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Dynamic composite faces are processed holistically

Simone Favelle [a,*], Alanna Tobin [a], Daniel Piepers [b], Darren Burke [c], Rachel A. Robbins [b]

[a] School of Psychology, University of Wollongong, Australia
[b] School of Social Sciences and Psychology, University of Western Sydney, Australia
[c] School of Psychology, University of Newcastle, Australia

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ABSTRACT

Holistic processing is considered one of the hallmarks of face recognition. Recent studies using the composite task claim to show a lack of holistic processing for dynamic faces, however they only presented moving faces in the learning phase and tested with static composite images. So while previous research has addressed the question of whether moving faces influence the processing of subsequently viewed static faces, the question of whether moving faces are processed holistically remains unanswered. We address that question here. In our study participants learned faces in motion and were tested on moving composite faces, or learned static faces and were tested on static composite faces. We found a clear composite effect for both upright static and dynamic faces, with no significant difference in the magnitude of those effects. Further, there was no evidence of composite or motion effects in inverted conditions, ruling out low level or other motion signal properties as explanations of performance in upright faces. Together, these results show that upright moving faces are processed holistically, in a similar manner to static faces, extending decades of research with static faces and confirming the importance of holistic processing to familiar face recognition.

1. Introduction

Faces, as we encounter them in the real world, are typically seen in motion. As such, there is an obvious ecological validity to studying faces in motion. Although much research has investigated the utility of motion for face recognition (e.g., O'Toole, Roark, & Abdi, 2002; Roark et al., 2003; Xiao et al., 2014), little has investigated how motion influences the *way* in which faces are processed. Further, the little research there is has led to inconsistent results.

Although there is often disagreement on exactly what holistic processing is, and whether it can only be applied to faces, there is general agreement that holistic processing is fundamental to face recognition (see Piepers & Robbins, 2012). Holistic processing is defined here as the perceptual integration of information across the whole face. The most common direct measure of holistic processing is the composite face effect, in which recognition of a target face half is much harder when it is aligned with a complementary face half than when the halves are misaligned. The new "identity" created when two face halves are aligned is processed holistically, making it difficult to attend to and identify the target face half while ignoring the other half (see Rossion, 2013, for review). However the vast majority of studies examining holistic face processing have only tested static faces, whereas real faces move. Facial motion may be rigid, involving changes in orientation to the head, or elastic, involving non-rigid transformation of muscles as occurs during speech and expressions. Recently, Xiao et al. (2012, 2013) published two studies employing the composite task, which they claim show that holistic processing is absent or significantly reduced for rigid and non-rigid moving faces. If true, this would require a fundamental re-think of face perception. However we argue that while these studies may answer the question of how motion in a previously seen face influences recognition in a static image, they leave open the question of whether information across moving faces is integrated in a holistic fashion. In this paper we directly address this issue by testing whether faces in motion are susceptible to the composite illusion to a similar degree to static faces.

In both of their studies, Xiao et al. (2012, 2013) had participants learn whole faces in motion or in "multi-static" conditions but tested recognition accuracy of the target face half with *static* composite images using a front view. Xiao et al. (2012) used rigid motion in the familiarisation phase, comparing a head turn (coherent motion rotating from profile to profile) with a multi-static condition in which the same static image frames were presented in randomised order, thus providing only incoherent

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* Corresponding author at: School of Psychology, University of Wollongong, Northfields Ave, Wollongong 2522, NSW, Australia.

E-mail address: simone_favelle@uow.edu.au (S. Favelle).

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motion (Experiment 1) or a multi-static condition in which the same images were presented in sequence with large intervals between images to prevent apparent motion (Experiments 2 and 3). Results showed a significant composite effect when target faces were learned in the multi-static condition, but none when learned with rigid motion, suggesting that rigid motion somehow disrupted the ability to process subsequently seen test faces holistically, whereas presenting the same images without coherent motion did not interfere with holistic processing. Xiao et al. (2012) argued that rigid motion provides stable viewing conditions that allow attention to parts, however the typical composite task shows a stable single static image (or a pair of static images), and this is where holistic processing is typically found. In a subsequent study, Xiao et al. (2013) compared the composite effect when faces were learned in elastic motion (a front view face chewing and blinking) with a multi-static condition (in which six frames from the motion sequence were presented in random order, similar to the multi-static condition in their previous study, but confusingly called "static" in this paper). Xiao et al. (2013), unlike Xiao et al. (2012), found a significant composite face effect when faces were learned in elastic motion, although it was smaller than the multi-static condition.

