Cognitive Processing of Humanoid Robots' Faces: Detecting Anthropomorphism through Scrambled Face Decision Tasks.

Cocchella F. [1,2], Sacino A.[3,4], Rea F. [5], Sciutti A.[1], & Andrighetto L.[4].

1 CONTACT Unit, Italian Institute of Technology (IIT), Genova. **2** DIBRIS, University of Genoa, Genova. 3 Department of Psychology, University of Bologna, Bologna. **4** DISFOR, University of Genova, Genova. **5** RBCS, Italian Institute of Technology (IIT), Genova.

francesca.cocchella@iit.it

INTRODUCTION

- Anthropomorphism (Epley et al., 2007) plays an important role in facilitating the acceptance of social robots (SR; Duffy, 2003).
- Faces are a prominent element in the process of social judgment (Todorov, 2017).
- No systematic investigation of the cognitive processing featuring humanoid robots' faces.

Research question: Are SR's faces cognitively processed as human stimuli or as objects?

Cognitive elaboration of stimuli is considered a continuum between analytical process (typical of objects) and configural process (typical of humans)

The study of cognitive elaboration:

1) Inversion Effect Paradigm (Sacino et al., 2022). SR's Bodies are cognitively anthropomorphized at all levels of human-likeness while only SR's faces with **high** levels of human-likeness are cognitively anthropomorphized.

2) Scrambled Effect Paradigm: a better tool to study faces (Reed et al., 2006).

TWO EXPERIMENTAL STUDIES

Research aim: Examining the cognitive anthropomorphism of social robots' faces through scrambled face tasks, outlining possible factors modulating this cognitive process: (**1**) The human-like appearance (**2**) The salience of social categorization of robots (Hackel, 2014).

METHOD

Face Stimuli:
- humans (created ad hoc)
- high and low human-like robots (ABOT database)

STUDY 1: 118 participants (Male = 73, M_{age} = 26,9; *SD* =11,8).
- 96 trial (32 per category).
- Experimental design: 2 (stimulus manipulation: intact vs. scrambled) x 3 (stimulus category: human faces vs. robot faces with high human-likeness vs. robot faces with low human-likeness) with both factors within-subjects.

The categorization of the stimuli (human vs robot) declared to the participant before each block

STUDY 2: 159 participants (Male= 79; M_{age} = 29.6; *SD* = 14).
- Same procedure as Study 1.

This time the categories (robots vs human) are not declared to the participant before each block

Stimuli Manipulation: (e.g., Leder & Bruce 2000; Dahl et al., 2011.)

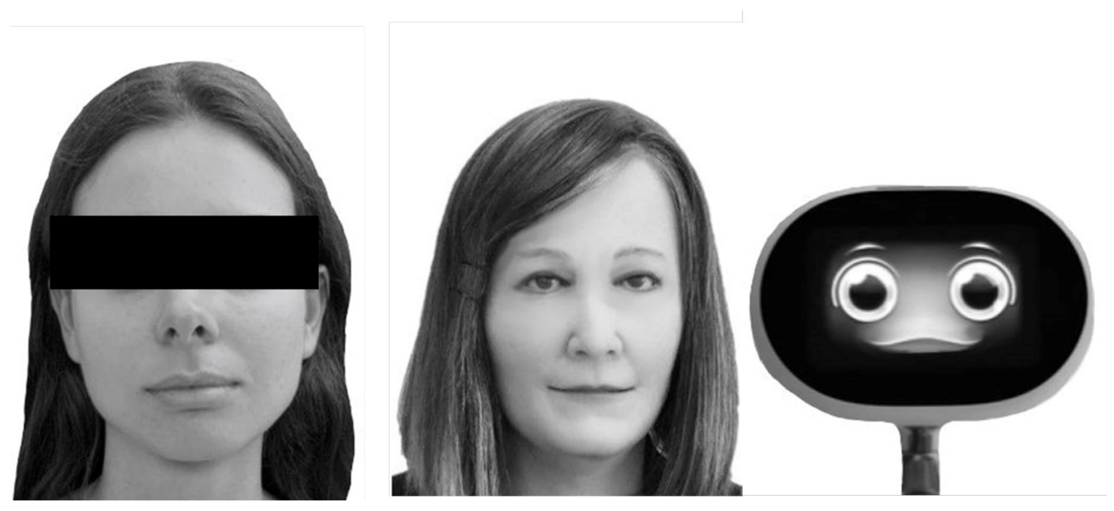

Figure 1. Example of stimulus manipulation: human intact face, high human-like robot scrambled face, low human-like robot scrambled face.

