Simulating Deceptive Cues of Joy in Humanoid Robots

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Abstract. Although generally not appreciated, lying constitutes a great part of human conversation. Thereby the nonverbal behavior plays a crucial role, as so-called deception cues can reveal the real intention or emotion by facial expressions or body movements. In this paper, we examine facial cues of deception and present a preliminary perception study with a humanoid robot that exhibits these cues. Initial results indicate that the shown expressions affect the observer's impression.

Keywords: Social Robots, Affective Computing, Facial Expressions.

1 Introduction

Most people would spontaneously not admit that they lie on a daily basis or that they would appreciate being lied to. DePaulo and colleagues [1] investigated this phenomena in more detail by testing daily deceptive situations. *"As predicted, lying was an everyday event."* Their results reveal, amongst others, that *"students reported lying in approximately one out of every three of their social interactions"*[1].

When humans lie, deception cues often show unintentionally in their nonverbal behavior. In principle, a humanoid robot could conduct a perfect lie, meaning that no cues would show on its face or in its body movements. In this contribution we address the question whether it is possible to convey subtle cues as shown during lies with the limited channels of expression of humanoid robots. It should be noted that a robot should not touch the domain of *serious lies* which could be harmful to a human user. However, so-called *social lies*, as commonly used for politeness reasons, might be a desirable feature of a humanoid robot.

Most related work on deceiving robots takes a game-theoretic approach to model the robot's strategic behavior by enhancing their decision by a deceptive layer. Work has been carried out by Wagner and Arkin, e.g. [2], who developed an algorithm to determine for an artificial system whether deception is warranted in a social situation. Other work investigates the question whether a robot can successfully deceive humans and presents studies where a robot showed behavior against the user's prediction [3]. In contrast, we do not target strategic lies but focus on simulating socially desired behaviors. To the best of our knowledge,

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no research has been carried out so far on showing subtle emotional expressions such as deception cues with a humanoid robot.

In the area of virtual humans, facial deception cues have been investigated. Buisine and colleagues [4] present the simulation of blended emotions on different modalities of a virtual character along with the perception of these complex emotions on human observers. In our own former work [5], we found that even subtle expressions of deception can have a negative impact on the users' perception of an agent. To this end, it is not certain whether the observations made for virtual characters apply for humanoid robots as well.

2 Background

The most fundamental and influential work on lies and deception was presented by Ekman and colleagues (e.g., [6,7]). Several modalities of human behavior can be involved while lying. In this paper, facial expressions are further investigated.

According to Ekman and colleagues' studies, there are at least four ways in which facial expressions may vary if they accompany lies: (1) Micro-expressions: A false emotion is displayed but the felt emotion is unconsciously expressed for the fraction of a second. (2) Masks: The felt emotion is intentionally masked by a not corresponding facial expression. (3) Timing: Facial expressions accompanying felt emotions do not last for a very long time. Thus, the longer an expression is shown the more likely it is accompanying a lie. (4) Asymmetry: Voluntarily shown facial expressions tend to be displayed in an asymmetrical way.

In the research literature from the social sciences a real smile (often refered to as Duchenne smile) contains not only lip movements but also movement in the eye region. A so-called faked smile (or Pan-Am smile) vice versa lacks this motion in the eye region, e.g., [6,8].

3 Facial Deception Cues for a Humanoid Robot

For our implementation, we use the *Hanson Robokind* robot Alice[1] which provides a silicon face that can be animated by internal motors. Our facial animations are based on the Facial Action Coding System (FACS) [9] that describes over 40 Action Units (AUs) for a human face. We identified seven of the AUs that can be simulated with the robot's joints: Upper face: *inner brows raiser* (AU 1), *brow lowerer* (AU 4), *upper lid raiser* (AU 5) *eye closure* (AU 43); Lower face: *lip corner puller* (AU 12), *lip corner depressor* (AU 15), and *lip opening* (AU 25).

One facial expression was designed to simulate a real joyful face (Duchenne smile) that serves as a basis for comparison with deceptive smiles. Another facial expression simulates the faked smile (Pan-Am smile) where no movement in the eye region is shown. According to Eckman [9] voluntary produced smiles are often displayed asymmetrically. Following FACS, we created different intensities

[1] http://hansonrobokind.com

of asymmetric smiles varying in how far each lip corner is pulled upwards: AB, AC, BC (A=trace, B=clearly visible, C=marked). In masks, different emotions are blended on different parts of the face. Most commonly smiles are used to mask real emotions. For our experiment we blended anger or surprise shown in the eye-region with a smile. Micro expressions and timing were not investigated for reasons such as too slow maximum speed of the joints or audible movements. Figure 1 shows different variations of smiles on the robotic face. Please note, that the motion into these final states is more expressive than the pictures.

