Research Article

Deciphering the Enigmatic Face

The Importance of Facial Dynamics in Interpreting Subtle Facial Expressions

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ABSTRACT—*Most studies investigating the recognition of facial expressions have focused on static displays of intense expressions. Consequently, researchers may have underestimated the importance of motion in deciphering the subtle expressions that permeate real-life situations. In two experiments, we examined the effect of motion on perception of subtle facial expressions and tested the hypotheses that motion improves affect judgment by (a) providing denser sampling of expressions, (b) providing dynamic information, (c) facilitating configural processing, and (d) enhancing the perception of change. Participants viewed faces depicting subtle facial expressions in four modes (single-static, multi-static, dynamic, and first-last). Experiment 1 demonstrated a robust effect of motion and suggested that this effect was due to the dynamic property of the expression. Experiment 2 showed that the beneficial effect of motion may be due more specifically to its role in perception of change. Together, these experiments demonstrated the importance of motion in identifying subtle facial expressions.*

Facial expressions come in all varieties. Some are intense and sustained, whereas others are subtle and fleeting. Despite the great diversity of facial expressions, the vast majority of studies investigating the recognition of facial expressions have focused on static displays of intense emotions. As a result of this limited focus on exaggerated static facial expressions, it seems quite plausible that researchers may have underestimated the importance of factors such as motion, which may be critical for deciphering the fleeting subtle expressions that permeate real-life situations.

Although motion has been largely overlooked, a few studies have examined its effect on deciphering faces. However, these studies either have failed to find a role of motion (Kamachi et al., 2001) or have provided only minimal evidence for such a role. For example, Dube (1997) found a nonsignificant tendency for dynamic presentation to lead to a general increase in identification rates and saliency judgments, as compared with static presentation. Harwood, Hall, and Shinkfield (1999) found that dynamic presentation improved perception of sad and angry facial expressions, but not other facial expressions of emotion. Using synthesized faces, Wehrle, Kaiser, Schmidt, and Scherer (2000) also found a nonsignificant tendency for the beneficial effect of dynamic relative to static presentation.[1]

One possible limitation of all of these studies is their reliance on the use of intense facial expressions. Not only is there a problem of ecological validity with using strong facial expressions (Carroll & Russell, 1997; Tian, Kanade, & Cohn, 2001), but intense expressions may mask the subtle effects of dynamic displays, thereby contributing to failures to demonstrate a robust effect of motion on judgments of facial affect.

How might motion improve perception of facial expressions? Ekman and Friesen (1982) and Hess and Kleck (1990, 1994) proposed that the dynamic display of facial expressions provides unique temporal information about the expressions that is not available in static displays. Alternatively, motion might improve perception of facial expressions because moving expression sequences provide larger samples of the expressions. By definition, a moving sequence contains multiple static images, and hence offers a larger sample of the expression in progress than a single static display does. This fact alone suggests the possibility that it is the additional static information that helps in disambiguating the emotion signal. This possibility, although implicitly recognized (Ekman & Friesen, 1978, 1984; Hess & Kleck, 1990), has not been tested empirically.

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[1]Edwards (1998) found that subjects could reproduce the progression of facial expressions from a scrambled set of photographs and concluded that subjects were using temporal information. However, because the displays were static and motion was absent, these findings provide evidence only that the sequence of facial expressions can be inferred from static cues.

Previous studies examining the effects of motion on perception of facial expressions (e.g., Dube, 1997; Wehrle et al., 2000) have simultaneously varied both the number of frames and the static/dynamic nature of the display, thereby confounding the effect of motion with that of the additional information associated with multiple images. However, the importance of this additional information can be determined by comparing perception of dynamic sequences with perception of static sequences that present the same frames with masks between images, thereby attenuating the perception of motion. This *multi-static* condition was used in the current study.

