Running head: DYNAMIC ATTRIBUTES OF SMILES

Effects of Dynamic Attributes of Smiles in Human and Synthetic Faces: A Simulated Job Interview Setting

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Abstract

We examined the effects of the temporal quality of smile displays on impressions and decisions made in a simulated job interview. We also investigated whether similar judgments were made in response to synthetic (Study 1) and human facial stimuli (Study 2). Participants viewed short video excerpts of female interviewees exhibiting dynamic authentic smiles, dynamic fake smiles or neutral expressions, and rated them with respect to a number of attributes. In both studies, perceivers' judgments and employment decisions were significantly shaped by the temporal quality of smiles, with dynamic authentic smiles generally leading to more favorable job, person, and expression ratings than dynamic fake smiles or neutral expressions. Furthermore, authentically smiling interviewees were judged to be more suitable and were more likely to be short-listed and selected for the job. The findings show a high degree of correspondence in the effects created by synthetic and human facial stimuli, suggesting that temporal features of smiles similarly influence perceivers' judgments and decisions across the two types of stimulus.

Keywords: facial expression; smile; dynamics; job; social perception; decision.

Effects of Dynamic Attributes of Smiles in Human and Synthetic Faces: A Simulated Job Interview Setting

Many decisions in human life are based on limited information available for a short period of time. There is often no or minimal knowledge of other persons we encounter and as a result first impressions are determined by any available cues (Forgas, 1985). Furthermore, some of these decisions do not take place in the real world, but are made in virtual environments such as the worldwide web. In such contexts, the interface with which we are communicating increasingly consists of virtual humans who exhibit various types of life-like behavior (see Blascovich, 2001; Dehn & van Mulken, 2000). Whether others are synthetic or real, we are often faced with minimal information about them and in consequence have to rely on brief observations of their behavior (see Ambady, Bernieri, & Richeson, 2000; Ambady & Rosenthal, 1992, 1993). In the present research we examine the impact of facial information on social perceptions and decisions made on the basis of short segments of expressive behavior. Moreover, we investigate whether similar judgments are made in response to synthetic and real human faces.

In recent years, there has been a growing interest in making animated characters depicted in film and online games (see Kerlow, 2004) and human–computer interaction (see Blascovich, 2001; Dehn & van Mulken, 2000) more human-like, with photorealistic faces (Takács & Kiss, 2003). A goal in computer graphics is to develop these computer-generated humans in such a way that they are capable of expressing fine shades of emotions. Although previous research has investigated general evaluations of animated figures such as embodied interface agents (Blens, Krämer, & Bente, 2003; Koda & Maes, 1996; Wiberg & Wiberg, 2001; see Dehn & van Mulken, 2000, for a review), the effects of specific nonverbal behaviors when exhibited by virtual characters have rarely been studied in detail (for gestural activity, see Krämer, Tietz, & Bente, 2003; for gaze behavior, see Bailenson, Blascovich, Beall, & Loomis, 2001). Moreover, researchers have not explored whether these nonverbal actions (e.g., facial expressions) are interpreted in the same way when seen in synthetic cartoon faces or more realistic human faces. Thus, the same facial actions could lead to different judgments and decisions, depending on the type of stimulus. Although Bente, Krämer, Petersen, and de Ruiter (2001) compared original video recordings of two interacting people with recordings of computer animations, their study pertained to whole body movements rather than facial behavior in particular. In the present research, we investigated the perception of different temporal forms of smiles[1] in synthetic faces and explored whether the findings obtained with these stimuli are paralleled when the stimuli are real human faces.

The smile is a particularly relevant expression to study because it not only occurs in conjunction with a positive affect, but can also be faked to convince another that enjoyment is occurring when it is not (Ekman, 1985; Ekman & Friesen, 1982; Ekman, Friesen, & O'Sullivan, 1988). A distinction therefore needs to be drawn between genuinely happy smiles and fake or false smiles. Several morphological and temporal differences between these two types of smile have been noted (Ekman, Davidson, & Friesen, 1990), but most past research has focused on the Duchenne marker (with its morphological features of raised cheeks, bulges around the eyes, crow's feet wrinkles) and its role in smile differentiation (see Ekman, 1992). However, the temporal feature of smiles also provides a potentially important way of distinguishing between smile types (see Ekman & Friesen, 1982).

