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Paper 27

HOW DOES THE TRANSFORMATION OF AN AVATAR FACE GIVING A FAVORABLE IMPRESSION AFFECT HUMAN RECOGNITION OF THE FACE?

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Abstract:
We investigated how different appearances in the favorable impressions of 3D avatar faces affect face-recognition performances by humans. We conducted an encoding and testing experiment using synthesized facial images and artificially manipulated the strength of the perceived impressions in three different dimensions. We also subjectively assessed the favorability of the synthesized faces that were used as visual stimuli in face- recognition tests and found that facial transformation, which decreasedthe favorability impressions, generally deteriorates human face-recognition performance.

Keywords: Social impression of face, morphable 3D facemodel, facial impression manipulation, Thurston's pairedcomparison, face memory

I. INTRODUCTION

Faces play an important role in person-to- person communication as a kind of media that convey a variety of information that involves both personal identity and a person's emotional state and social impressions. This idea also applies to visual communication between humans and synthesized avatar faces based on virtual reality technologies. It remains unclear, however, how the transformation of the appearance of 3D faces actually affects people's identification of such faces. In this work, we investigated the relationship between the favorability of a face and human recognition performance.

II. OUR PREVIOUS WORK

In our previous work [1], we examined whether subjects can identify faces when their specific social impressions have been modulated between encoding and recognition phases.

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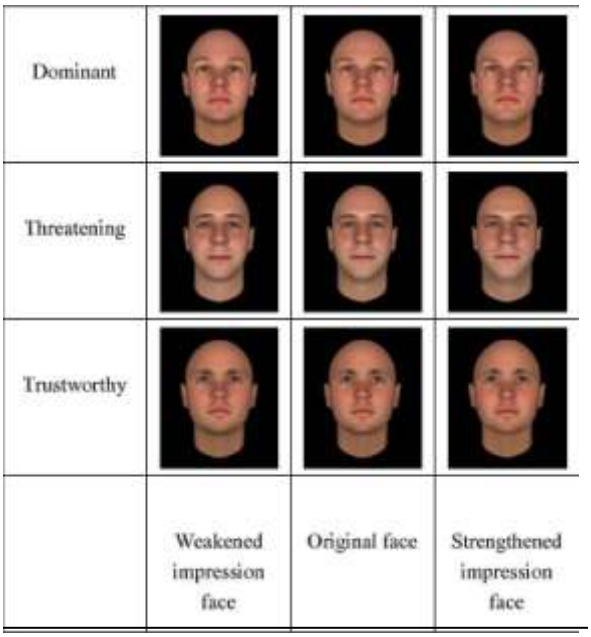

Fig 1. Examples of impression-manipulated faces

The Todorov Face Database [2][3] is a set of computer-generated faces based on the morphable 3D facemodel that was implemented by Facegen Modeler [4] , which is an extension of Blanz and Vetter's work [5]. It includes impression-transformed faces in three different dimensions: trustworthy, dominant, and threatening. For each dimension, impression manipulations were made at several intensity levels. Some examples of impression-manipulated faces are shown in Fig. 1. Subjective scrutiny of the perceived impressions of these stimuli has already been published [2]. Our face identification experiment consisted of encodingand recognition phases, and in both we used a set of imagesprovided by the Todorov Face Database as target anddistractor stimuli. In the encoding phase,
11 face images(including two dummy stimuli that appeared at the testphase's beginning and ending) were presented one by onefor seven seconds. All of the face images were neutral andno impressions were manipulated. We asked the participantsto memorizethem. In the recognition phase, we conductedan old-new recognition test and made judgments on a6-point scale: "I've definitely seen it (1)" to "I've neverseen it before (6)". For this test, we presented 18 faceimages one by one for seven seconds each. Three of theimages were the same neutral faces presented in theencoding phase, three had weakened impressions, and threehad strengthened impressions. The remaining nine weredistracters. We provided three sets of images that dependedon one of the three dimensions assigned for impressionmanipulations: trustworthy, dominant, and threatening.For the analysis method, we introduced hit rates, whichare indexes of the correct recognition performance achievedby humans, to represent the probability of the target facethat was previously presented in the encoding phase that was correctly judged as an already "seen"

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face. We identified three intensity levels of each impressionmanipulation (i.e., strengthened, no change, and weakened)with three semantic direction classes (i.e. positive, neutral,and negative) (Table 1).