Another way in which motion can affect perception of facial expressions is through its role on the mode of processing employed by the observer. In the literature on face perception, a distinction often is made between configuration-based processing and feature-based processing (Bartlett & Searcy, 1993; Leder & Bruce, 2000; Leder, Candrian, Huber, & Bruce, 2001; McKelvie, 1995); the former involves relations among features, and the latter focuses on individual features. By using manipulations, such as face inversion, that disrupt configural processing, investigators have demonstrated that face recognition is highly reliant on configural information (Bartlett & Searcy, 1993; Freire, Lee, & Symons, 2000; Hancock, Bruce, & Burton, 2000; Leder & Bruce, 2000; Leder et al., 2001). Although less conclusive, a handful of studies have also provided some evidence that judgment of facial expressions may depend in part on configural information (e.g., Bartlett & Searcy, 1993; McKelvie, 1995; Muskat & Sjoberg, 1997; Searcy & Bartlett, 1996; White, 1999, 2000). Indeed, such studies have exclusively relied on intense facial expressions. Consequently, they may have overlooked the value of configural information in enhancing the decipherability of more subtle expressive information.

Although no prior research has explicitly examined whether dynamic facial displays enhance configural processing, it seems reasonable that motion promotes the perception of coherence of facial features. Accordingly, synchronous movement of facial features may enable the interpretation of facial expression in much the same way as synchronous motion of an object's elements helps individuals recover the nature of the object's actions (Braunstein, 1962; Cutting, Moore, & Morrison, 1988).

EXPERIMENT 1: THE EFFECT OF MOTION AND ORIENTATION

In Experiment 1, we sought to demonstrate a robust effect of motion on the identification of facial expressions. To do this, we compared emotion identification in dynamic displays that depicted the emergence of a subtle expression (dynamic condition) with emotion identification in displays that presented only the final expression (single-static condition). In addition, in order to assess the impact of the additional information associated with multiple frames, we included a third condition (multi-static condition), in which visual noise masks were interspersed in the same series of images used in the dynamic condition, so that the informational content of the sequences was maintained but the experience of motion was eliminated. If dynamic displays facilitate performance by providing more static information than single-static displays, then performance in the multi-static and dynamic conditions should be superior to performance in the single-static condition, and there should be no difference between performance in the multi-static and the dynamic conditions. Alternatively, if movement is the critical aspect of dynamic displays, then performance in the dynamic condition should be significantly better than performance in both the single-static and the multi-static conditions.

In order to test the hypothesis that motion facilitates the configural processing of faces, we varied the orientation (upright or inverted) in which the stimuli were presented. A significant interaction between motion and orientation would indicate that the hypothesized effect of motion on emotion judgments is mediated by configural processing.

Method

Participants

Participants were 68 undergraduate students (38 females) at the University of Pittsburgh. They received class credit for participating. The majority of the participants were Caucasians (79%); 8.8% were African American, and 11.8% were of other ethnicities. The rights of the participants were protected, and applicable human research guidelines were followed.

Design

Experiment 1 had a $3 \times 2 \times 6$ mixed design. The within-subjects factors were motion (single-static, multi-static, or dynamic) and emotion (anger, disgust, fear, happiness, sadness, or surprise). The between-subjects factor was orientation (upright or inverted).

Stimuli

The facial stimuli were derived from the Cohn-Kanade Facial Expression Database, which was produced by instructing undergraduates to display facial expressions of basic emotions. The expressions were video-recorded in real time (Kanade, Cohn, & Tian, 2000). In order to generate dynamic emotion displays that would be challenging to identify, we truncated full displays (originating at neutral baseline and progressing to full depiction of the emotion) so that they ended at the first visible display of the expression.

These segments were then pretested in a pilot study in order to identify sequences that (a) were correctly judged by 60% to 75% of the participants and (b) showed facial movements involving more than one facial feature (so that configural processing was possible). We identified 36 expression sequences that met these criteria and used them in this experiment. These expressions were posed by 29 different individuals (all Caucasian, 22 female). Each sequence began at a neutral baseline and progressed through three to six frames, ending at a subtle facial expression of one of six basic emotions. Each emotion was represented by 6 sequences. Masks were created for each of the 36 sequences, using Photoshop 5.0, by filling in the face area (within an oval frame) with black-and-white Gaussian noise. The masks were used to prevent perception of motion in the multi-static condition and to orient the participants to the location of the face in the beginning of each sequence.