Despite finding an alignment effect for faces learned in elastic motion conditions, Xiao et al. (2013) concluded that these two studies together show that motion enhances part-based processing and that "natural face processing may not be done primarily in a holistic manner" (p. 9). However, an alternative explanation may be that the composite effect requires stability or similarity of the presentation and viewing conditions from learning to test (Richler, Bukach, & Gauthier, 2009; Richler et al., 2008; Rossion, 2013). One way that study and test faces may differ is in their alignment (e.g., aligned or whole faces are studied and misaligned faces are tested). Explanations of results become complicated when alignment conditions differ at study and test since they cannot be argued to have arisen solely from part-based processing on misaligned trials (because the face is seen in the first instance as whole and unaltered). Another way that study and test faces may differ is in their motion (e.g., moving faces are studied and static faces are tested). When motion differs from study to test, results may be a product of mismatching cues. Regardless of whether static and moving faces are both processed holistically, it remains that case that there are different perceptual cues and processes (e.g., changes in shape and speed of elements over time) available in each format. It may be more difficult to complete the composite task based on holistic perception when certain information available at study is no longer available at test. To compensate for this dissimilarity participants may adopt a diagnostic feature-based strategy or attend to a smaller region of the face, thus reducing the size of the composite effect. When study and test faces are in the same format, all information remains and switching strategies is unnecessary.

The results of Xiao et al. (2012, 2013) relate to how faces seen in motion might be subsequently recognised in a photograph. While this is a research problem with potential implications for security (e.g., matching real faces to passport photographs), the question of whether faces in motion are processed holistically remains unanswered. Until now, the composite identity effect has not been tested with dynamic face stimuli. A fundamental issue is whether two moving, aligned halves will be perceived as a novel whole face. There is some evidence to support this idea. Chiller-Glaus et al. (2011) show composite effects for some dynamic facial expressions. Note, though, that expression composites comprise two halves of the *same* identity with different expressions. Steede and Hole (2006) showed that while half faces primed famous face recognition, neither static nor dynamic (artificially animated) composite faces did. This result suggests that both static and dynamic composites were processed holistically as new whole faces (making identification of the target half for priming more difficult). More generally, the composite illusion is quite robust to image distortions. It has been shown that it is the spatial contiguity of the face halves that is essential for forming a whole face percept (Rossion, 2013; de Heering, Wallis, & Maurer, 2012) so it is expected that the aligning of dynamic face halves from two different identities will induce the illusion of a "new" composite face.

There is also indirect evidence for the holistic processing of moving faces using the inversion task. Studies have shown equivalent sized inversion effects when identifying famous faces in dynamic compared to static images (Knight & Johnston, 1997; Lander, Christie, & Bruce, 1999), suggesting similar levels of holistic processing. More recently, Thornton, Mullins, and Banahan (2011) found larger inversion effects in a gender categorisation task for dynamic faces compared to static faces (and no inversion effects for bodies) suggesting potentially enhanced holistic processing in dynamic faces (since gender judgements require holistic processing; Zhao & Hayward, 2010).

In the current experiment, we used a naming composite task to measure recognition of face halves learned and tested as dynamic stimuli or learned and tested as static stimuli. That is, participants learned to name dynamic (elastic motion) face halves and, crucially, were tested on recognition of target halves in a dynamic composite. As such, the target face half information available at learning and at test is equivalent. We compared performance on dynamic faces at learning and test with static faces and included an inversion manipulation to control for any effects of the task procedure and low-level properties (e.g., contrast, motion signals). Note that using a naming version of the composite task (see Carey & Diamond, 1994; McKone, 2008) has the advantage of avoiding the "standard" vs "complete" design issue (see Rossion, 2013 and Richler & Gauthier, 2013).

We expect to replicate the robust composite effect for upright static face stimuli and find no evidence of alignment effects for inverted static faces. If faces in motion are also processed holistically then we should find the same pattern for dynamic face stimuli. If integration does not occur across two moving face halves, that is, dynamic faces are not processed holistically, then we should expect to find either: (i) no alignment differences for upright dynamic stimuli, or (ii) equivalent composite effects for both upright and inverted dynamic stimuli (suggesting that the motion signal alone is sufficient to complete the task).