Several studies have shown that genuine smiles differ from false ones in their temporal parameters. Specifically, longer onset and/or offset durations were found for spontaneous felt smiles than for posed or false ones (Bugental, 1986; Hess & Kleck, 1990; Schmidt, Ambadar, Cohn, & Reed, 2006; Weiss, Blum, & Gleberman, 1987). Temporal dynamics of moving displays have also been shown to have a beneficial effect on the recognition of personal identity in humans (e.g., Bassili, 1978; Bruce & Valentine, 1988; Lander, Christie, & Bruce, 1999), and the identification or discrimination of emotional expressions (Ambadar, Schooler, & Cohn, 2005; Bassili, 1979; Bould & Morris, in press; Kamachi et al., 2001; Wehrle, Kaiser, Schmidt, & Scherer, 2000). An under-researched issue is the role played by temporal features in emotion interpretation. While Sato and Yoshikawa (2004) explored the effects of different presentation velocities on the perceived artificiality of morphed expressions, their study related more to the plausibility, rather than the perceived genuineness of facial displays.

In previous work we therefore investigated whether temporal dynamics influenced the interpretation of Duchenne smiles, particularly with respect to their rated truthfulness. Using synthetic facial stimuli, we showed that variations in temporal parameters influenced trait judgments and perceptions of smile authenticity. Specifically, Duchenne smiles with longer onset and offset durations were judged as more authentic than their shorter counterparts, whereas genuineness ratings decreased as a function of how long the smile was held at the apex (Krumhuber & Kappas, 2005). Furthermore, stimulus persons who displayed Duchenne smiles with long onset durations were rated as more trustworthy, more attractive, and less dominant (Krumhuber, Manstead, & Kappas, 2007b).

In a recent study using real human facial stimuli, we showed that these temporal dynamics of smiles also influenced decisions and behavioral intentions in trust game scenarios (Krumhuber et al., 2007a). Independently of the presence of the Duchenne marker, the temporal form of smiles significantly shaped participants' choices of counterparts and decisions to cooperate and trust in the game. The influence of facial dynamics on intentions to cooperate was found to be mediated by perceived trustworthiness. Together, these studies show that the temporal quality of smile expressions (with or without the Duchenne marker) has a significant impact on perceptions of expression and person, and on decision making.

There are nevertheless several questions that still need to be addressed. First, although the influence of temporal dynamics was found in synthetic and human faces independently, no study has compared affective responses to temporal features of smiles across the two types of stimulus. That is, it remains unclear whether judgments based on synthetic faces straightforwardly generalize to real human faces. Second, the impact of smile dynamics on decisions has been shown for human, but not for synthetic faces. It would be interesting to test whether the temporal form of smiles also shapes decisions and behavioral intentions in synthetic faces, given their use in mediated communication settings, such as e-commerce. Third, only one type of situational context (i.e., trust game scenarios) has been employed to study affective and behavioral responses to dynamic smile stimuli. This raises the question of whether previous findings generalize across different social settings.

We used a simulated job interview situation to examine whether temporal parameters of smiling have a similar effect on interview impressions and employment decisions in synthetic and human faces. Although synthetic stimuli may lack realism, there is evidence that people treat virtual characters as if they were actual humans (Bailenson et al., 2001). Moreover, recent business analyses suggest that more and more companies rely on simulated job situations involving virtual humans to train their staff (BusinessWeek, 2006). The job interview situation as used in this research may therefore share some commonalities with those simulation/training games. This allows for an environment in which it becomes increasingly natural to interact with synthetic, artificial characters.

There is considerable evidence that nonverbal behavior (i.e., eye contact, gesturing, and smiling) plays an important role in influencing interview impressions and hiring decisions (Edinger & Patterson, 1983; Imada & Hakel, 1977; Young, & Beier, 1977). Specifically, job applicants who displayed higher levels of smiling were found to be evaluated more favorably and their chances of being hired were increased. Forbes and Jackson (1980) showed that ‘accept’ interviews were characterized by more smiling, whereas more neutral facial expressions appeared in ‘reject’ interviews. The impact of different forms (i.e., temporal) of smiles on hiring decisions has not yet been investigated. This seems relevant given that smile expressions in job interview settings are often likely to be voluntarily produced for impression management purposes (see DePaulo, 1992). Given the varying meanings of smiles (see Ekman, 1985) such managed expressions need to be distinguished from authentic smiles which spontaneously occur in conjunction with felt positive emotions (Ekman & Friesen, 1982).

