# *Frequently asked questions about the composite face paradigm/effect*

***(Bruno Rossion, June 2014)***

*Note*: this reflects a personal view of the author, based on the extensive review:

**Rossion, B. (2013). The composite face illusion: a whole window into our understanding of holistic face perception. *Visual Cognition*, 21, 139-253.**

## Background

***Q: Where does the term composite face effect come from?***

A: We owe the term to Young, Hellawell and Hay (1987), who aligned the top and bottom halves of celebrities' faces (e.g., the top half of Marilyn Monroe's face with the bottom half of Margaret Thatcher's face). Participants in that study had more difficulty identifying familiar people from the top or bottom half of the composite faces when these halves were aligned rather than misaligned.

***Q: Which study introduced the matching task in the composite face paradigm?***

A: Hole (1994) compared the matching of two top halves when aligned with different bottom halves, at upright and inverted orientations.

***Q: How many studies with the composite face paradigm are there in the literature?***

A: In early 2013, there were about 70 published studies that used the composite face paradigm. This number is larger if one includes studies that used a congruency face paradigm with composite faces, following Gauthier & Bukach (2007; the so-called "full design"). However, these studies measure a general congruency/interference effect, similar to a Stroop effect; this interference can arise anywhere in the system and cannot be related to holistic processing.

***Q: Is the composite effect specific to faces?***

A: Because it involves an objective manipulation (spatial misalignment), the composite face paradigm could be applied to nonface object shapes relatively easily. Yet, the composite face paradigm leads to effects that are highly **specific**: they are not found for nonface object shapes (Gauthier et al., 1998; Macchi Cassia et al., 2009; Robbins & McKone, 2007; Taubert, 2009).

***Q: What are the neural correlates of the composite face effect?***

A: Schiltz & Rossion (2006) used fMRI with a repetition suppression paradigm to answer this question. The logic of this study was that if two identical top halves of faces are perceived as being different, they should lead to a release from adaptation as compared to two identical top halves truly perceived as identical. Indeed, they found larger fMRI activation to aligned vs. misaligned trials, in the right middle fusiform gyrus in particular. This is not a main effect of alignment (i.e., there was no difference when both the top and bottom halves were identical) and is not found for inverted faces. Schiltz et al. (2010) replicated this effect in an event-related paradigm. This does not mean that the question is resolved though, and we are far from understanding the neural mechanisms of holistic face perception.

**Numbers**

***Q: How big is a typical composite face effect?***

A: It's difficult to answer this question because the effect is usually observed either in accuracy rates, correct RTs or (often) both. It's not unusual to observe a 20% decrease in accuracy or increase in RTs in the aligned *vs*. misaligned condition.

***Q: What is the split-half reliability of the composite face effect?***

***A:*** It is rather low (e.g., split-half reliability = .65 in Zhu et al., 2010; 0.43 in Wang et al., 2012; 0.52 in Laguesse & Rossion, 2013). This is not so surprising for a behavioral measure: behavioral performance of participants tested at different times in the same test vary according to many factors that are not directly related to the perception of the stimuli.

**Parts and Wholes**

***Q: What is a part in the composite face paradigm?***

A: The definition of a part is "a subset of a whole face". In the composite face paradigm, a part is the top or bottom half of a face.

***Q: Why include a small gap between face halves?***

A: If there is no gap in the aligned condition, how do subjects know what is meant by matching 'the top half' of a face? Subjects may consider that the top half includes the whole nose and may attempt to match two top halves that contain some information that *is* physically different (e.g., the lower part of the nose). The paradigm may thus lead to 'different' responses for same aligned trials, even in the absence of perceptual integration. Therefore, without using a gap, the composite face effect could be artificially increased because the two parts are segmented in the misaligned condition, and not segmented in the aligned condition (i.e., a methodological confound).