All sequences were duplicated in three conditions: single-static, multi-static, and dynamic (see Figs. 1a–1c). Each sequence started with an oval noise mask (presented for 200 ms). In the single-static condition, the mask was followed by the last image of the sequence (target). In the multi-static condition, the initial mask was followed by the first (neutral) image of the sequence (500 ms) and then the rest of the images (each for 500 ms, except for the target), with a 200-ms mask between successive images. In the dynamic condition, the first image was presented for 500 ms after the initial mask and was followed by the rest of the images presented in real time (30 frames/s). Each sequence ended at the same target picture in all conditions. Examples of the single-static, multi-static, and dynamic presentation in upright and inverted orientations can be seen on the Web at http://www.pitt.edu/∼ambadar/stimuli.htm.

The resulting 108 sequences were divided into three sets of stimuli, counterbalanced across conditions. Thus, in each set, there were equal numbers of single-static, multi-static, and dynamic sequences. In any given stimulus set, each sequence was presented only once, and the six emotions were represented equally often. The order of items within a set was randomized with one restriction: The same face was never shown consecutively. All stimuli were duplicated and inverted to make the corresponding inverted sets.

Procedure

Participants, who were randomly preassigned to the upright or inverted condition, viewed one of three randomly preassigned stimulus sets in a computer lab. Four to 16 participants were tested at a time. They were instructed to play each sequence at least once and to report their responses only after they had reached the end (the last image) of the sequence. They were allowed to play a sequence multiple times before responding on the response sheet. For each item, participants chose the emotion that best described the facial expression from among seven options: anger, disgust, fear, happiness, sadness, surprise, and neutral. They also used a 5-point Likert-type scale to rate their confidence in their emotion judgment (1 = *not confident at all*, 5 = *very confident*) and indicated whether or not they had perceived "motion" in the face ("yes" or "no"). Motion was defined as "when you actually see the face move as in a movie clip."

Results

Accuracy

Participants were substantially more accurate in identifying the emotion in the dynamic condition than in the two static conditions, $F(2, 132) = 32.996$, $p < .001$, $\eta_p^2 = .33$. The difference between the single-static and the multi-static presentations was not significant, $F(1, 66) = 2.584$, $p = .133$. There was a highly significant effect of orientation, with inversion impairing perception of facial expressions, $F(1, 66) = 78.822$, $p < .001$, $\eta_p^2 = .54$. There was no interaction between orientation and motion (see Fig. 2).

Analysis of the effect of emotion revealed a highly significant result, $F(5, 100) = 22.885$, $p < .001$, $\eta_p^2 = .32$. In the upright condition, happy expressions were more likely to be judged