Participants were shown short excerpts from a simulated job interview in which each of three interviewees responded to a mildly amusing utterance made by the interviewer. We expected that the temporal form of interviewee's smiles in reaction to this remark would provide important information to observers about the genuineness of the expression. Specifically, we hypothesized that dynamic authentic smiles would be perceived as more immediate and genuine, leading to more favorable ratings of the interviewee (i.e., friendly, warm, kind) and of her job related attributes (i.e., reliable, trustworthy, involved). Such immediacy (see Imada & Hakel, 1977) would be absent in dynamic fake smiles, which are put on to make it appear that positive feelings are experienced when in fact nothing much is felt (i.e., phoney smiles, Ekman & Friesen, 1982). Interviewees displaying authentic smiles should therefore be rated higher on expression, person and job attributes than falsely smiling or non-expressive interviewees. Furthermore, they should receive more favorable hiring evaluations and be considered more suitable for the job.

Experiment 1

In this first study we examined the impact of varying the temporal parameters of smiles in synthetic faces on interview impressions and decisions. Thin-slice samples of a simulated job interview situation were employed in which interviewees displayed authentic smiles, fake smiles, or neutral expressions.

Method

Participants. Seventy-two participants (36 males, 36 females) at Cardiff University, UK took part. They were aged 18 to 39 years (M = 22.89) and were given either course credit or a payment of £3.00.

Stimulus material. The stimulus material consisted of brief (30 s) video excerpts depicting a job interview situation. Each excerpt was accompanied by the same audio recording in which an interviewer was heard making some general remarks about the nature of the job for which the candidate seen in the video had supposedly applied. In the course of these remarks he made a mildly amusing utterance, thereby providing an occasion for the interviewee to smile. Each participant viewed three video excerpts, each with a different interviewee: one in which the interviewee displayed an authentic smile, one in which the interviewee displayed a fake smile; and one in which the interviewee remained neutral. The sequence of facial expressions was counterbalanced across interviewees.

Facial stimuli consisted of synthetic faces generated using Poser 4 (Curious Labs, Santa Cruz, CA) animation software. The three female faces chosen for this experiment were matched for attractiveness (*M* = 5.15, scale 1-7) and trustworthiness (*M* = 4.98), as determined in a pilot study (N = 16). For each Poser face, a neutral expression and two dynamic smile expressions differing in onset, apex, and offset durations were synthesized at a frame rate of 30 images per second. Smiles with long onset (16 frames) and offset (64 frames) durations and relatively short apex (40 frames) durations were designated “authentic smiles”. Fake smiles were characterized by short onset (4 frames) and offset (5 frames) durations and long apex (111 frames) durations. These parameters were derived from a previous study (Krumhuber & Kappas, 2005), in which it was found that the perceived genuineness of smiles increased as a function of onset and offset durations, and decreased as a function of apex duration. The smile expression was operationally defined as an upper smile (lip corner pull, AU 12, Facial Action Coding System; Ekman & Friesen, 1978) with mouth opening (AU 25), and set at a medium intensity of 0.8 (see Figure 1 for examples of neutral and smile expressions). Because we aimed to study the effects of the temporal dynamics independently of other morphological features, such as the “Duchenne marker” (i.e., *orbicularis oculi* activity, AU 6), only the mouth region was animated[2]. To create realistic looking smiles that would be natural in their appearance, we chose a medium level of smile intensity, allowing us to examine the impact of smile dynamics independently of the influence of AU 6 (see

Krumhuber et al., 2007a, for a similar procedure). All smiles lasted 120 frames (i.e., 4 seconds). The three Poser models showing three different facial expressions were rendered in color with the same viewpoint, camera focal length, and lighting. The resulting images measured 411 x 491 pixels each and were shown in random order as movie-clips in Medialab (Empirisoft).

Procedure. Participants arrived individually at the laboratory and were seated at a table with a computer workstation. After signing a consent form, they were instructed that they would view three short video excerpts depicting a job interview situation. They were told that in each excerpt a head and shoulders shot of the interviewee would be visible as he or she listened to the interviewer. Participants were made aware that the interviewee was not a human person, but virtual characters whose behavior was modeled on real humans. They were also told that the interviewer would follow the same script because the interview was intended to be a standard situation for all interviewees. After answering any of the participants' remaining questions regarding the procedure, the experimenter left the room. The video sequences were initiated by clicking on a 'Start' button on the computer screen. After each sequence, participants were instructed to respond to several judgment scales. The next video sequence was started by clicking a 'Continue' button on the screen.

