We considered reports falling in categories three and/or four as perception of the multiple-faces phenomenon. The reports on video were analysed independently by six–ten observers and an overall agreement recorded. Across all subjects 84%, 60%, 87%, and 68% reported categories (i), (ii), (iii), and (iv), respectively. All effects occurred more frequently with pictures of mother ($n = 30$), 87%, 60%, 90%, and 73%, respectively, as compared to father ($n = 22$), 64%, 36%, 82%, and 41%.

We have noted several characteristics of the phenomenon. It seems to be easier to observe: (i) with highly familiar faces; (ii) when centred at the blind spot; (iii) with achromatic stimuli; (iv) with faces varying in size from 7 cm to about 14 cm; and (v) with medium-contrast levels. It often occurs in bursts, generally very fast, may encompass an emotional response, may involve a number of unrecognised faces, and generally tends to take at least 20 – 60 s to start for subjects observing it for the first time. Further, it seems to be more specific to human faces as compared to monkey faces. It can be triggered by small eye movements.

The multiple-faces phenomenon appears to be related to adaptation to a very familiar face; as adaptation occurs, other face-related stored information is displayed by visual memory (overlaying the priming face). Such mechanism initially seems to act locally, as for eyes, mouth, nose, moustache, etc [more related to our category (iii)], and later, globally, as for whole faces, hair, beard, etc [more related to our category (iv)]. We have not found in the literature studies on face adaptation, however.

We base our main hypothesis on physiological studies that identified cells responsive to faces, profile, and elements of a face in monkeys' inferotemporal cortex (for a review, see Desimone 1991). We suppose that mechanisms for detecting and identifying faces exist, and that these are primarily tuned in very early infancy to faces more frequently viewed (ie generally the mother's or first care-giver's face) and that later, as other faces are detected and stored, this mechanism builds upon previously stored most (similar?) seen faces, or opens new categorical face matrices. It is interesting to observe that male faces can be seen in female's photos and vice-versa. We are still gathering additional and more controlled data to learn more about the occurrence and characteristics of this phenomenon.

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Near the zone of totality: an eclipse observed

I was visiting Britain when a total eclipse of the sun occurred on the morning of 11 August 1999. My wife and I shunned travelling to the zone of totality in the Duchy of Cornwall, and instead observed the eclipse from the grounds of Claydon House, a stately home in Oxfordshire where the occlusion was said to be 97% complete. We anticipated that 97% totality would be a spectacular event, but it turned out to be rather disappointing as a visual experience. As a psychophysicist, I should not have been disappointed, and so this is a report of what I experienced, and why.

The sun shone brightly among a few scattered clouds in Oxfordshire, so we were able to observe its gradual occlusion until, shortly after 11 am, it became a crescent sliver in our makeshift pinhole viewer. But, at 97% totality, our surroundings were remarkably bright. Our shadows were clearly visible on the grass, which remained green. We were therefore still functioning in the suprathreshold photopic level of our visual system, rather than the rod-dominant scotopic level.

I should, of course, have expected nothing less. The luminance of the sun is some 10^{16} times greater than that of our threshold of seeing, and so 3% of that is still a very large number. Following Stevens (1955), I like to think of the dynamic range of human vision in terms of the decibel scale. On that score, the sun's luminance is 160 dB above the threshold of seeing. Reducing that to 3% reduces its luminance by a mere 15 dB [$10\log_{10}(0.03) = -15$]. The luminance of the objects in our surroundings (the product of their reflectance and the illuminance incident on them) was therefore also reduced by only 15 dB. I should not have been surprised. If the luminance of the white paper of our makeshift viewer was of the order of 10 000 cd m^{-2} in full sunlight [Le Grand (1957) provides some typical values], then its luminance would have been reduced to about 300 cd m^{-2} at maximum occlusion. At that level it would have been some 80 dB above absolute visual threshold, and perhaps 20 to 30 dB above the photopic threshold.

Still another psychophysical principle was at work—perceptual constancy. The perceived lightness or brightness of objects is only loosely coupled to the incident illuminance, a phenomenon known as lightness constancy. Putting it another way, although we are good at judging relative brightnesses, we are poor at making absolute judgments of brightness, and so a gradual 15 dB drop in luminance would have been hard to perceive in an absolute sense. No doubt, had I been asked, I should have been happy to agree that the luminance of the objects around me was somewhat less than it was half an hour earlier, but that would have been a relative judgment. As Donald Laming (1997) has shown, an analysis of the psychological process entailed in absolute judgments reveals their relative nature.

Still, it would be wrong to suppose that we observed nothing. We noticed a drop in temperature, for one thing, and a cock crowed. Evidently, the small range of bodily temperatures that are tolerable makes slight changes easily discernible.

This counterintuitive episode underscores the fact that the science of the senses is not to be equated with 'common sense'. As a recent summary by Gilchrist (1999) shows, the seemingly simple question of how we perceive the lightness of objects, although a longstanding problem in visual science, is still not entirely understood. I should have liked the lesson of this experience to be part of my lectures on visual perception, but retirement has brought its own eclipse to my teaching, and students will not benefit from my misconception.

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