Design and Evaluate Embodied Agents

Procheta Nag
M.Sc. Research, Simon Fraser University

Research Summary

This research is intended as an effort towards a progressive and inclusive approach for gender representations in virtual agents.

- Researched and identified problem space of AI conversation system through user testing, qualitative and quantitative study and secondary research.
- Ideate and created new design solution for 3D embodied agents
- Validated and iterated design with two quantitative and qualitative study
- Evaluated the research assumption by quantitative research method

Virtual Agent

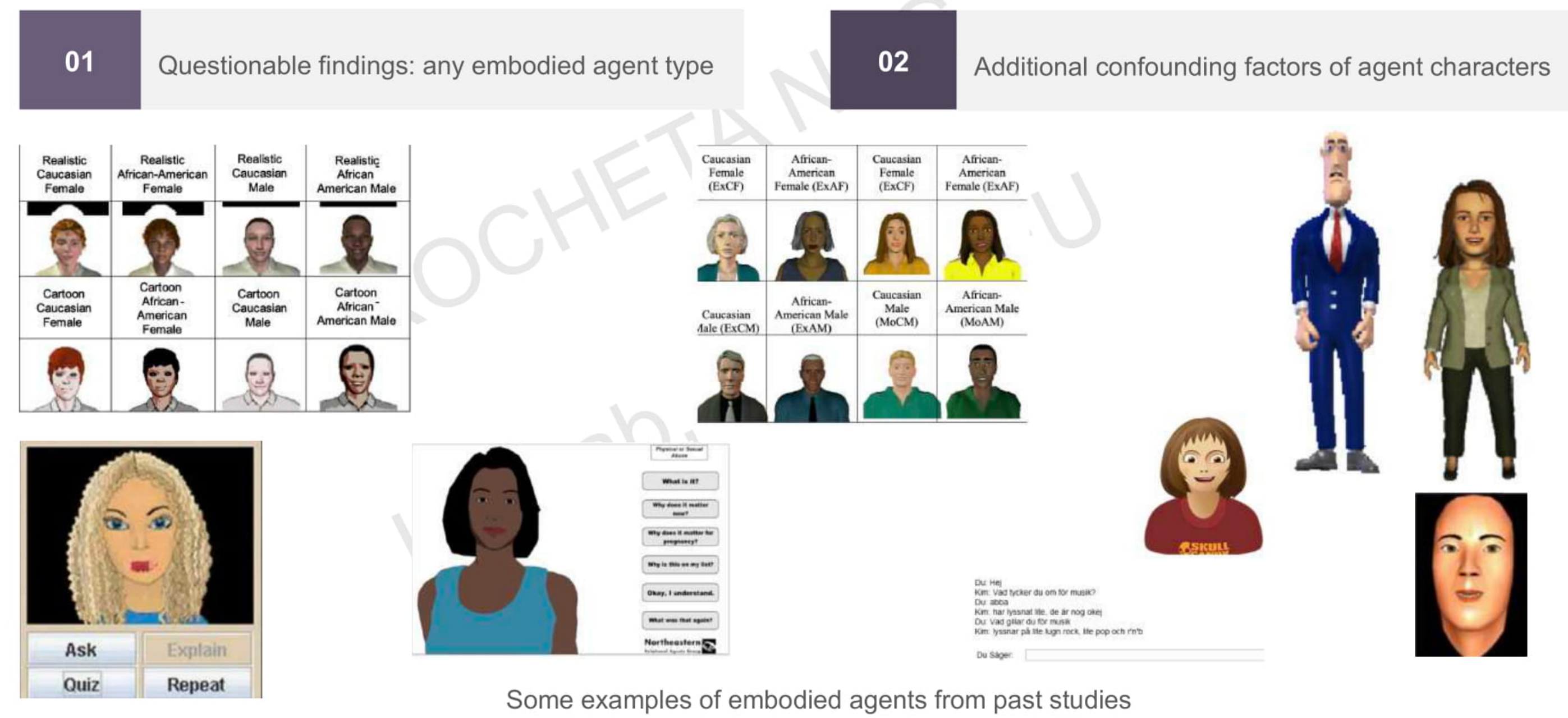Virtual Agents (VA) are AI agents created for user (human) interaction like:
- Chatbots
- Voice only agents
- Embodied agents
- Embodied conversational agents (ECA)