Dependent Variables. Participants rated each video excerpt with respect to how *kind*, *sociable*, *attractive*, *likeable*, *warm* and *friendly* they thought the interviewee was, and how *spontaneous*, *genuine*, *formal*, *tense*, *flirtatious*, *polite*, *charming*, and *seductive* they perceived the interviewee's expression to be. Interviewees were also evaluated on six dimensions that had been rated in a pilot study (N = 17) as important for job applicants in any field: *competent*, *motivated*, *trustworthy*, *involved*, *interested*, and *reliable*. These 20 adjectives were presented in random order. Participants were asked to respond by clicking on the appropriate points of a 7-point scale with response options ranging from 1 (*not at all*) to 7 (*very*). After the final adjective, participants were asked to judge a) how suitable the person was for the job (1 = *not suitable at all*, 7 = *very suitable*), b) how likely it was that this person would be short-listed for further interview (1 = *not likely at all*, 7 = *very likely*), and c) how likely it was that this person would be selected for the position (1 = *not likely at all*, 7 = *very likely*). For each employment decision, participants were also asked to indicate how confident they were about the judgment they had just made (on a 7-point scale, 1 = *not confident at all*, 7 = *very confident*).

Results

Data reduction. The 26 ratings made by participants were subjected to principal components analysis to guide scale construction. This led to the construction of four scales. Internal consistency was assessed separately for each of these scales for authentic smiles, fake smiles and neutral expressions. The first scale reflected *job* ratings (authentic: α = .84, fake: α = .81, neutral: α = .91) and consisted of the items reliable, interested, involved, trustworthy, motivated, and competent. The second scale reflected *decision* ratings (authentic: α = .92, fake: α = .87, neutral: α = .94) and consisted of the items suitable, short-listed, and selected (item content abbreviated). The third scale reflected *confidence* ratings (authentic: α = .94, fake: α = .91, neutral: α = .91) and consisted of the items confidence/suitable, confidence/short-listed, and confidence/selected (item content abbreviated). The fourth scale reflected *person* ratings (authentic: α = .87, fake: α = .87, neutral: α = .86) and consisted of the items sociable, likeable, kind, friendly, warm, and attractive. Due to the varied nature of the items relating to the interviewee's *expression*, scale construction proved to be difficult. Items such as spontaneous, genuine, tense (reverse-coded), polite, formal (reverse-coded), charming, flirtatious, and seductive were therefore retained as individual measures in further analyses. The first two expression items (spontaneous, genuine) served as manipulation checks.

Analysis of variance. To rule out possible effects of the identity of the encoder, a preliminary multivariate analysis (MANOVA) was conducted on the dependent measures described above using encoder face as unit of analysis. There was no significant effect of encoder face, $F(24, 47) = 1.62$, $p > .05$, $\eta^2 = .45$. Therefore, results were collapsed across all three encoders to investigate differences as a function of facial expression. A MANOVA with the between-subjects factor sex of perceiver and repeated measures on the facial expression factor was performed on the 4 scale measures (job, decision, confidence, and person) and on each of the expression items. The multivariate main effect of facial expression was highly significant, $F(24, 47) = 7.54$, $p < .001$, $\eta^2 = .79$. Univariate tests showed significant main effects on job, $F(2, 140) = 11.61$, $p < .001$, $\eta^2 = .14$; decision, $F(2, 140) = 8.81$, $p < .001$, $\eta^2 = .11$; and person ratings, $F(2, 140) = 40.70$, $p < .001$, $\eta^2 = .37$; and on each of the expression items: spontaneous, $F(2, 140) = 24.32$, $p < .001$, $\eta^2 = .26$; genuine, $F(2, 140) = 36.56$, $p < .001$, $\eta^2 = .34$; tense, $F(2, 140) = 4.77$, $p < .05$, $\eta^2 = .06$; polite, $F(2, 140) = 16.52$, $p < .001$, $\eta^2 = .19$; formal, $F(2, 140) = 17.78$, $p < .001$, $\eta^2 = .20$; charming, $F(2, 140) = 18.05$, $p < .001$, $\eta^2 = .20$; flirtatious, $F(2, 140) = 18.00$, $p < .001$, $\eta^2 = .20$; seductive, $F(2, 140) = 10.50$, $p < .001$, $\eta^2 = .13$. Means and standard errors are shown in Table 1.

The manipulation of the two temporal forms of smiles was successful. Authentic smiles (long onset and offset, short apex duration) were perceived as significantly more spontaneous and genuine than fake smiles (short onset and offset, long apex duration) or neutral expressions. Interviewees displaying authentic smiles attracted significantly higher ratings and were evaluated more favorably with respect to job attributes and decision ratings than their fake smiling or non-expressive counterparts. Specifically, they were judged to be more suitable, and more likely to be short-listed and selected for the job. Similar effects were found for the person ratings, with interviewees attracting most favorable trait ratings when they showed an authentic smile. The difference between authentic and fake smiles however did not reach significance, as was also the case for various expression items. Overall, the neutral expression was perceived most negatively, with low ratings on almost all dependent measures. No significant effect of expression was found on participants' confidence ratings, $F(2, 140) = 2.59$, $p > .05$, $\eta^2 = .04$. The multivariate main effect of the sex of perceiver was not significant, $F(12, 59) = 1.08$, $p > .05$, $\eta^2 = .18$.