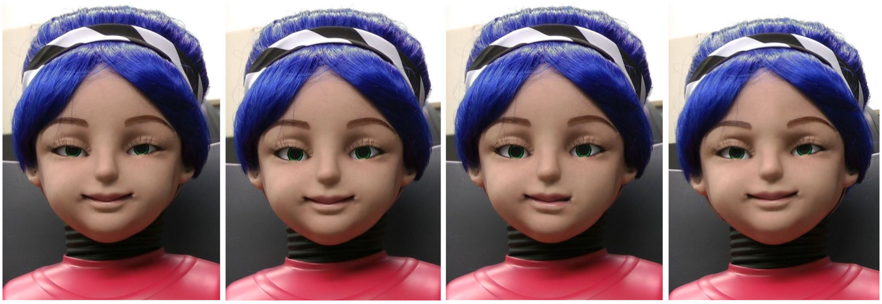

Fig. 1. Different smiles shown on the robotic face. Left: smile with eyes; middle-left: smile without eyes; middle-right: asymmetric smile (AC), right: blended anger.

4 Preliminary Study

In a preliminary perception study we addressed the question whether users react to the subtle deception cues or whether they stay unrecognized. Therefore, seven videos of the animated robotic face were embedded in an online survey, where human observers had to judge how happy Alice seems on a 7-point Likert scale (unhappy to happy): smile with eyes (real or Duchenne smile), smile without eyes (faked or Pan-Am smile), asymmetric smiles (varying in intensities AB, AC, BC), blended surprise, and blended anger. We hypothesize that the *deceptive* smiles are perceived as less happy than the *real* smile (Duchenne smile).

96 participants took part in our study (28 female, 68 male, mean age 22.5). The mean values of their ratings are summarized in Figure 2. We conducted a repeated-measures ANOVA with different facial expressions as within-subjects factor. The test revealed a significant main effect on perceived happiness, $F(6, 90) = 30.275, p < .000$. Within-subject contrasts were calculated, comparing each of the deceptive facial expressions with the expression simulating a real smile (smile with eyes). Regarding asymmetrical smiles, we archived significant results ($p < .000$) for the intensities AB and AC, being rated less happy than symmetric smiles independent from their different eye movements. In line with Krumhuber and Manstead [8], who found that the typically mentioned crinkles around the eyes are not a good hint to spot faked smiles, no differences were observed comparing the smile with eyes to the smile without eyes ($p > .05$). Blended emotions (blended anger and blended surprise) did not show the intended results ($p > .05$) and were rated quite similar to the smile with or without eyes. Both

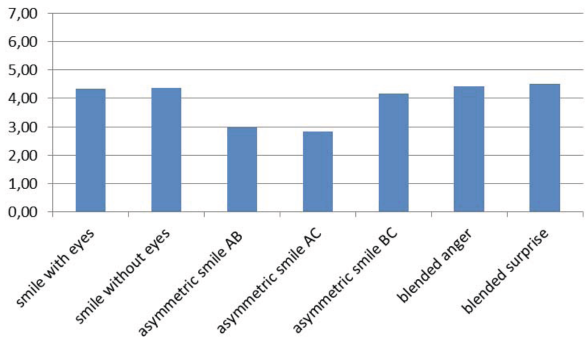

Fig. 2. Mean values of perceived happiness for the different smile conditions

latter results suggest that participants focused on the mouth region more than on the eye region of the robot.

5 Conclusions and Future Work

The present contribution investigates deception cues for a humanoid robotic face and presents a first step towards robots that are able to show subtle emotional cues as indicators of socially expected lies.

As a next step, our findings need to be integrated into a greater scenario, to see whether the solely nonverbal differences investigated in this study apply to a multi-modal setting.

References

1. DePaulo, B.M., Kashy, D.A., Krikendol, S.E., Wyner, M.M., Epstein, J.A.: Lying in everyday life. Journal of Personality and Social Psychology 70(5), 979–995 (1996)
2. Wagner, A.R., Arkin, R.C.: Acting deceptively: Providing robots with the capacity for deception. International Journal of Social Robotics 3(1), 5–26 (2011)
3. Terada, K., Ito, A.: Can a robot deceive humans? In: Proc. of 5th ACM/IEEE Int. Conf. on Human-Robot Interaction (HRI), pp. 191–192 (2010)
4. Buisine, S., Abrilian, S., Niewiadomski, R., Martin, J.-C., Devillers, L., Pelachaud, C.: Perception of blended emotions: From video corpus to expressive agent. In: Gratch, J., Young, M., Aylett, R.S., Ballin, D., Olivier, P. (eds.) IVA 2006. LNCS (LNAI), vol. 4133, pp. 93–106. Springer, Heidelberg (2006)
5. Rehm, M., André, E.: Catch me if you can - exploring lying agents in social settings. In: Int. Conf. on Autonomous Agents and Multiagent Systems, pp. 937–944 (2005)
6. Ekman, P.: Telling Lies - Clues to Deceit in the Marketplace, Politics, and Marriage. Norton & Company, New York (1992)
7. Ekman, P., Friesen, W., O'Sullivan, M.: Smiles when lying. Journal of Personality and Social Psychology 54(3), 414–420 (1988)
8. Krumhuber, E.G., Manstead, A.S.: Can duchenne smiles be feigned? new evidence on felt and false smiles. Emotion 9(6), 807–820 (2009)
9. Ekman, P., Friesen, W.: Facial Action Coding System (1978)