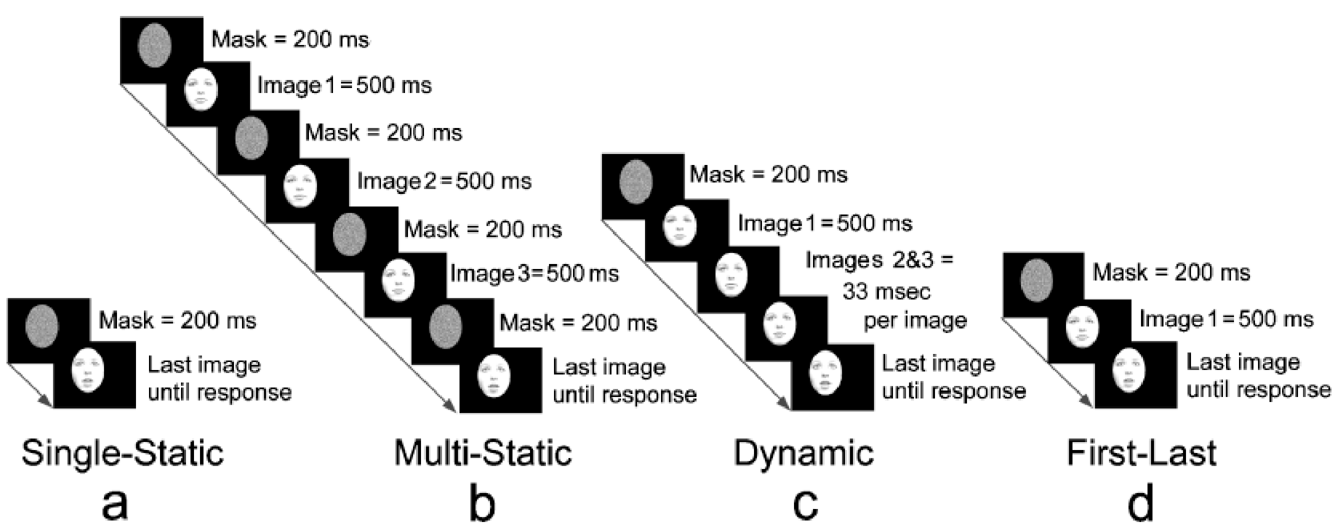

Fig. 1. Diagram illustrating stimulus presentation in the four motion conditions. Experiment 1 included the single-static (a), multi-static (b), and dynamic (c) conditions. Experiment 2 included these three conditions plus the first-last (d) condition. In the example shown here, the complete sequence consists of four images.

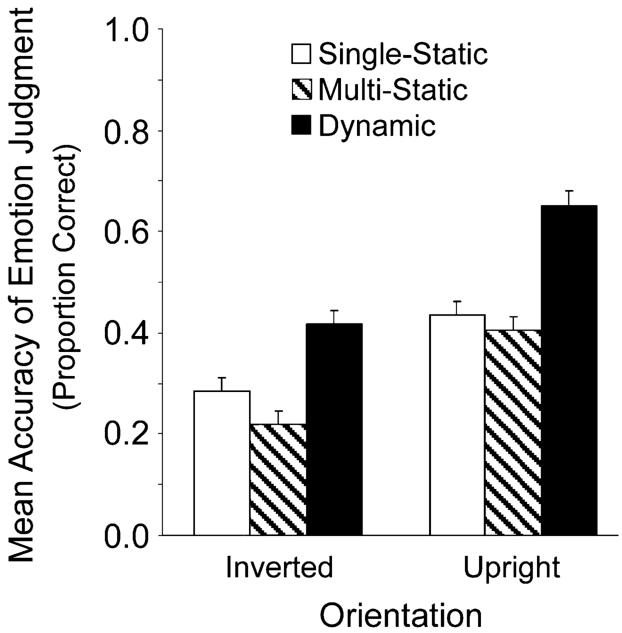

Fig. 2. Experiment 1 results: effect of motion and orientation on accuracy of identifying emotion in facial expressions.

correctly than other emotional expressions, and surprise expressions were the least likely to be judged correctly.

Two-way interactions between emotion and motion and between emotion and orientation were highly significant, $F(10, 200) = 4.674$, $p < .001$, and $F(5, 100) = 9.62$, $p < .001$. However, the three-way interaction of emotion, motion, and orientation was not significant.

In the upright condition, the pattern for the effect of motion was similar in all emotions except happiness: superiority of dynamic over single-static displays without significant differences between the two static displays (see Table 1).

Confidence Ratings

There was a significant main effect of motion on mean confidence ratings for correctly judged items, $F(2, 132) = 3.873$, $p < .05$. This main effect seemed to be driven by the difference between the dynamic and the multi-static conditions in the inverted orientation, $F(1, 66) = 6.965$, $p < .01$. Participants felt more confident with their judgments for dynamic items than multi-static items, especially when the faces were upside down. A similar effect was found between dynamic and single-static presentations in the inverted orientation, but not in the upright orientation. There was also a significant main effect of orientation, $F(1, 65) = 4.940$, $p < .05$. The interaction between motion and orientation was not significant.