Discussion

There was a strong and significant effect of facial expression on participants' impressions and employment decisions made in the context of a simulated job interview. More positive job evaluations were made of interviewees who showed an authentic smile than of those who exhibited a fake smile or a neutral expression. Moreover, facial expressions affected decisions of the targets' suitability for the job in question. These findings extend previous evidence for synthetic faces (Krumhuber & Kappas, 2005; Krumhuber et al., 2007b), by showing that the temporal parameters of smiles influence not only impressions of the target person but also more consequential decisions. In previous research the effect of smile dynamics on decisions has been demonstrated for human faces (Krumhuber et al., 2007a), but not synthetic ones.

Smiles with dynamic properties that were intended to convey genuineness led to most favorable person and expression ratings. Although the difference between authentic and fake smiles did not reach significance on various items, interviewees who smiled (even though it was a fake smile) attracted more positive evaluations than did their non-expressive counterparts. Thus, some form of smiling, even when it did not appear genuine, had a more positive effect than did remaining neutral. In a further study, we examined whether these findings obtained with synthetic faces would be replicated with human faces. Synthetic faces clearly differ from real faces with respect to photo-realistic quality, so it remains to be seen whether similar variations in the temporal dynamics of smiles leads to similar effects on evaluations and decisions.

Experiment 2

In a second study we explored the impact of smile dynamics in real human faces. The behavior of these faces was manipulated using computer generation techniques. The procedures and measures were in all other respects identical to those used in Study 1.

Method

Participants. Seventy-two participants (36 males, 36 females), aged 18 to 38 years (*M* = 22.89) took part in this study. They were all students at Cardiff University, UK, and were given either course credit or a payment of £3.00.

Stimulus material. The video excerpts were similar to those in Study 1, with the same audio script. Participants were shown three short excerpts (30 s) from a job interview in each of which one of three interviewees reacted with a neutral expression, a fake smile or an authentic smile to a mildly amusing utterance made by the interviewer. The sequence of facial expressions was counterbalanced across interviewees.

Facial stimuli consisted of real human faces that were subjected to computer animation. The three female characters chosen for this experiment were matched on attractiveness (*M* = 5.57, scale 1-7) and trustworthiness (*M* = 4.56), as determined in a pilot study (N = 16). To construct dynamic smile expressions with standardized timing parameters, a smile synthesis model was built on each face (see Cosker, Rosin, & Marshall, 2007). The smile model was restricted to the lower face and was shown against a neutral background movie of the person. Thus only the mouth region was animated (lip corner pull, AU 12), thereby allowing the study of the influence of the smile dynamics independently of *orbicularis oculi* activity (AU 6) (see Krumhuber et al., 2007a, for a similar approach). For animation, smile parameters were extracted from videos of the females by setting landmarks around the mouth, jaw and the corner of the eyes. Using the mouth landmarks, an appearance model of the mouth could be constructed. The resulting appearance parameter then represented a smile as a measure of texture variation, where a full smile represented a maximum change in texture variation with respect to a neutral mouth. Varying the onset, apex, and offset durations of this parameter equated to reordering lower face textures from the original video. This resulted in the creation of smiles with the same temporal properties as those used in Study 1. The smile expression was operationally defined as an upper smile (lip corner pull, AU 12) with mouth opening (AU 25) and synthesized at a medium level of intensity (see Figure 2 for examples of neutral and smile expressions). All smile stimuli lasted 120 frames (i.e., 4 seconds). The three female characters showing three different facial expressions were displayed in random order as movie-clips (504 x 403 pixels) in Medialab (Empirisoft).