(Cassell et al., 2000)
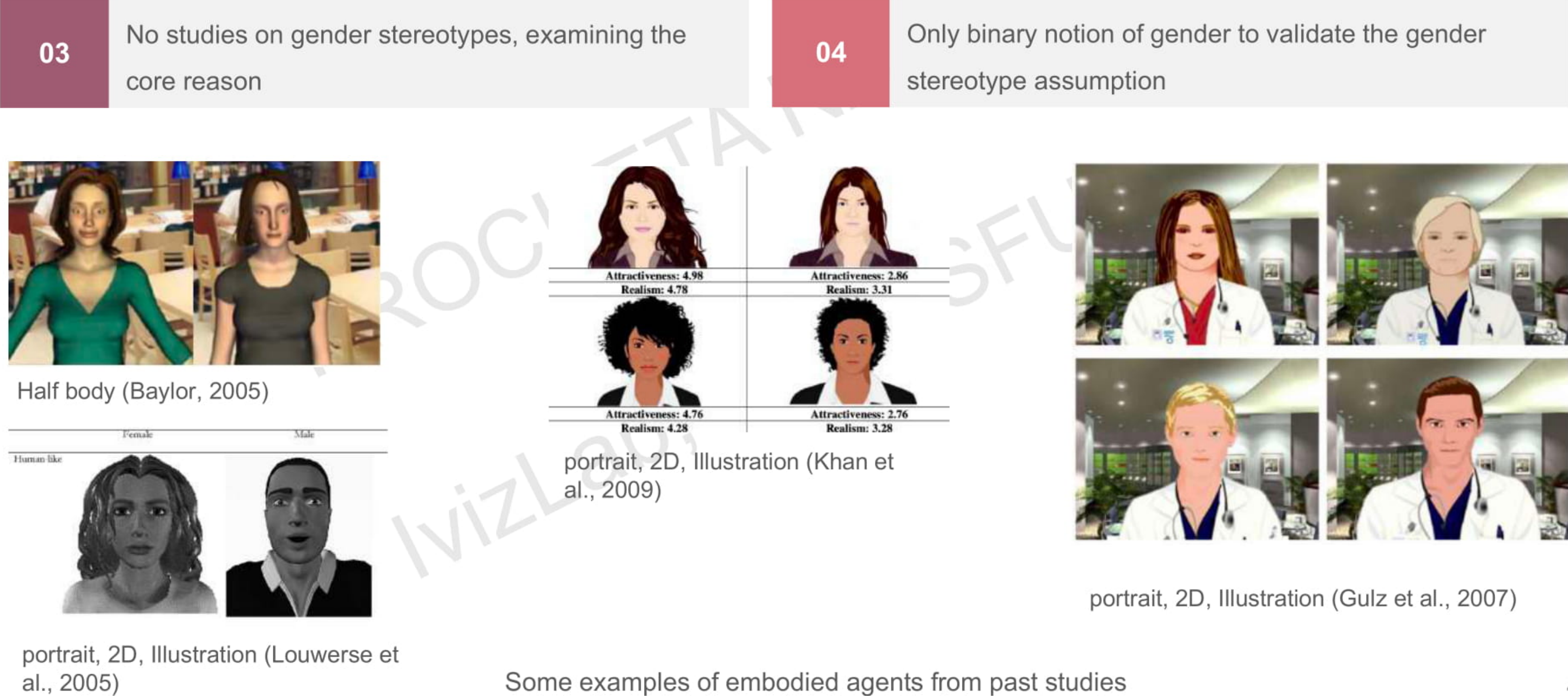

Virtual AI Agent (ivizlab)