2. Method

2.1. Participants

Thirty-two undergraduate students (nine male) from the University of Wollongong participated in the experiment. Sample size was comparable with that of similar studies. The age range of participants was 18–45 years ($M = 22.0$ years). All participants gave informed consent. Research was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) and research protocol approved by the University of Wollongong Human Research Ethics Committee (reference HE13/267).

2.2. Design

All manipulations were within subjects. That is, each person participated in 2 (motion: static and dynamic) × 2 (alignment: aligned and misaligned) × 2 (orientation: upright and inverted) conditions. The experiment comprised four blocks, one for each condition: upright static, upright dynamic, inverted static, and inverted dynamic. Aligned and misaligned trials were intermixed within each block. The order of the blocks was pseudo-randomised across participants, with the condition that the first block was counterbalanced across conditions and subsequent blocks presented in random order.[1] In each block participants learned to name the top half of six individuals in each of the static and dynamic conditions. Because participants were pre-trained to name the faces, repetition of targets was not an issue and the same targets were used in each block. Each of the six target individuals was then shown with 1 of 10 different bottom-half individuals in aligned and misaligned versions and in upright and inverted orientations. The task was to name the top half of a face (alone in the learning phase or in a composite at test) with a key press, with both accuracy (proportion correct) and response time (RT) recorded as the dependent measures.

2.3. Materials

The stimuli were created from faces taken from the Amsterdam Dynamic Facial Expression Set (ADFES; Van der Schalk et al., 2011). Six male faces were selected displaying expressions of joy. Joy was used as it is rarely confused with other expressions and recognition accuracy is consistently high (Palermo & Coltheart, 2004; Tracy & Robins, 2008). Importantly for the composite task, expressions of joy involve both the top and bottom half of the face (Duchenne, 1990; Ekman, 1992). The low confusability and global nature of the motion made it likely that the dynamic face would be processed as a whole. Note that while previous studies have used motion not associated with emotion (e.g., blinking and chewing; Xiao et al., 2013), the use of a facial expression as motion in the current study should not present an issue. Expression was held constant across stimuli, was congruent in the top and bottom halves and was irrelevant to the task; successful performance in the composite task required face identity to be processed.

Faces were isolated with an oval surround so that most of the hair, neck and background was masked with solid black colour (see Fig. 1). Dynamic stimuli were movie sequences starting with the onset of the expression, and then the face held at apex (i.e. displaying a smile) for a total movie length of 5 s (see Supplemental Material). The frame rate was 24 frames per second. Static stimuli were created by taking a single frame from the movie of the peak expression. Faces were divided with a horizontal cut across the bridge of the nose. Composites were made by combining each of the six individual top half faces with each of ten different bottom half faces and aligning the middle of the nose (see Fig. 1 and Supplemental material for dynamic composites). If necessary, bottom half faces were adjusted in size to match the external contours of the top half face.

Misaligned composites were created by offsetting the halves in aligned composites by approximately half a face width. The top half was shifted to the left for 50% of the stimuli, and to the right for the other 50% of the stimuli, and presented in the centre of the screen (i.e., so that neither the top nor bottom half was presented in the centre of the screen). In total, there were sixty identity composites for each condition – static and dynamic, aligned and misaligned – for a total of 240 composite stimuli. Inverted composites were created by rotating each of the 240 aligned and misaligned composites 180°.

At the 85 cm viewing distance, top half face stimuli (hairline to midline) in the training phase subtended approximately 4.7° of visual angle when presented individually and approximately 3.0° of visual angle when presented as part of an array. Aligned composites (hairline to chin) subtended approximately 8.9° of visual angle. The stimuli were presented in full colour on a 48 cm flat-screen monitor with a resolution of 1024 × 768 pixels. The experiment was run on a Macintosh G5 computer with Psyscope experimental software Version X B57 (Cohen et al., 1993; http://psy.ck.sissa.it/) controlling the trial sequence.