Results

Data reduction. Principal components analyses were performed on the 26 items to guide scale construction. As in Experiment 1, items were grouped into four scales that had good internal consistency within each expression condition. The scales were interpreted as *job* (reliable, interested, involved, trustworthy, motivated, competent; authentic: $\alpha = .91$, fake: $\alpha = .93$, neutral: $\alpha = .90$), *decision* (suitable, short-listed, selected; authentic: $\alpha = .91$, fake: $\alpha = .93$, neutral: $\alpha = .93$), *confidence* (confidence/suitable, confidence/short-listed, confidence/selected; authentic: $\alpha = .92$, fake: $\alpha = .92$, neutral: $\alpha = .90$), and *person* (sociable, likeable, kind, friendly, warm, attractive; authentic: $\alpha = .86$, fake: $\alpha = .89$, neutral: $\alpha = .86$). As in the previous experiment, scale construction was not possible for items relating to the interviewee's *expression*. Ratings on the spontaneous, genuine, tense (reverse-coded), polite, formal (reverse-coded), charming, flirtatious, and seductive items were therefore retained as single item scores.

Analysis of variance. A preliminary multivariate analysis (MANOVA) on the dependent measures with face of encoder as unit of analysis showed that there was no main effect of encoder face, $F(24, 47) = 1.32$, $p > .05$, $\eta^2 = .40$. Results were therefore collapsed across all encoders. A MANOVA with the between-subjects factor sex of perceiver and repeated measures on the facial expression factor was performed on the job, decision, confidence, and person scales, and on each of the expression items. As in Experiment 1, there was a significant multivariate main effect of facial expression, $F(24, 47) = 11.97$, $p < .001$, $\eta^2 = .86$. Univariate tests showed significant main effects on all four scale measures: job, $F(2, 140) = 18.12$, $p < .001$, $\eta^2 = .21$; decision, $F(2, 140) = 17.06$, $p < .001$, $\eta^2 = .20$; confidence, $F(2, 140) = 4.07$, $p < .05$, $\eta^2 = .05$; and person, $F(2, 140) = 50.19$, $p < .001$, $\eta^2 = .42$. Furthermore, univariate effects were significant for most of the expression items: spontaneous, $F(2, 140) = 24.54$, $p < .001$, $\eta^2 = .26$; genuine, $F(2, 140) = 21.63$, $p < .001$, $\eta^2 = .24$; tense, $F(2, 140) = 2.23$, $p > .05$, $\eta^2 = .03$; polite, $F(2, 140) = 14.67$, $p < .001$, $\eta^2 = .17$; formal, $F(2, 140) = 8.26$, $p < .001$, $\eta^2 = .11$; charming, $F(2, 140) = 16.73$, $p < .001$, $\eta^2 = .19$; flirtatious, $F(2, 140) = 33.58$, $p < .001$, $\eta^2 = .32$; and seductive, $F(2, 140) = 14.52$, $p < .001$, $\eta^2 = .17$. Means and standard errors are shown in Table 2.

As in Experiment 1, manipulation of the two smile types was successful. Authentic smiles were judged to be significantly more spontaneous and genuine than were fake smiles or neutral expressions. Interviewees displaying authentic smiles attracted more favorable ratings with respect to job, decision, person and expression attributes and than did their fake smiling or non-expressive counterparts. On all three scale measures and several expression items, authentic smiles received the highest scores and these differed significantly from those made in the fake smile and neutral expression conditions. Specifically, interviewees were judged to be more suitable for the job, and more likely to be short-listed and selected. Interestingly, participants were also more confident in their judgments of interviewees who showed a fake smile than they were in their judgments of interviewees displaying a neutral expression. The multivariate main effect of sex of perceiver was not significant, $F(12, 59) = 0.84$, $p > .05$, $\eta^2 = .15$.

Discussion

The results of this experiment are in most respects very similar to those found in Study 1. The temporal quality of interviewees' smiles had a significant impact on impression ratings and employment decisions. In the context of a simulated job interview, participants made more positive evaluations of interviewees who displayed authentic smiles than of those who exhibited fake smiles or neutral expressions. In addition, authentic smiles resulted in more favorable hiring evaluations and employment decisions. The results of this study are consistent with our previous research with human faces (Krumhuber et al., 2007a), in which we found an influence of temporal dynamics on decisions and behavioral intentions in the context of trust games. The fact that similar effects were observed in a job interview setting shows that the effects of variations in the temporal dynamics of smiles generalize across social settings.

As in Study 1, interviewees displaying authentic smiles were evaluated most favorably on person and expression items. The difference between authentic and fake smiles was significant on many measures, showing that participants were sensitive to temporal dynamics of smiles in human faces. Again, neutral expressions attracted the lowest ratings. An interesting finding that we did not find in Study 1 was that confidence ratings were also significantly influenced by facial expression. Participants were more confident about their hiring evaluations when judging fake smiling interviewees as compared with neutral ones.