"An image will remain on the screen for only a few moments. Immediately afterward you will be presented with two images, one next to the other, and you will have to press a button to indicate which of the two images is the same as the one you saw previously."

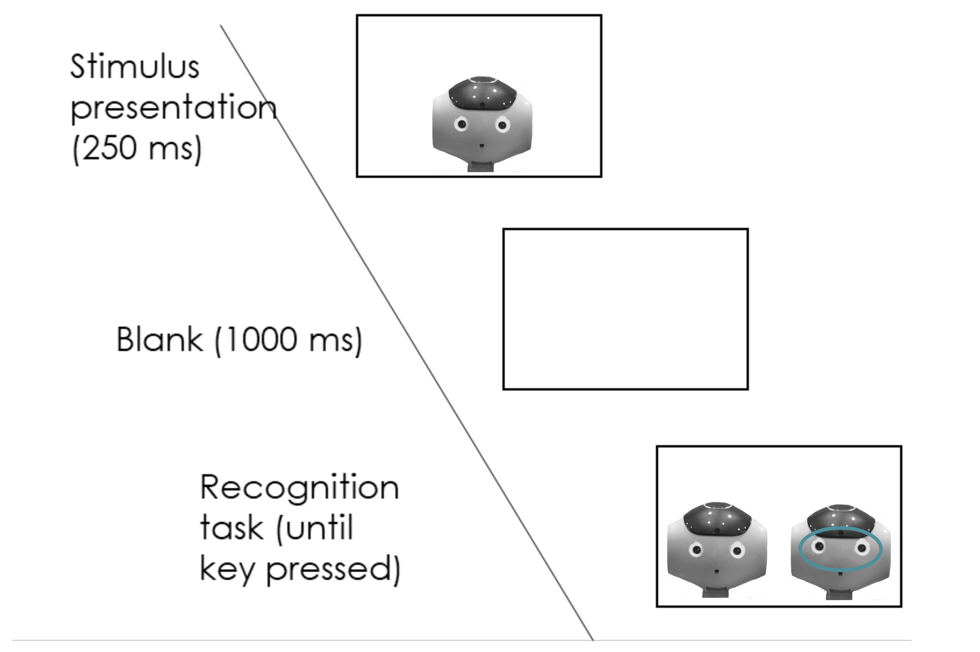

Figure 2. Example trial of the scrambled effect task, SR stimuli.