Perception of Motion

The main purpose of asking participants to report whether or not they perceived motion in the faces was as a manipulation check; that is, participants should have perceived motion in the dynamic condition, but not in the two static conditions. We analyzed the percentage of items for which movement was reported in each motion condition. On average, 87% of items in the dynamic condition were reported as showing movement, whereas in the single-static and multi-static conditions, the perception of motion was negligible (3%, or 1 item, in the single-static condition and 13%, or 4 items, in the multi-static condition). The effect of motion was highly significant, $F(1, 66) = 363.537$, $p < .001$, and was observed in both the upright and the inverted orientation, $F(1, 66) < 1$.

Discussion

The results of Experiment 1 confirmed the hypothesis that motion improves perception of facial expressions. Participants were much more accurate and confident in judging the facial expressions when they viewed moving displays than when the faces were static. This beneficial effect of motion was observed for all emotions tested except happiness. Experiment 1 also showed that inverted depictions of subtle facial expressions are harder to judge than upright depictions, which suggests that configural processing contributes to perception of facial expression.

The lack of a significant difference between the single-static and the multi-static conditions suggests that additional information alone is not enough to improve perception of facial expression significantly. Therefore, the beneficial effect of motion observed in this study could not have been due to the fact that motion provides extra static information.

The lack of a significant interaction between motion and orientation indicates that motion does not improve perception of facial expression by facilitating configural processing. Thus, Experiment 1 suggests that the beneficial effect of motion is due to something inherent in the dynamic property itself.

The question remains, why did dynamic presentation have such a large effect? One possibility is that temporal characteristics of the expression, such as its velocity (Schmidt, Cohn, & Tian, 2003), uniquely characterize each emotion and assist people in identifying the emotion. Alternatively, motion may simply enhance the perception of changes in the face. In other words, the movement of facial features allows perceivers to observe changes in the composition of the features, whereas with static pictures, perceivers have to envisage the course of changes, which might make them less accurate. The idea that it is difficult to observe change in two static pictures has been studied quite extensively in the literature on change blindness (Levin & Simons, 1997; O'Regan, Deubel, Clark, & Rensink, 2000; O'Regan, Rensink, & Clark, 1999; Rensink, 2000; Rensink, O'Regan, & Clark, 1997, 2000; Simons & Levin, 1998, 2003). The results of Experiment 1 suggest that motion might enhance sensitivity to facial changes. The possible roles of temporal information and perception of change were investigated in Experiment 2.