***Q: Why a gap instead of a colored line?***

A: A line that differs from the background is an occluder and may draw the eyes away from fixation and toward the bottom face half

***Q: Why not define a top part by the "eye region"?***

*A: This is ambiguous: where does the "eye region" ends? Does it include the eyebrows?*

***Q: What size should be gap be?***

*A: Visible and then as small as possible. There are no studies that have investigated the effect of gap size by parametrically increasing it. And to date, no studies has compared the effect of having a gap or not on the magnitude of the composite effect (we presented something on this at the VSS meeting 2014, paper in prepration).*

***Q: Is the presence of a gap detrimental for holistic face perception?***

A: Although, ideally, one would like to keep the face intact, a small gap between face halves is important (see above). Bigger effects might be found when there is no gap between the two halves, but this is because the effect could be artificially inflated without a gap (see above). In fact, the *absence* of a gap might play a negative role for perceptual integration because the visual system tends to enclose a line or a space by completing a contour and ignoring such gaps in a figure (the Gestaltist law of *closure)*. If there is no gap, the continuous border,

defined by a small variation of luminance and texture gradient, is enhanced. Hence, the face may appear as a more integrated and plausible combination of top and bottom halves when there is a gap: this is the *paradoxical gap composite face illusion* (see Figure 31 of Rossion, 2013).

***Q: Does 'holistic' mean 'global'?***

A: Holistic or configural face perception should not be confounded with the processing of a visual stimulus at a global scale. "Holistic" refers to a process by which the parts of the face are integrated, glued together, into a single representation, without part structure. This process can be applied locally (for instance if the two eyes are presented in isolation). The term "holistic" also refers to a mode of representation.

***Q: How early in time are facial halves integrated into a holistic individual representation?***

A: According to the holistic view, the face is *never* decomposed into parts! Or, it does not *have* to be decomposed into parts. Tanaka and Farah (1993) define a holistic face representation as a *representation without part structure*. What this means is that at a high level of representation, the face is only represented as a whole, not as separate parts. We have provided evidence for this view, showing that as early as *face-selective* responses emerge in the system (i.e., N170 ERP component), the response to a part is not independent of another part (Jacques & Rossion, 2009).

**Paradigm: Standard composite vs. congruency**

***Q: Why is the standard composite face paradigm sometimes referred to as a "partial" design?***

A: Gauthier & Bukach (2007) characterized the composite face paradigm as being "partial", a terminology that Gauthier, Richler and colleagues have consistently used in their studies. This labeling of the composite face paradigm as "partial" is not only incorrect but is misleading (no one would want to use a "partial" design!). It refers to the notion that in a "full" or "complete" paradigm,

there would be a condition in which the unattended bottom face halves are identical but the top halves are the same. Such a condition is unnecessary, being based on an understanding of congruency/interference, not holistic perception (see the question below). In reality, the standard composite face paradigm can be considered as a complete paradigm with aligned and misaligned composite conditions already. And if you want you may have a baseline by using 'same' trials in which both parts are identical between the faces to match (e.g., Jiang et al., 2011). Adding unnecessary conditions to this paradigm would just makes it overextended (or "fool" rather than "full" ☺).

***Q: Is the composite face paradigm a congruency/interference paradigm?***

A: No, no, and no! ☺ If you see it this way, you misunderstand the paradigm entirely. The composite face paradigm is not a congruency/interference paradigm, it is inspired by phenomenology: it is a powerful visual illusion. A congruency paradigm measures congruency (or interference) between two dimensions, such as the font color of a word and the written label. Gauthier & Bukach (2007) replaced the two dimensions of the Stroop task by the top and bottom halves of a face in their "full" design. The problem is that such interference can occur at any stage of the system, and is generally attributed to an attentional or decisional response conflict. Congruency/interference paradigms have been used in Experimental Psychology since Stroop (1935) to measure attentional/decisional response conflicts. A Stroop effect is never interpreted in terms of holistic processing (between the label and the color !). In short, Gauthier & Bukach (2007) introduced attentional and response conflict biases in their design with faces. In subsequent publications, these authors claimed that "holistic processing" is attentional/decisional rather than being perceptual. It seems circular.

***Q: Should I use a "full" design or a "partial" design to measure the composite face effect?***

A: There is no such thing as a "partial" design and a "full" design. There is a standard **composite face design**, as originally developed by Young et al. (1987) and Hole (1994), and there is a **congruency face design**, as developed by Gauthier & Bukach (2007) and used essentially by Gauthier, Richler and

colleagues.

**Standard Paradigm: Continued**

***Q: Why use misalignment as a control?***

A: Misaligning the top and bottom halves of a face breaks the Gestalt law of *continuity* by introducing an edge, or a non-accidental property. Thus, spatial misalignment corresponds to a *physical separation* of the whole face into parts. Moreover, spatial misalignment in the composite face paradigm prevents the visual system from completing the contour of the face (the Gestaltist law of *closure*). It is an excellent control manipulation.