General Discussion

The goal of the current research was to investigate the impact of varying the temporal parameters of smiles on impressions and decisions made in a simulated job interview context. We also examined whether similar findings would be obtained in response to synthetic faces and human faces. Participants saw either synthetic (Study 1) or human (Study 2) characters who responded to a mildly amusing utterance made by the interviewer either by smiling that looked authentic or fake, or by remaining neutral. It was predicted that authentic smiles would be perceived as more spontaneous and genuine, and would attract more positive person and job ratings than would fake smiles or neutral expressions. In the context of a job interview we assumed that fake smiles in reaction to the interviewer's remark would appear phony, as being put on for impression management purposes.

The results of the two studies confirmed that temporal dynamics had an effect on job, person and expression ratings, and on employment decisions. In general, interviewees displaying dynamic authentic smiles were evaluated more favorably with respect to job attributes, traits and some of the expression items than were those who showed fake smiles or neutral expressions. They were also judged to be more suitable and were more likely to be short-listed and selected for the job. The findings extend previous evidence on the perception of dynamic Duchenne smiles (Krumhuber & Kappas, 2005; Krumhuber et al., 2007b) and show that temporal dynamics similarly influence relevant decisions and behavioral intentions. Moreover, such effects occurred for human as well as for synthetic faces.

For both types of stimulus the timing parameters of dynamic authentic and fake smiles were exactly the same and differed between conditions by only a few milliseconds. Minimal temporal changes in facial displays are therefore sufficient to influence impressions and decisions. Furthermore, this happened in the absence of smile-related activity around the eyes (the Duchenne marker). Such evidence is consistent with our previous findings (Krumhuber et al., 2007a), and shows that temporal dynamics alone have the capacity to influence perceivers' judgments and decisions. This suggests that the temporal parameters of smiling are worthy of careful consideration, alongside the Duchenne marker, as reflections of the genuineness of smiles.

Overall, there was noteworthy correspondence between synthetic and human facial stimuli with respect to the effects of the variations in temporal parameters. This correspondence is consistent with prior research comparing these two types of stimulus with respect to impressions formed on the basis of whole body movements (Bente et al., 2001). Importantly, the present findings suggest that it is safe to generalize from findings observed using synthetic faces to the perception and judgment of human faces. This is valuable from the perspective of emotion researchers interested in using synthetic faces because of the ready way in which they can be manipulated for experimental purposes. It should also be encouraging for computer scientists who are engaged in synthesizing emotions in virtual humans (Blascovich, 2001; Cosker, Paddock, Marshall, Rosin, & Rushton, 2005; Cosker et al., 2007; Takács & Kiss, 2003; Wallraven, Breidt, Cunningham, & Bülthoff, 2005). Although it is challenging to create emotion portrayals that are believable and convincing, the present results suggest that reasonably subtle variations in the dynamics of smiles in synthetic faces have effects on perceivers that parallel those found when similar variations are made in human faces.

The role of nonverbal behavior in shaping the outcome of job selection interviews has been investigated by previous researchers (Edinger & Patterson, 1983; Imada & Hakel, 1977; Young & Beier, 1977). However, the effect of different temporal forms of smile on impressions and decisions in job interviews has not been explored before. The present study extends previous findings by suggesting that it is not only *what* you show on the face, but also *how* you show it that influences impressions and decisions (cf. Imada & Hakel, 1977). Putting on a smile may be advantageous by comparison with remaining neutral, which may be seen as reflecting a lack of interest or involvement. However, the *quality* of the smile also has an influence on the overall impression and subsequent decisions.

A possible limitation of the present research is the fact that only female stimulus faces were used. Future research should examine whether similar effects are also found for male faces. There is evidence of gender stereotypic effects in the perception of facial expressions (Hess, Blairy, & Kleck, 1998, 2000), and specifically smile expressions (Hess, Adams, & Kleck, 2005; Shrout & Fiske, 1981; Senecal, Hess, & Kleck, 1996, as cited in Hess, 2001). If women are expected to smile more than men in a given setting, it may be that the impact of changes in the temporal parameters of smiles would not be the same when seen in the context of a male face. Another limitation is that the present research only considered the effects of varying the temporal parameters of smile expressions. It would be interesting to establish whether changes in temporal dynamics also have an effect on perceptions of negative facial displays. Negative expressions such as anger are regarded as more appropriate in men than in women (Hess et al., 2005), so it is possible that temporal variations in facial displays of anger might lead to different judgments depending on the sex of the encoder.