TABLE 1
Mean Accuracy of Emotion Judgments in Experiments 1 and 2

Emotion	Condition: Single-static	Multi-static	Dynamic	First-last	Total	Effect of motion	Planned comparison: Single-static vs. multi-static	Single-static vs. dynamic	Multi-static vs. dynamic	Dynamic vs. first-last
					Experiment 1					
Upright										
Anger	.36 (.03)	.32 (.06)	.53 (.06)	—	.40 (.03)	$p < .05$	n.s.	$p < .05$	$p < .05$	—
Disgust	.44 (.06)	.35 (.07)	.70 (.06)	—	.45 (.03)	$p < .01$	n.s.	$p < .01$	$p < .01$	—
Fear	.50 (.08)	.55 (.08)	.72 (.05)	—	.52 (.04)	$p < .05$	n.s.	$p < .01$	n.s.	—
Happiness	.83 (.03)	.62 (.06)	.85 (.05)	—	.74 (.03)	$p < .01$	$p < .05$	n.s.	$p < .01$	—
Sadness	.53 (.08)	.66 (.07)	.73 (.03)	—	.62 (.05)	n.s.	n.s.	$p < .05$	n.s.	—
Surprise	.24 (.07)	.22 (.09)	.70 (.08)	—	.29 (.04)	$p < .001$	n.s.	$p < .001$	$p < .01$	—
Total	.43 (.03)	.40 (.03)	.65 (.03)	—		$p < .001$	n.s.	$p < .001$	$p < .001$	—
Inverted										
Anger	.20 (.05)	.15 (.04)	.38 (.05)	—	.24 (.03)	$p < .01$	n.s.	$p < .05$	$p < .01$	—
Disgust	.29 (.07)	.16 (.06)	.35 (.06)	—	.24 (.03)	n.s.	n.s.	n.s.	$p < .05$	—
Fear	.20 (.05)	.17 (.07)	.20 (.04)	—	.20 (.03)	n.s.	n.s.	n.s.	n.s.	—
Happiness	.59 (.07)	.53 (.07)	.74 (.06)	—	.58 (.04)	n.s.	n.s.	n.s.	$p < .05$	—
Sadness	.29 (.06)	.24 (.04)	.21 (.05)	—	.26 (.02)	n.s.	n.s.	n.s.	n.s.	—
Surprise	.27 (.05)	.32 (.09)	.71 (.08)	—	.33 (.03)	$p < .01$	$p < .01$	$p < .01$	$p < .05$	—
Total	.28 (.02)	.22 (.02)	.42 (.02)	—		$p < .001$	$p < .05$	$p < .01$	$p < .001$	—
					Experiment 2					
Anger	.25 (.06)	.19 (.05)	.66 (.06)	.72 (.06)	.47 (.03)	$p < .001$	n.s.	$p < .001$	$p < .001$	n.s.
Disgust	.41 (.06)	.44 (.06)	.77 (.05)	.73 (.06)	.59 (.03)	$p < .001$	n.s.	$p < .001$	$p < .001$	n.s.
Fear	.42 (.06)	.58 (.06)	.50 (.06)	.53 (.06)	.51 (.03)	n.s.	$p < .05$	$p < .05$	n.s.	n.s.
Happiness	.63 (.06)	.67 (.06)	.92 (.03)	.89 (.04)	.78 (.03)	$p < .001$	n.s.	$p < .001$	$p < .001$	n.s.
Sadness	.34 (.06)	.31 (.06)	.63 (.06)	.59 (.06)	.47 (.03)	$p < .001$	n.s.	$p < .001$	$p < .001$	n.s.
Surprise	.19 (.04)	.25 (.05)	.66 (.06)	.63 (.06)	.48 (.02)	$p < .001$	n.s.	$p < .001$	$p < .001$	n.s.
Total	.39 (.02)	.43 (.02)	.69 (.03)	.69 (.02)		$p < .001$	n.s.	$p < .001$	$p < .001$	n.s.

Note. Standard errors are in parentheses. Experiment 1 did not include the first-last condition.

EXPERIMENT 2: UNIQUE TEMPORAL CHARACTERISTICS VERSUS SENSITIVITY TO CHANGE

In Experiment 2, we included a new condition that contained only the first and last images of each sequence. This new condition (first-last) substantially changed the temporal characteristics of the facial expressions while preserving the perception of motion (see Fig. 1d). If the beneficial effect of motion is due to increased sensitivity to changes, then there should be no difference in performance between the dynamic and the first-last conditions. If, however, the effect is due to unique temporal characteristics of each emotion, then performance in the dynamic condition should be superior to performance in the first-last condition, and performance in the first-last condition should not differ from performance in the two static conditions.

Experiment 2 also addressed an unexciting account of the results of Experiment 1: that the superiority of the dynamic displays might have arisen because participants viewed them more times than the static displays. To test this possibility, we recorded and analyzed the number of times participants reviewed the faces in all conditions.

Method

Participants
Participants were 64 undergraduates at the University of Pittsburgh. They received class credit for participating.

Design
Experiment 2 had a 4 × 6 within-subjects design. The within-subjects factors were motion (single-static, multi-static, dynamic, or first-last) and emotion (six basic emotions).

Stimuli
The initial stimuli were 24 sequences (24 posers, 18 females) taken from the stimulus pool used in Experiment 1. Each sequence was duplicated to create stimuli in the four conditions. The procedure for creating single-static, multi-static, and dynamic displays was the same as that in Experiment 1. In the

first-last condition, the mask was followed by the first (neutral) image of the sequence (500 ms), then the last image (target).

The resulting 96 sequences were divided into four sets, counterbalanced across conditions. Thus, each set contained equal numbers of stimuli in all four conditions, and the six basic emotions were represented the same number of times in each set.