RESULTS

STUDY 1: *explicit categorization of stimuli (robot vs human).*

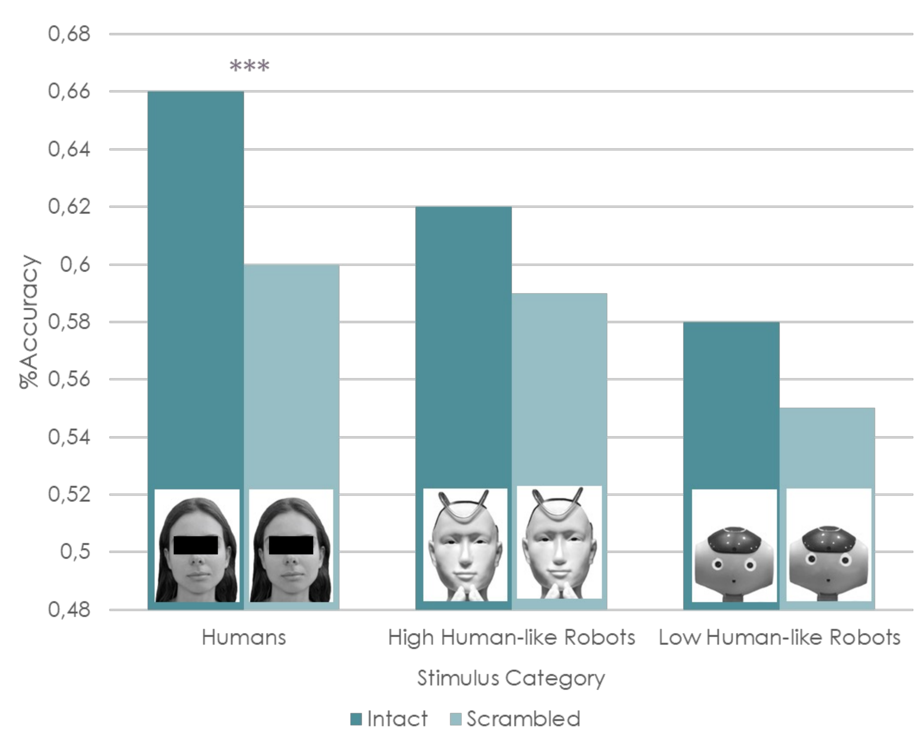

Figure 3. Accuracy (% of correct responses) results of Study 1.

Main Effects:
- Stimulus manipulation: $\chi2(1)$ = 14.50, p < .001
- Stimulus category: $\chi2(2)$ = 5.41 p = .067

Interaction - Stimulus category X Stimulus manipulation: $\chi2(2)$ = 1.47, p =.479

- Only in the human category ($\chi2$ = 9.87, p =.002) the stimuli are better recognized intact than scrambled.

STUDY 2: *non-explicit categorization of stimuli.*

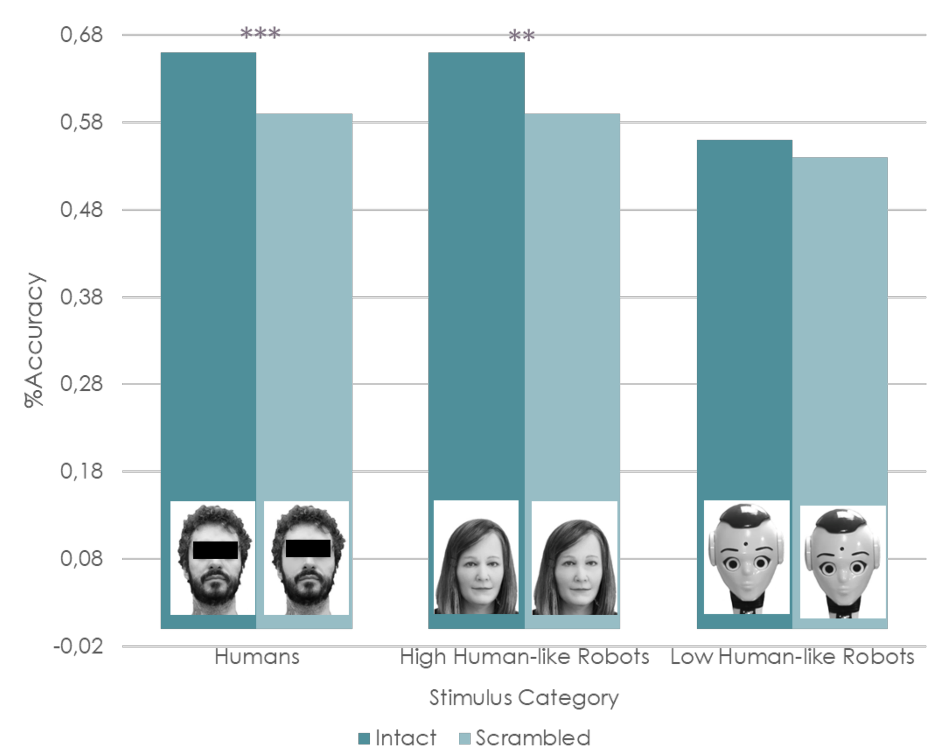

Figure 4. Accuracy (% of correct responses) results of Study 2.

Main Effects:
- Stimulus manipulation $\chi2(1)$ = 40.28, p < .001
- Stimulus category: $\chi2(2)$ = 23.21 p < . 001

Interaction – Stimulus category x Stimulus manipulation $\chi2(2)$ = 9.41, p =.009.

- Scrambled Effect for Humans and High Human-like Robots, not for Low Human-like Robots.

CONCLUSIONS

Remarks:
- High human-like robots are cognitively anthropomorphized only when their categorization as robots is not salient (Study 2), not when it is salient (Study 1).
- Low humanlike robots are not cognitively anthropomorphized.

The **salience of categorization** (second-order process) **affects the cognitive anthropomorphism** (first-order process) of (high human-like) social robots.

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