2.4. Procedure

Each participant provided written informed consent prior to the start of the experiment. The procedure closely followed that of McKone (2008). Each of the four blocks (e.g., upright dynamic) contained a training phase, with two parts, followed by a test phase. The presentation format of each face in the training and test phase of a block was the same, that is, static upright, dynamic upright, static inverted or dynamic inverted. Participants learned the names of the six target individuals (Bob, Dave, Ken, Nick, Max, Tim), shown as top halves only, and made responses by pressing the numbers 1–6 on the keyboard, each associated with a name (e.g., 1. Ken, 2. Bob, 3. Tim, 4. Dave, 5. Nick, 6. Max). There were two different label orders used and these were counterbalanced across participants.

For the initial familiarisation, within each block, all six targets were shown in an array (i.e., simultaneously) without names for 60 s. (Note that wherever stimulus presentations times exceeded 5 s, dynamic face videos were looped.) This was followed by the presentation of each target alone with the name underneath for 3 s each, during which subjects studied the face and read the name aloud. Presentation order was randomised and each target was presented three times. Finally, all six targets were presented simultaneously with names below for 30 s. The second part of the training phase followed, including feedback. There were four sets of 24 trials (4 presentations × 6 targets) in which the target top halves were presented individually in random order until participants indicated the name of the face via a key press. The names and associated numbers were displayed on screen below the face stimuli. The computer beeped if an incorrect response was made and the correct name was displayed for 500 ms, regardless of response accuracy. The inter-trial interval was 200 ms. Participants were given self-timed breaks between sets. During the training phase, the experimenter monitored participants' accuracy and apparent confidence. All participants attained reliable performance (no more than one error in the final set of feedback training trials) in the training phase. In order to reach this level of accuracy, most participants required one or two repeats of the training phase in their first block. No participant required a repeat of the training phase in any subsequent blocks.

The test phase in each block consisted of 120 trials in the relevant orientation and motion (60 aligned composites and the 60 misaligned composites) presented in random order. Self-timed breaks were provided after 40 and 80 trials. On each trial, participants were required to name the top half of the composite as quickly but also as accurately as possible. The composite stayed on the screen with the names displayed below until a response was made. The position of the composite was jittered vertically (± approximately 0.4° or 0.7° of visual angle above/below the centre of the screen) to prevent participants locking spatial attention on the target half. No feedback was given. The inter-trial interval was 800 ms.

3. Results

Accuracy (proportion correct trials) and RT for correct trials were the dependent variables in this experiment. Because trials did not "time out", the RT data were Winsorized such that

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[1] Note that complete counterbalancing of block order and label order (see Section 2.4) would have resulted in 48 combinations.

Fig. 1. Example of an aligned and a misaligned static composite face. See Supplemental material for examples of dynamic composites.

participant outliers in each condition beyond the 95th percentile were replaced with the value for the 95th percentile (resulting in 5 cell values in total being replaced). While accuracy was very high (greater than 95% across all conditions), and the same pattern of results was found with raw RT for correct trials, we calculated inverse efficiency (RT for correct trials/accuracy) for each participant for each condition (see Rossion, 2013) to account for any possibilities of speed-accuracy trade-offs. The inverse efficiency for naming the top half of composite faces can be seen in Fig. 2 (see Appendix A for raw accuracy and RT data).

Evidence for holistic processing is provided by a composite effect where performance on aligned trials is significantly worse than on misaligned trials (for inverse efficiency, larger is worse). The inverse efficiency data was analysed using a 2 (orientation: upright and inverted) × 2 (motion: static and dynamic) × 2 (alignment: aligned and misaligned) repeated measures ANOVA. Results showed a significant main effect of alignment, $F(1,31) = 6.70$, $p = .02$, $\eta_p^2 = .18$, ($M_{aligned} = 1756.94$ ms, $SD_{aligned} = 377.97$ ms; $M_{misaligned} = 1690.67$ ms, $SD_{misaligned} = 405.31$ ms) which was qualified by a significant interaction between orientation and alignment, $F(1,31) = 6.55$, $p = .02$, $\eta_p^2 = .17$. No other main effects or interactions reached the level of significance (all $F < 1.10$, $p > .30$).[2] Based on the significant orientation × alignment interaction, the inverse efficiency data was then analysed using 2 (motion: static and dynamic) × 2 (alignment: aligned and misaligned) repeated measures ANOVAs for the upright and inverted conditions. These were followed by two paired samples *t*-tests comparing performance in aligned versus misaligned conditions for static and dynamic composites.