Issues with past studies

(From literature review)

01	Questionable findings: any embodied agent type

02	Additional confounding factors of agent characters

Some examples of embodied agents from past studies

Issues with past studies

From literature review

03	No studies on gender stereotypes, examining the core reason

04	Only binary notion of gender to validate the gender stereotype assumption

Half body (Baylor, 2005)

portrait, 2D, Illustration (Khan et al., 2009)

portrait, 2D, Illustration (Louwerse et al., 2005)

portrait, 2D, Illustration (Gulz et al., 2007)

Some examples of embodied agents from past studies
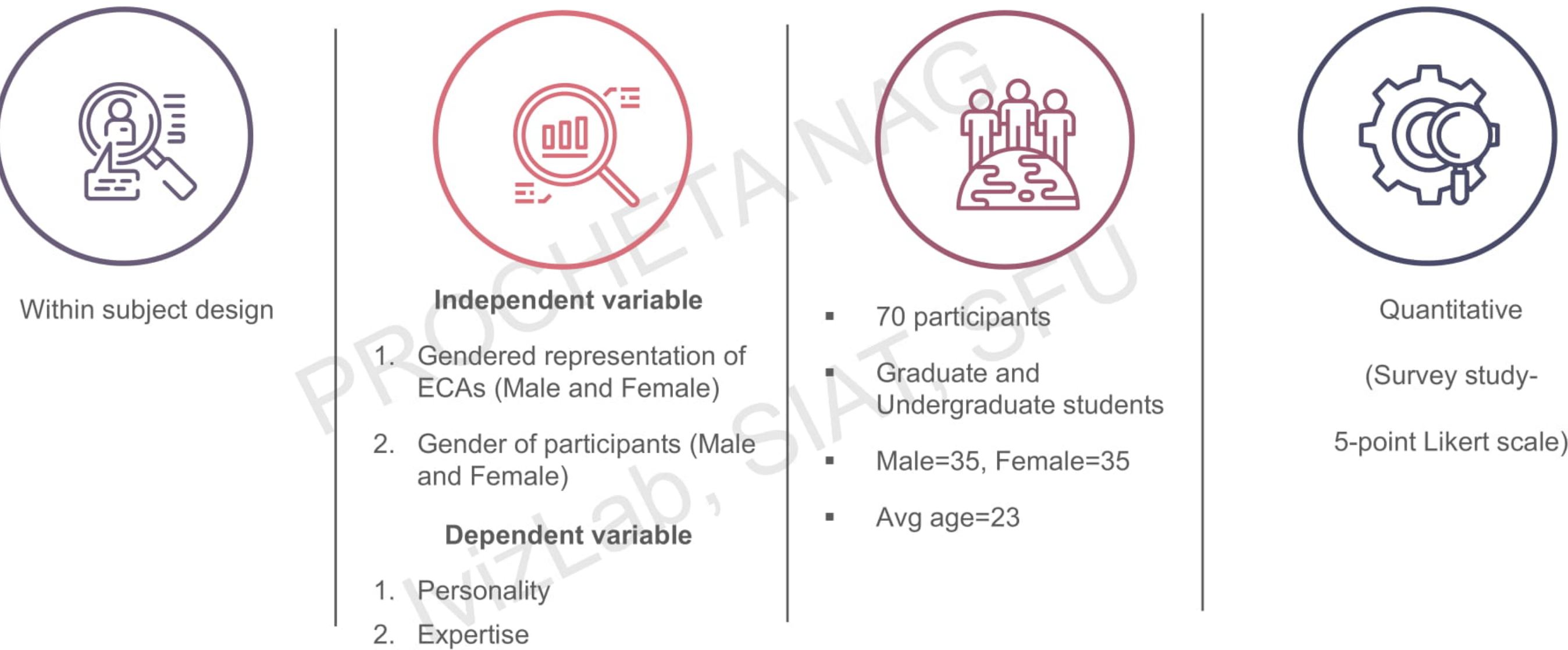
Research Objectives

Objective #1
Examine the **effect of gender during a user's conversation** with the embodied conversational agent (ECA).