Social impressions	Strengthened	No change	Weakened
Trustworthy	Positive	Neutral	Negative
Dominant	Negative	Neutral	Positive
Threatening	Negative	Neutral	Positive

Table 1 Positive/negative categorization of impression manipulations

Fig. 2 shows the hit rates under themanipulation of the original faces with respect to threetypes of social impressions in either positive/negativedirections. We confirmed a significant difference in thecategory of negative impression manipulations. Participantsgenerally failed to properly recognize the encoded faces aspreviously "seen" ones when the impression manipulationwas made in a semantically negative direction (e.g., morethreatening).

Fig. 2 Hit rate for operating impressions

III. EXPERIMENTAL METHOD

Our subjective assessment assigned favorability ratings to each synthesized face used in our previous work [1] as the visual stimuli of the "seen" faces. This procedure was achieved with 120 university participants with Thurston's method of paired comparison[7] for each set composed of four synthesized faces (Fig. 3).

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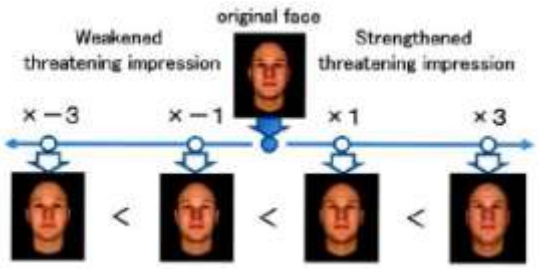

Fig. 3 Examples of impression-manipulated faces directed to paired comparison

Two faces in the set were synthesized by weakening and twoothers by strengtheningtheimpression manipulation degree along each of three dimensions: trustworthy, dominant, and threatening. Each pair of facial images was presented on a 12.5-inch computer display (Fig. 4), and subjects selected relatively favorable faces.

Fig. 4 Display of two stimuli for Thurston's methodofpaired comparison

IV. EXPERIMENTAL RESULTS

Based on the favorability rating results, we classified the face stimuli made by impression manipulation into two classes: relatively favorable and unfavorable faces. Table 2 shows the average hit rates achieved with faces that belong to each favorability class manipulated in terms of specified impression dimensions and in comparison to the average scores achieved with the original faces without impression manipulation.

When the faces were manipulated within the trustworthy dimension that generally projects a positive image to recipients, the difference in the hit rate, caused by the difference in the perceived favorability, was small. But when the faces were manipulated within the dominant and threatening dimensions that generally project negative feelings, the difference in the hit rate, caused by the difference in favorability, was large. Since unfavorable faces among those strengthened with negative impressions are less favorable than those with positive impressions, it seems difficult to recognize faces that have already been seen before.

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Dimension of impressions manipulation	Favorability of synthesized faces		
	Decreased	Original	Increased
Trustworthy	58%	69%	75%
Dominant	25%		67%
Threatening	8%		75%

Table 2 Hit rates achieved in seen-unseen tests

Table 3 shows the result of a one-way analysis of variance (ANOVA) conducted for the hit rate in which the three levels for the strength of impression manipulation were analyzed. The main effect of the strength of the impression manipulations was significant ($F(2, 29) = 4.238$, $p < .05$). Thus we found that the hit rate is affected by differences in the strength of impression manipulations.

Table of Analysis of Variance

source	SS	df	MS	F	p
Acst reneth of the impression	0.6371528	2	0.3185764	4.238	0.0251 *
error[MC]	2.0295139	27	0.0751672		
Total	2.6666667	29			

+ p<.10, * p<.05, ** p<.01, *** p<.005, **** p<.001

Table 3 Results of analysis of variance

V. CONCLUSION

We found that people generally failed to properly recognize encoded faces as previously "seen" ones when impression manipulation reduced their favorability. We expect that such findings will contribute to designing avatars with higher communicative competence, especially in people-search applications. Based on the results obtained by a pairwise comparison method, our future work will investigate whether gaze movements during recognition tests differ depending on the face's favorability.

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