For upright faces there was a significant and strong main effect of alignment, $F(1,31) = 21.16$, $p < .001$, $\eta_p^2 = .41$, indicating a clear composite effect for upright faces, regardless of motion ($M_{aligned} = 1843.72$ ms, $SD_{aligned} = 553.18$ ms; $M_{misaligned} = 1695.76$ ms, $SD_{misaligned} = 536.81$ ms). Performance was overall similar for static ($M = 1764.33$ ms, $SD = 827.08$ ms) and dynamic trials ($M = 1775.16$ ms, $SD = 712.35$ ms) as shown by the absence of a main effect of motion, $F(1,31) = 0.003$, $p = .96$, $\eta_p^2 < .001$. Finally, there was no interaction between alignment and motion, $F(1,31) = 0.73$, $p = .40$, $\eta_p^2 = .02$ indicating that the size of the composite effect was similar in size for static and dynamic trials. Despite there being no significant interaction between alignment and motion, to confirm that the composite effect was significant for both static and dynamic composites we conducted paired samples *t*-tests for each; static $t(31) = 3.80$, $p = .001$, $d = 0.67$, and dynamic $t(31) = 3.16$, $p = .006$, $d = 0.56$.

For inverted faces there was no evidence of composite effects (see Fig. 2, bottom panel). There were no significant main effects of alignment, $F(1,31) = 0.10$, $p = .76$, $\eta_p^2 = .003$ ($M_{aligned} = 1670.16$ ms, $SD_{aligned} = 405.07$ ms; $M_{misaligned} = 1685.57$ ms, $SD_{misaligned} = 548.33$ ms), or of motion, $F(1,31) = 0.75$, $p = .39$, $\eta_p^2 = .03$ ($M_{static} = 1764.81$ ms, $SD_{static} = 788.15$ ms; $M_{dynamic} = 1590.92$ ms, $SD_{dynamic} = 480.95$ ms) and no interaction between alignment and motion, $F(1,31) = 0.45$, $p = .51$, $\eta_p^2 = .014$. Paired samples *t*-tests also showed no evidence of composite effects for either static $t(31) = -0.51$, $p = .62$, $d = -0.09$ or for dynamic $t(31) = 0.71$, $p = .49$, $d = 0.12$ composites.

4. Discussion

In this study, we examined the effect of elastic facial motion on the holistic processing of learned dynamic faces, directly addressing the question of whether moving faces are processed holistically. In a composite face naming task, participants showed significantly greater efficiency in naming the top half of misaligned composites of learned faces compared to aligned composites only when faces were upright; that is, holistic processing of upright but not inverted faces. Critically, these composite effects (or lack of them) did not differ significantly for static and dynamic faces. Thus, we show that not only are dynamic faces processed holistically, but to a similar degree as static faces.

Our results that faces are holistically processed when moving at both learning and test are in line with other studies using moving composites (Chiller-Glaus et al., 2011; Steede & Hole, 2006). Further, we confirmed that the composite effects were specific to upright faces. In showing that there are no composite effects for dynamic inverted faces, we rule out the possibility that the global motion pattern of a happy expression across the face stimulus *per se* might lead to alignment effects (see McKone et al., 2013 and Rossion, 2013 for discussions of the role of attention in the composite task).

The fact that faces in the current study were displaying a joyful emotion should not affect generalizability of the results to faces with other types of motion. Since expression was held constant across faces, was always congruent and visible in top and bottom halves, and irrelevant to the identity task, we do not believe that facial emotion would contribute to holistic processing of identity. In any case, there is evidence that identity and expression are processed relatively independently (see Calder & Young, 2005 for a

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[2] While having no main effect of orientation may appear to be unusual, note that participants were trained to name inverted faces as well as upright faces. Further, there was an interaction with alignment showing large alignment differences for upright but not inverted faces.