Objective #2
Examine the user experience on perceiving realistic 3D ECA characters, where **all other factors are kept as uniform as possible**, to measure for differences in ECA visual gender cues only.

Objective #3
Examine the effect of the agents' gender-related appearance: **male, female and androgynous**, on user perception in terms of gender stereotype traits and roles.

Research Questions

Question #1
When only varying with binary gender related appearance of embodied virtual agents (ECAs), how does the experience of the user change?

Question #2
Moving past binary distinctions of male and female, how does the more fluid notion of gender (or even gender neutral) affect a user's experience with ECAs?

Question #3
How does the gender-related appearance of male, female and androgynous agents impact the user perception in terms of gender stereotypes traits?
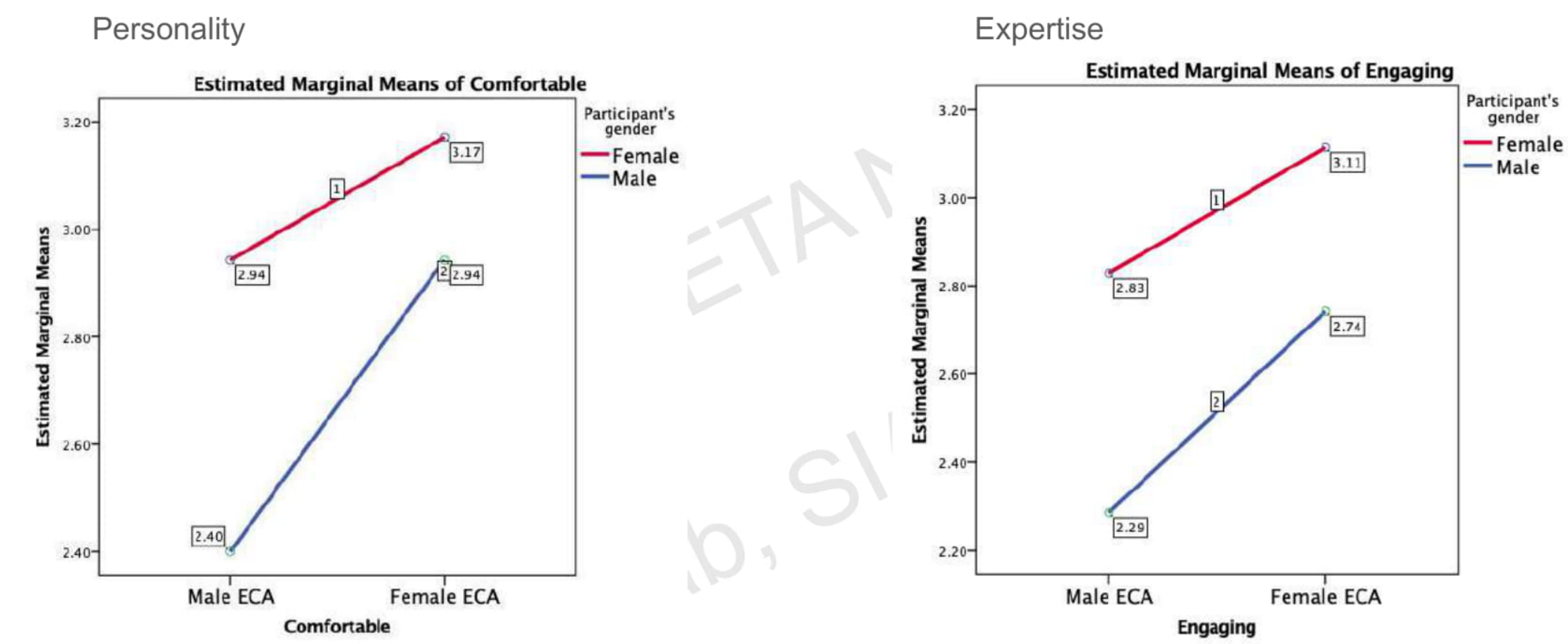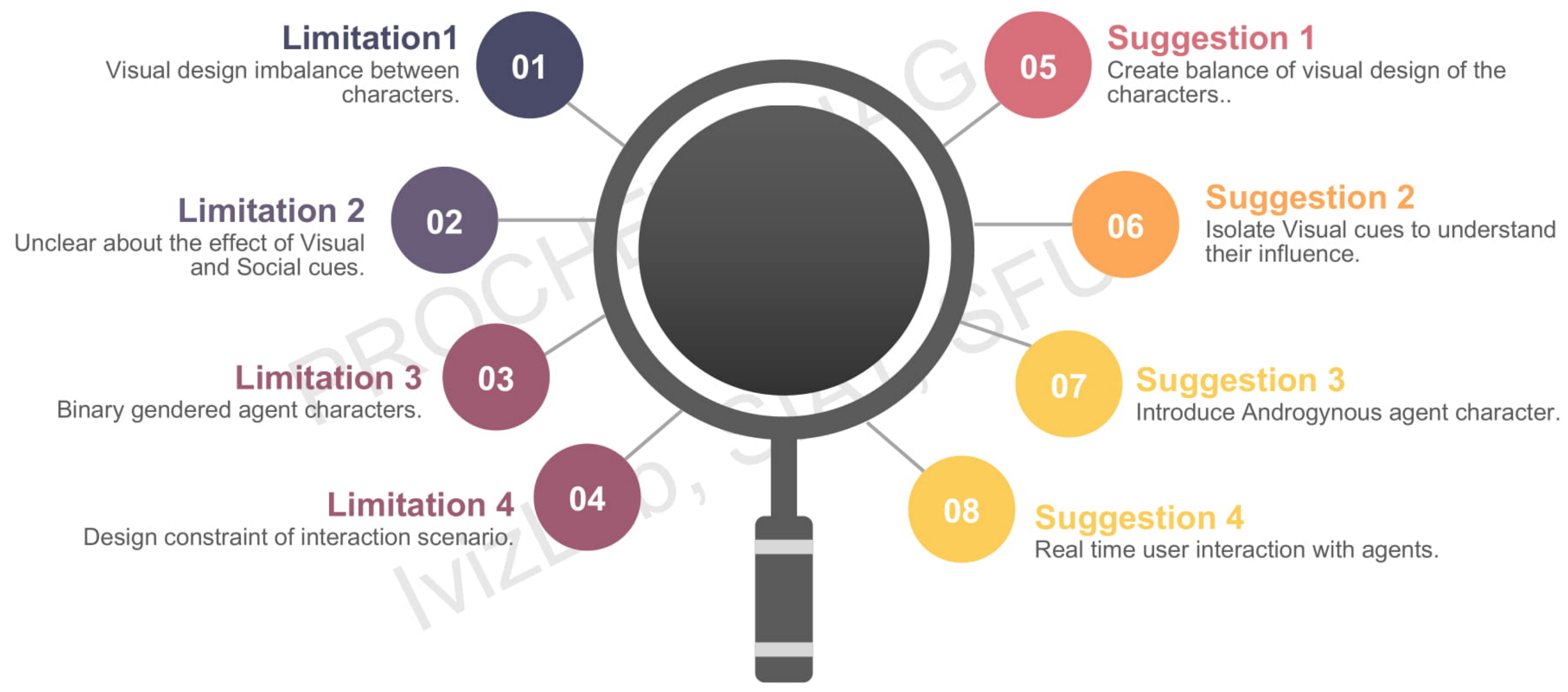
Study Design STUDY 1