A final point is that changes in smile dynamics may well interact with other nonverbal or verbal behavior to create impressions and influence decisions in perceivers. Indeed, we know from previous research (Krumhuber et al., 2007b) that the influence of smile dynamics can be moderated by head-tilt behavior. Verbal content may compete with nonverbal behavior in influencing interview impressions (Rasmussen, 1984; Riggio & Throckmorton, 1988). Future research could examine the relative impact of each component. It would be especially interesting to consider the effects of contradictory nonverbal and verbal information (as when an interviewee says that he or she enjoys being challenged at work while smiling in an inauthentic fashion).

The present study has demonstrated the impact of different temporal forms of female smiles on job-related impressions and decisions and has replicated these effects using synthetic and human facial stimuli. It falls to future research to examine responses to variations in the dynamics of smiles in male faces, or to variations in the dynamics of other expressions.

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Footnotes

[1] In the context of this paper, the temporal form or quality of smiles refers to the dynamic or moving aspect of facial expressions and is operationalized in terms of its onset, apex and offset duration.

[2] Clearly, the Duchenne marker as a morphological feature is a perceptible signal in social interaction separate from the effect of temporal features. However, we argue that temporal dynamics may themselves be sufficient to shape perceptions and strategic decisions independent of this morphological marker (see Krumhuber et al., 2007a for a similar approach).

Table 1

Means and Standard Errors (N = 72) for Dependent Measures as a Function of Facial Expression (Experiment 1).

	Facial Expression					
	Authentic smile		Fake smile		Neutral expression	
Measure	*M*	*SE*	*M*	*SE*	*M*	*SE*
scales:						
job	4.41_a	0.10	3.97_b	0.09	3.74_b	0.13
decision	4.44_a	0.14	3.80_b	0.12	3.70_b	0.17
confidence	4.50_a	0.18	4.25_a	0.17	4.46_a	0.16
person	4.42_a	0.12	4.12_a	0.11	3.21_b	0.11
express. items:						
spontane (MC)	5.07_a	0.13	4.64_b	0.16	3.62_c	0.19
genuine (MC)	4.11_a	0.18	3.54_b	0.16	2.35_c	0.14
tense (rvs)	4.17_{ab}	0.17	3.54_a	0.18	4.28_b	0.20
polite	3.64_a	0.19	3.26_a	0.20	2.25_b	0.15
formal (rvs)	3.78_a	0.14	3.76_a	0.16	5.08_b	0.19
charming	4.10_a	0.18	2.89_b	0.18	4.22_a	0.17
flirtatious	3.21_a	0.18	3.12_a	0.17	2.07_b	0.15
seductive	3.15_a	0.17	2.97_a	0.17	2.31_b	0.14

Note. All ratings were made on Likert-scales from 1 to 7, with higher numbers indicating greater levels of that dimension. Row means not sharing a common subscript differ at $p \leq .05$ or better. MC = manipulation check; rvs = reverse scored.

Table 2

Means and Standard Errors (*N* = 72) for Dependent Measures as a Function of Facial Expression (Experiment 2).

	Facial Expression					
	Authentic smile		Fake smile		Neutral expression	
Measure	*M*	*SE*	*M*	*SE*	*M*	*SE*
scales:						
job	3.97_a	0.13	3.09_b	0.14	3.09_b	0.12
decision	4.16_a	0.16	2.99_b	0.16	3.15_b	0.15
confidence	4.70_{ab}	0.18	4.97_a	0.18	4.68_b	0.17
person	4.36_a	0.12	3.37_b	0.14	2.70_c	0.11
express. items:						
spontane (MC)	4.69_a	0.16	3.54_b	0.18	3.14_b	0.18
genuine (MC)	3.85_a	0.18	2.67_b	0.18	2.50_b	0.14
tense (rvs)	4.15_a	0.19	3.72_a	0.19	4.24_a	0.20
polite	3.53_a	0.20	3.43_a	0.25	2.14_b	0.16
formal (rvs)	3.87_{ab}	0.16	3.36_a	0.19	4.46_b	0.21
charming	3.56_a	0.19	2.17_b	0.18	3.50_a	0.19
flirtatious	3.57_a	0.19	2.75_b	0.18	1.97_c	0.12
seductive	3.37_a	0.18	2.49_b	0.17	2.28_b	0.16

Note. All ratings were made on Likert-scales from 1 to 7, with higher numbers indicating greater levels of that dimension. Row means not sharing a common subscript differ at $p < .05$ or better. MC = manipulation check; rvs = reverse scored.

Figure Captions

Figure 1. Three Poser female characters with a neutral expression (top) and an open-mouth smile (bottom) used in Experiment 1.

Figure 2. Three human female characters with a neutral expression (top) and an open-mouth smile (bottom) used in Experiment 2.