***Q: How big should the misalignment be between the top and bottom halves?***

A: Even a minimal alignment of 8% of face width is sufficient: misaligning the two halves further does not increase performance further relative to aligned faces (Laguesse & Rossion, 2013).

***Q: Why do we match the top halves and not the bottom halves in the composite face paradigm?***

A: There is no composite face illusion for bottom halves: identical bottom halves aligned with different top halves do not look different (Rossion, 2013, Figure 29). This may be because, under natural (unforced) circumstances, the location of the optimal fixation for face recognition is central, slightly below the eyes. This fixation is associated with the 'center of mass' of the face, and holistic face perception (Orban de Xivry, et al., 2008). Consequently, forcing an observer to fixate on the bottom half of the face may reduce holistic face perception. Moreover, the top half of the face contains more elements (two eyes, eyebrows, …) than the bottom half, which contains mainly the mouth as a salient part. Therefore, the diagnosticity of the top half might be more *dependent* on the integrity of holistic perception, that is, the ability to see the many elements of a face as an integrated representation.

***Q: Is there a response bias in the composite face paradigm?***

A: In the critical condition (aligned composite trials), the top halves of faces are

perceived as slightly different despite being identical. Hence, the proportion of 'different' responses will be higher than expected in this condition (and in the whole experiment). This response bias is *exactly* what experimenters aim for in this same/different composite face paradigm: people's perception is fooled and it leads them to increase artificially their proportion of 'different' trials. However, critically, this response bias is expected only in the aligned condition, not the misaligned condition. Such a response bias simply reflects how the face is erroneously perceived and drives an incorrect behavioral response … it should not be interpreted as a methodological problem in the paradigm, or evidence for a locus of the effect at the response level.

***Q: Which proportion of 'different' trials should there be in the task?***

A: It depends on the time you (or your participants) have… with the standard composite face paradigm, you can use 50% 'different' trials. But you can use a lower proportion, as long as you use the same amount for aligned and misaligned trials.

**Types of Face Stimuli**

***Q: Why use greyscale faces when measuring the composite effect?***

A: The CFE is based on shape information, primarily. Surface properties such as color and texture do not play a big role in the effect. The presence of color might even reduce the behavioral composite face effect by helping participants to match the identical top halves despite other differences in perception. We are currently testing this hypothesis. See Jiang et al., 2011.

***Q: How should I make my composite face stimuli***

*A: Just use ours ! available here: http://face-categorization-lab.webnode.com/resources/ To date we have "only" 30 pairs of composite face stimuli, explanation about how they were done, and an experiment ready to be run. They exist only for Caucasian faces at the moment, but we are working on a set of Asian faces. Otherwise, we also indicated instructions on how these stimuli were made (by Talia Retter).*

***Q: Why is the composite face effect present for contrast-reversed faces?***

A: Contrast-reversed faces, in which surface cues are no longer diagnostic, do not lead to a significant reduction of the composite face effect (Hole et al., 1999; Taubert & Alais, 2011). This could be because the effect is driven essentially by shape-based cues, not surface-based cues (see Jiang et al., 2011). Yet, a careful look at the data suggests that with more power, there should be a significant decrease of the effect for contrast-reversed faces (Figure 2 of Taubert & Alais, 2011). More work is needed on this!

***Q: Is the composite face effect specific to "own race" faces?***

A: It's not specific to own-race faces, but it is larger for own-race than other-race faces (Michel et al., 2006; also Michel et al., 2007) with Caucasian participants tested only). But another study has not found that difference (Mondloch et al., 2010). More work is needed on this too!

**Analysis**

***Q: Why should 'different' trials not be used in the computation of the effect?***

A: There is no composite face illusion on 'different' trials: two top halves do not look identical (or more similar) to each other when they are aligned than when they are misaligned with identical bottom halves. Consequently, there is no point in searching for a 'composite face effect' on different trials. If there is a small effect (of alignment) on such trials, it is very difficult to interpret and may well reflect part-based processing.