Study 1 description

- Within subject design
- **Independent variable**
  1. Gendered representation of ECAs (Male and Female)
  2. Gender of participants (Male and Female)

  Dependent variable
  1. Personality
  2. Expertise

- 70 participants
- Graduate and Undergraduate students
- Male=35, Female=35
- Avg age=23

- Quantitative
  (Survey study- 5-point Likert scale)

Results STUDY 1

Used Two way 2 (ECAs gender: male or female) *2 (participant's gender: male and female) mixed ANOVA with repeated measures

Personality — Estimated Marginal Means of Comfortable

Expertise — Estimated Marginal Means of Engaging

- Significant main effect of comfortable conversation and engaging, $p<.001$
- Participants rated female conversation as more comfortable and engaging than male regardless of gender.
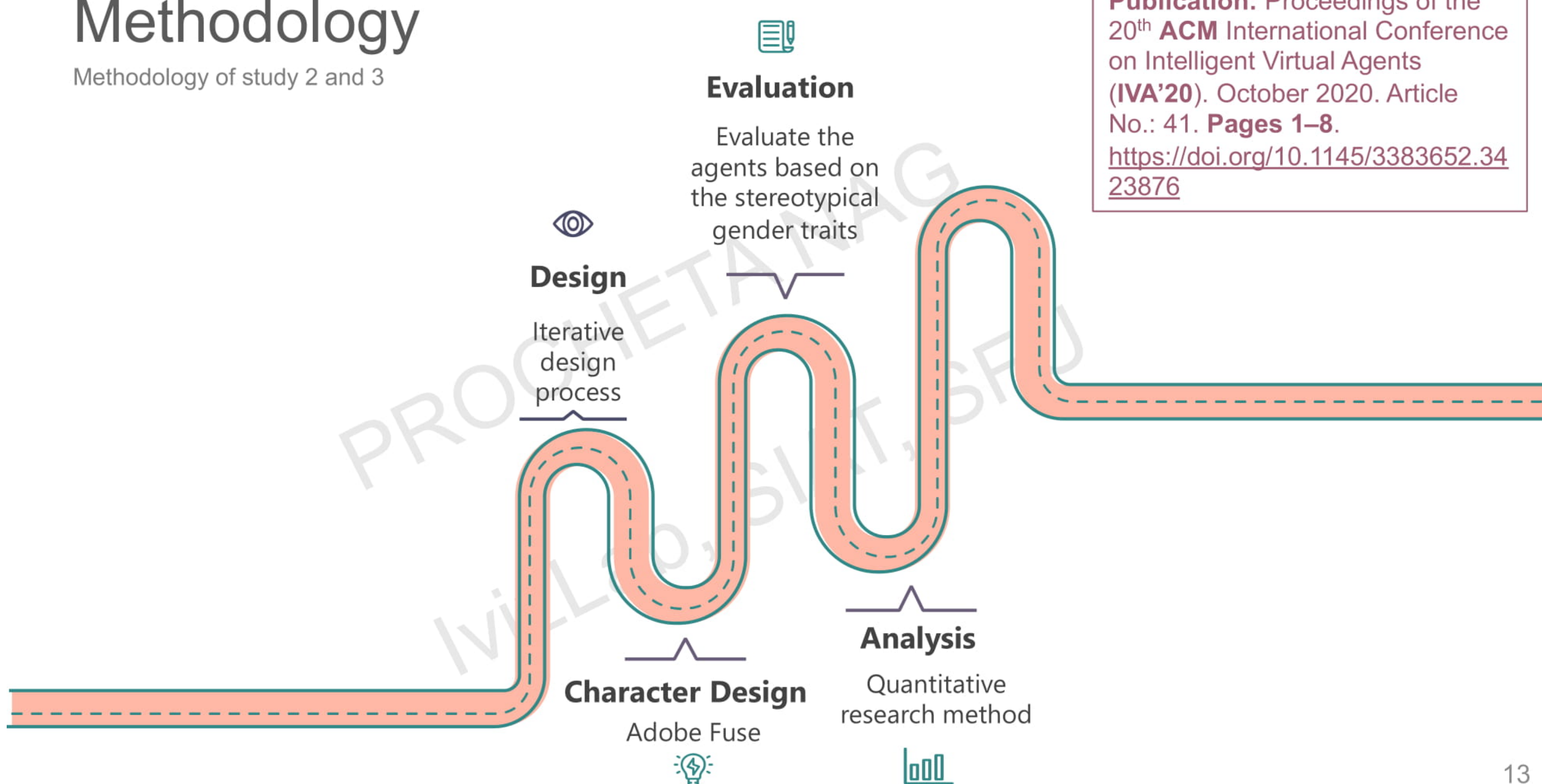
Discussion STUDY 1