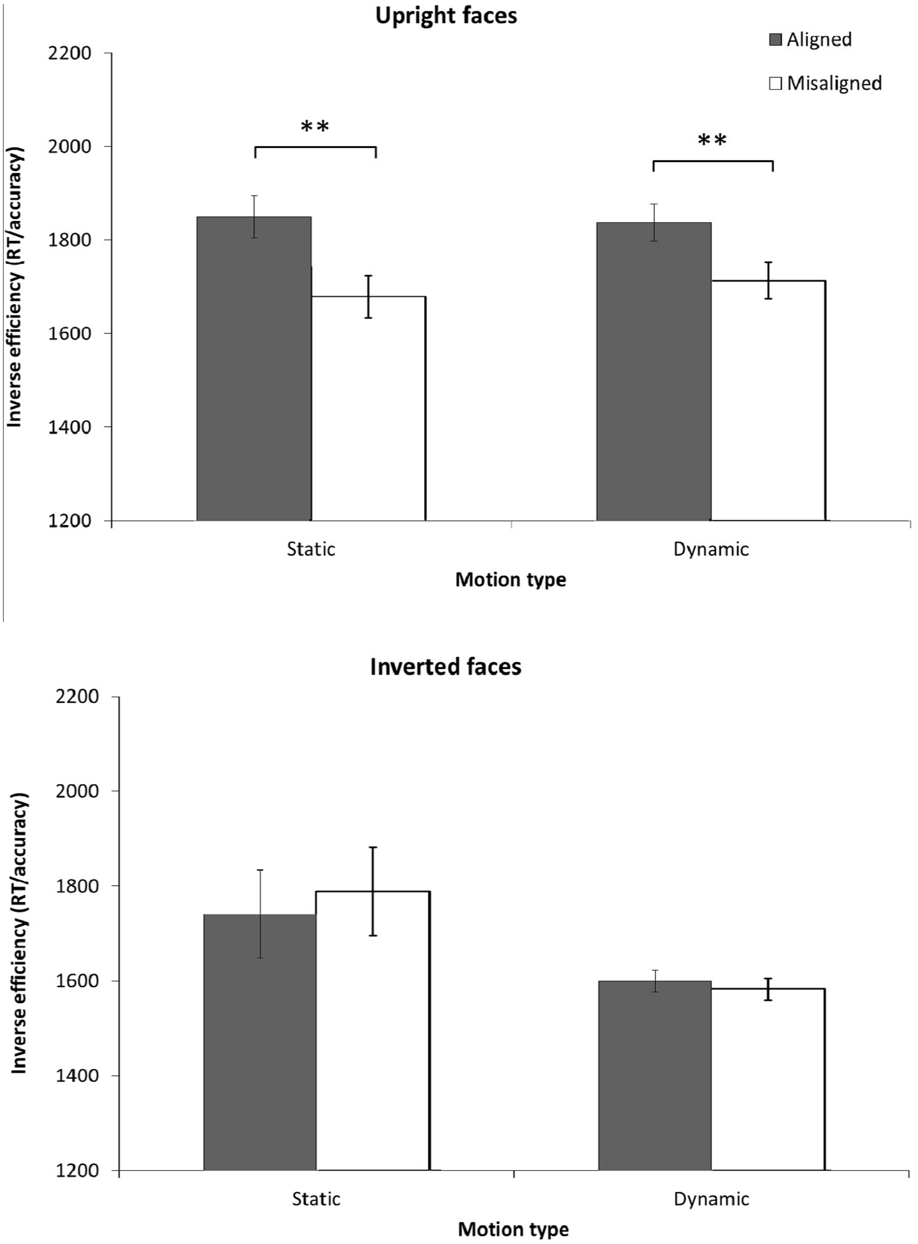

Fig. 2. Mean inverse efficiency scores for naming the top face half in aligned and misaligned static and dynamic composites. The top panel shows results for upright faces, the lower panel shows results for inverted faces. The asterisks indicate significant alignment differences between conditions ($^{**}p < .01$). Error bars show ±1 SE of the alignment difference scores.

review). Recent research has shown that joy in both static and dynamic faces is processed holistically in an *emotion* composite task (Chiller-Glaus et al., 2011), which in the context of an identity judgement task implies that an expression of joy is unlikely to encourage part-based processing in a whole face. Our findings also refute the claim of Xiao et al. (2013) that movement patterns need to be exactly matched to create an identity composite that will be perceived as a whole face.

While our results appear to contradict those of Xiao et al. (2012, 2013), note that we addressed the question of whether moving faces are processed holistically, whereas Xiao et al's studies appear to address the question of whether previously seen moving faces influence the degree of holistic processing for static faces and consequently our methods are different. Based on the current significant composite effects in dynamic conditions, we can conclude that moving faces are processed holistically. Xiao et al. (2012, 2013) concluded from their results that moving faces are processed in a predominantly parts-based manner, but we argue that a more appropriate claim based on those findings is that facial motion at study may result in less holistic processing of static face images at test.