***Q: But what if I get a small composite effect on 'different' trials? What should I do with it?***

A: You can't get a composite effect on misaligned trials because the composite effect makes sense only for 'same' trials. If you use the standard composite face paradigm, and get a small alignment effect on 'different' trials, you should never interpret that in terms of holistic processing.

***Q: Should Signal Detection Theory be used to analyze the composite face***

***paradigm?***

A: No need to do it. You can do it by using the 'different' trials in which both parts differ between the faces to match (correct response = 'different'), and using the 'same top/bottom different' trials (correct response = 'same'). But there is no gain in doing this compared to an analysis of accuracy rates. SDT is not useful in this context. Moreover, the composite face effect is often expressed in terms of correct response times.

**Attention and Decision**

***Q:* Can object-based attention account for the composite face effect*?***

A: It's a difficult issue. Since ignoring a distractor located in a different object than a target is easier than if both are embedded in the same object (e.g., Kramer & Jacobson, 1991), one could argue that (covert) attention is reduced for the misaligned bottom half as compared to the aligned bottom half. More generally, because perceptual organization constrains attentional selectivity (e.g., Chen, 2012; Kimchi, 2009; Kramer & Jacobson, 1991), it may be argued that the standard composite effect is due to a difference in (object-based) attention between aligned and misaligned trials. However, a putative difference in attention between aligned and misaligned faces does not necessarily mean that object-based attention *accounts* for the composite effect. Rather, in this situation at least, it is likely that perceptual integration (grouping) takes place *before* any attentional process, and could influence the *subsequent* allocation of attention (see Kimchi, 2009).

Moreover, there are a number of observations that seems incompatible with an account of the standard composite face effect in terms of object-based attention. First, object-based attention theories would predict a substantial reduction of the composite face effect when a horizontal gap is included between the two parts, yet the effect is very large with such a gap. Second, an object-based attention account is difficult to reconcile with larger composite effects for faces differing in shape rather than surface cues (Jiang et al., 2011), because in both cases the difference between aligned and misaligned trials, in terms of physical separation, is the same. Third, inversion offers an important additional control to misalignment because the stimulus remains a whole object.

Yet, the composite illusion/effect disappears or is largely reduced for inverted faces. Finally, the locus of the composite face effect in face-sensitive visual areas and on early visual ERPs with (Jacques & Rossion, 2009; Schiltz et al., 2010) or without (Kuefner et al., 2010; Schiltz & Rossion, 2006) concurrent behavioral responses, supports a perceptual locus of the effect independently or before any implication of putative attentional processes.

***Q: Does holistic processing have a decisional locus?***

A: This question does not make sense in the first place. It only emerged in the literature because of the use of a paradigm with composite faces that is inspired from the Stroop design: the congruency face design of Gauthier & Bukach (2007). In doing this, these authors introduced a response conflict bias in their design, and in subsequent studies they identified response conflict effects (Richler et al., 2008). Rather than questioning the validity of their paradigm, these authors claimed that "holistic processing is decisional". This is a good example of circularity.

***Q: Does holistic processing have an attentional locus?***

A: See the answer above about object-based attention

**Face Recognition and Prosopagnosia**

***Q: Does the composite face effect correlate with face recognition?***

A: Sometimes it does, and sometimes it does not. Wang et al. (2012) reported a weak correlation (r=0.13), suggesting that holistic perception (and face recognition performance) cannot be captured in a single measure, and that many factors contribute to the behavioral performance in this task. Another study (Avidan et al., 2011) took advantage of the increased variance between individuals with poor face recognition ability and found that the composite effect, in RTs, correlates (r=0.61-0.72) with the abnormality of performance on diagnostic face processing tasks (but see de Heering & Maurer, 2012).

***Q: Should the composite face effect correlate with face recognition performance?***

A: Not necessarily. It may well be that holistic perception is a ***necessary*** entry step for processing faces efficiently, a process which may vary very little across individuals and is certainly **not sufficient** for face recognition.

***Q: How is the composite face effect in patients with acquired prosopagnosia?***

A: It is either absent or decreased. Of course, normal controls may not show the effect in a single composite face test, so you need to show absence of the effect repeatedly in a single case of acquired prosopagnosia (see Ramon et al., 2010; also Busigny et al., 2010).

Send your questions about this phenomenon and paradigm to:

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Papers of the lab, cited in red font, are available at:

http://face-categorization-lab.webnode.com/publications/