Procedure

The procedure of Experiment 1 was replicated with the following modifications. Participants viewed each sequence and recorded their judgments using a computer running a Visual Basic program. The program was designed so that participants could make their judgments only after they had completed viewing a sequence. Participants were allowed to play each sequence as many times as needed, and the number of times the sequences were played was recorded and analyzed. The question about perception of motion was removed from the questionnaire as it was no longer necessary, given that Experiment 1 confirmed the motion manipulation. Up to 4 participants were run at a time.

Results

Frequency of Play

The results did not support the possibility that dynamic items were judged more accurately in Experiment 1 because they were played more times than the static items. The average number of times participants played the sequences was virtually the same among the four motion conditions: 1.44, 1.43, 1.50, and 1.48 for single-static, multi-static, dynamic, and first-last, respectively, $F(3, 189) = 1.124$, $p = .341$.

Accuracy

Participants were far more accurate judging facial expressions in the dynamic and first-last modes than in the single-static and multi-static modes, $F(3, 189) = 54.504$, $p < .001$, $\eta_p^2 = .46$. The difference between the two static modes was not significant, $F(1, 63) = 1.214$, $p > .1$, and neither was the difference between the dynamic and first-last conditions, $F(1, 63) < 1$ (see Fig. 3).

The main effect of emotion was highly significant, $F(5, 315) = 20.849$, $p < .001$, $\eta_p^2 = .25$. This effect was driven mainly by a "happy advantage" phenomenon; that is, participants were much more accurate recognizing a happy expression than any other emotional expressions.

The interaction between motion and emotion was significant, $F(15, 945) = 3.17$, $p < .001$, $\eta_p^2 = .048$. Post hoc comparisons among motion conditions for each emotion revealed that for all emotions except fear, the effect of motion was highly significant, whereas the differences between the two static conditions were not. For all emotions, the difference between the dynamic and first-last conditions was not significant (see Table 1).

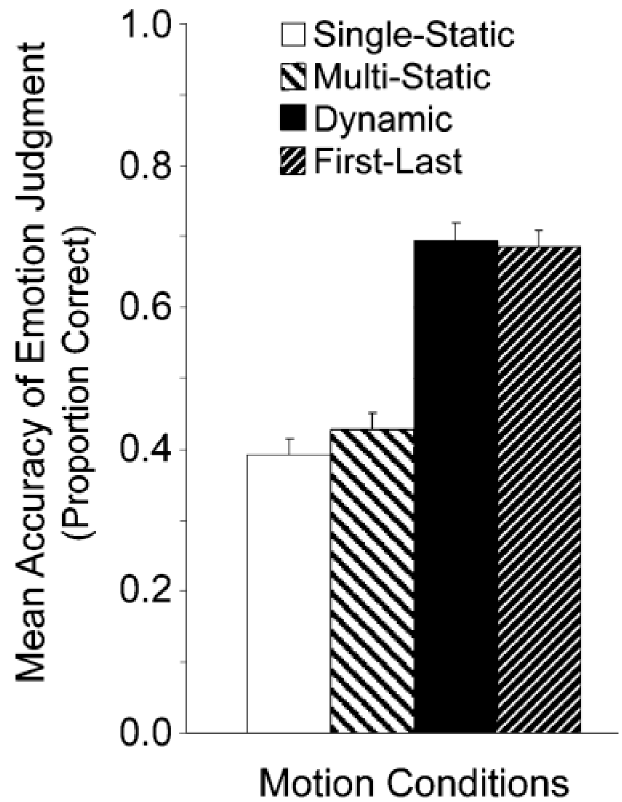

Fig. 3. Experiment 2 results: effect of motion on accuracy of identifying emotion in facial expressions.

Confidence Ratings

There was a significant main effect of motion on mean confidence ratings for correctly judged items, $F(3, 213) = 62.175$, $p < .001$. The difference between the single-static and multi-static conditions was not significant, $F(1, 98) < 1$. Participants were more confident with their judgments of the dynamic items than with their judgments of the multi-static or first-last items, $F(1, 164) = 8.164$, $p = .004$, and $F(1, 131) = 109.492$, $p < .001$, respectively. They were also more confident in the first-last condition than the multi-static condition, $F(1, 132) = 145.094$, $p < .001$.