With the nature of the information in a dynamic face being more complex than that in a static face, it is perhaps surprising that both are processed holistically. However, holistic face processing is simply the perceptual grouping and integration of information from across the whole face. Considering that the role of holistic processing in face perception is thought to be facilitation of extracting configural information that helps in the task of identifying and discriminating individual faces (for reviews see Maurer, Le Grand, & Mondloch, 2002; Rossion, 2013), and also face detection (McKone, 2004; Rossion et al., 2011; Taubert et al., 2011), this should apply equally to static and dynamic faces. There is evidence of holistic processing for faces shown in conditions other than the "canonical" static front view. McKone (2008) showed that the composite effect was equally as strong across front, three-quarter and profile views of faces despite the alteration (e.g., projection of the nose) or occlusion of features as faces were rotated away from a front view. McKone argued that the functional role of holistic processing is to achieve identification where local part information may be unreliable across views. While elastic motion in faces results in changes to local part information (e.g., edges), it may be the case that this kind of detailed featural information is not necessary for the extraction of configural information and that the locations of the features relative to each other is calculated on a coarser scale. For example, feature centre points that do not rely on feature boundaries may be used as anchor points for configural information in holistic integration (McKone & Yovel, 2009; Rossion, 2008). Thus, while the detailed featural information available in faces with elastic motion may change, there is still coarser information available regarding the location of parts. Since it involves integrating information across the whole of the face, holistic processing should be able to make use of the coarser featural information in the dynamic face. This explanation is in line with findings that show holistic processing relies mostly on low spatial frequencies (Goffaux & Rossion, 2006). Note that this explanation cannot account for the findings of reduced or no holistic processing when dynamic faces are learned and then tested with static composites (i.e., Xiao et al. (2012, 2013)), which instead, as discussed in the introduction, could be due to the mismatch in format between study and test.

Finally, our results show that composite faces with separate, although similar, patterns of facial movement are processed as a whole, novel face. In addition to what these results tell us about holistic processing of dynamic faces, they provide yet another set of conditions under which the composite effect is found and support the argument that as long as face composites are upright, have a complete contour and contain facial features in approximately normal first order configuration, the composite effect will tolerate deviations from typical front view face morphology (de Heering, Wallis, & Maurer, 2012; McKone, 2008; Rossion, 2013). This idea is consistent with Hole et al. (2002) who found that recognition of familiar faces survived blurring and global vertical, and to a lesser degree horizontal, stretching of the face. Recognition was impaired when vertical stretching was applied to only half of the face, thus disrupting global configural information.

5. Conclusion

Faces seen in elastic motion are processed holistically and the degree of holistic processing is similar for recently learned familiar static and dynamic faces. This finding confirms the importance of holistic processing for familiar faces in ecologically valid viewing conditions supporting decades of research with static faces across a range of conditions (see Rossion, 2013). We are not suggesting that static and dynamic faces are equivalent in all aspects of face perception. For example, there is consistent evidence for a benefit of motion over static images when learning and recognising faces, particularly in "non-optimal" viewing conditions (e.g., Lander & Chuang, 2005; O'Toole, Roark, & Abdi, 2002; Roark et al., 2003). However, while there may be other differences, holistic processing is not the primary distinction between static and dynamic face perception. Regardless of whether a face is viewed in elastic motion or as a static image, there is perceptual integration between facial parts.

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Appendix A

Raw accuracy and reaction time (RT) data per condition. SD in parentheses.
Upright accuracy (proportion correct):

	Static	Dynamic
Aligned	0.98 (0.04)	0.96 (0.09)
Misaligned	0.98 (0.05)	0.96 (0.09)

Inverted accuracy (proportion correct):

	Static	Dynamic
Aligned	0.95 (0.11)	0.99 (0.02)
Misaligned	0.95 (0.12)	0.98 (0.02)

Upright raw RT (ms):

	Static	Dynamic
Aligned	1820.94 (858.92)	1704.26 (481.79)
Misaligned	1621.58 (717.54)	1617.66 (496.25)

Inverted raw RT (ms):

	Static	Dynamic
Aligned	1617.48(504.05)	1599.55 (547.93)
Misaligned	1617.64 (578.46)	1571.32 (526.27)

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.visres.2015.05.002.

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