Discussion

Experiment 2 replicated the results of Experiment 1 in all dependent variables. Participants were more accurate and more confident judging facial expressions in the conditions in which they perceived motion (dynamic and first-last) than in the conditions in which motion perception was prevented. The improved accuracy was observed for all but one basic emotion tested (fear). The possibility that participants viewed the dynamic items more often than the static items was discounted in Experiment 2. Participants viewed the sequences on average 1.5 times each, regardless of motion condition. Like Experiment 1, Experiment 2 suggests that the beneficial effect of motion is attributable to something inherent in the dynamic property itself, rather than to the fact that motion provides extra static information. More specifically, the results show that motion increases human sensitivity to changes in the compositions of facial features due to facial expression and that this enhanced ability improves accuracy in identifying the emotion portrayed.

GENERAL DISCUSSION

Experiments 1 and 2 demonstrated the importance of motion in facilitating the perception of facial expressions. Subtle facial expressions that were not identifiable in static presentations suddenly became apparent in dynamic displays. In contrast to prior studies using more intense facial expressions (e.g., Dube, 1997; Harwood et al., 1999; Kamachi et al., 2001; Wehrle et al., 2000), this study demonstrated a highly robust effect of motion that was observed (across the two experiments) for all six basic emotions examined.

The two experiments also helped to rule out a number of possible mechanisms by which motion might have enhanced the recognition of subtle expressions. Although configural processing was found to be important for identifying the expressions (as indicated by the deficit in performance for inverted faces), the absence of an interaction between motion and orientation indicates that the effects of motion are not mediated by configural processing. The benefits of dynamic displays were not due to the increases of facial information inherent in the multiframe sequences, as demonstrated by the fact that nondynamic multiframe sequences failed to produce comparable benefits. Finally, the unique temporal characteristics of each kind of emotion expression also cannot explain the advantage of the dynamic displays, as comparable benefits were observed with displays that only included the first and last frame in each sequence, and thus eliminated any cues regarding the original temporal unfolding of the expression.[2]

The fact that, in the absence of a visual noise mask, a single shift between the first and last images of the sequences produced the full benefit associated with the dynamic sequences suggests that the critical advantage afforded by the dynamic displays was their ability to enable participants to perceive the change between the neutral base frame and the final subtle expression. This result also suggests that perception of facial expressions might be subject to the same change-blindness phenomenon that has been robustly observed in other types of perception tasks. Although additional research is needed to fully flesh out the relationship between the present paradigm and the change-blindness paradigm (e.g., Levin & Simons, 1997; O'Regan et al., 1999), the parallels of the phenomena are striking. In both cases, individuals are readily able to extract information stemming from the difference between multiple images when they are simply presented one after the other, but largely incapable of extracting the very same information when a brief noise mask separates the images. Given these parallels and the absence of evidence for any of the alternative roles of motion considered in the current studies, it seems quite likely that the benefits of motion observed here stem from its ability to enhance individuals' perception of the way in which expressions have changed. The present findings thus suggest that motion's role in the detection of change, a central though often underemphasized aspect of the change-blindness paradigm, is critical in mediating individuals' sensitivity to the communication of emotion.

Finally, although the primary import of this work is its demonstration of the importance of motion for deciphering facial expression, it also highlights the significance of another typically underexamined aspect of expressions, namely, their frequent subtlety. Using subtle facial expressions, we readily observed effects—of two variables (motion and orientation)—that have frequently eluded prior investigations using the standard displays of intense facial expressions. We can only speculate about what other important aspects of facial decoding may be revealed if researchers were to more regularly consider the processes associated with deciphering the enigmatic face.

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[2]This result does not mean that people are insensitive to the temporal information of facial expressions. A recent study by Schmidt, Ambadar, and Cohn (2004) demonstrated that individuals rely critically on the temporal information of a smile in order to assess its authenticity.

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