Lessons learned from study 1 applied to study 2 and 3

Limitation1
Visual design imbalance between characters.

Limitation 2
Unclear about the effect of Visual and Social cues.

Limitation 3
Binary gendered agent characters.

Limitation 4
Design constraint of interaction scenario

Suggestion 1
Create balance of visual design of the characters..

Suggestion 2
Isolate Visual cues to understand their influence.

Suggestion 3
Introduce Androgynous agent character.

Suggestion 4
Real time user interaction with agents.

Methodology

Methodology of study 2 and 3

Design
Iterative design process

Character Design
Adobe Fuse

Analysis
Quantitative research method

Evaluation
Evaluate the agents based on the stereotypical gender traits

13

Hypothesis

Combined hypothesis of study 2 and 3

Following the recent findings of Eagly and colleagues (Eagly et al.,2020) ...

1 **Hypothesis 1**
Communion traits would be rated significantly higher for the agents that are perceived as female, followed by androgynous and male agents.

2 **Hypothesis 2**
Agency traits would be rated significantly lower for the agents that are perceived as female, followed by androgynous and male agents.

3 **Hypothesis 3**
Competence traits would not be significantly different between agents that are perceived as more female, androgynous and male.

Design Character

First Iteration of Character Design

Avoided Clothing, Skin, hair and eye color, Body type and height, Facial expression differences.

M1 M2 A1 F1 F2 A2

Male (M1,M2), Female (F1,F2) and Androgynous (A1,A2) characters design

Design rational › **Design character** › Study › Result › Discussion 17

Design Evaluation

First Iteration of Character Design

Survey study

- 15 participants
- Familiar with 3D character and agent
- Male=8, Female=6
- Avg age=25

- Slider (0--------------20)
  (0: male, 10: androgynous, 20: female)
- Comment box

Design rational › Design character › **Study** › Result › Discussion 18

Redesigned **Male, Female and Androgynous** Characters

Second Iteration of Character Design (A…=Androgynous, M…=Male, F…=Female)

Removed overlooked features **Adam's apple, wide neck** and fuller **eyelashes**

F1.2 A1.5 A1.1 A1.3 A1.2
F3 M3 A1.6 A1.7 A1.9

Design Character › Study › Result › Discussion 20

Study Procedure

Conducted survey on Amazon Mturk with a link to a survey prepared in the Survey Monkey platform.

Male agent character | Androgynous agent character | Female agent character

* 6. In your opinion, which of these the following words defines the agent you see in the picture above?
The agent looks ...

| | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
Affectionate

* 7. In your opinion, which one of the roles below would fit the agent you have seen in the picture above?

| | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
Personal Assistant

To be continue | To be continue

25

Study Design

Study 3 design

Within subject design

Independent variable
1. Gendered representation of ECAs (Male, Female and Androgynous)
2. Gender of participants (Male and Female)

Dependent variable
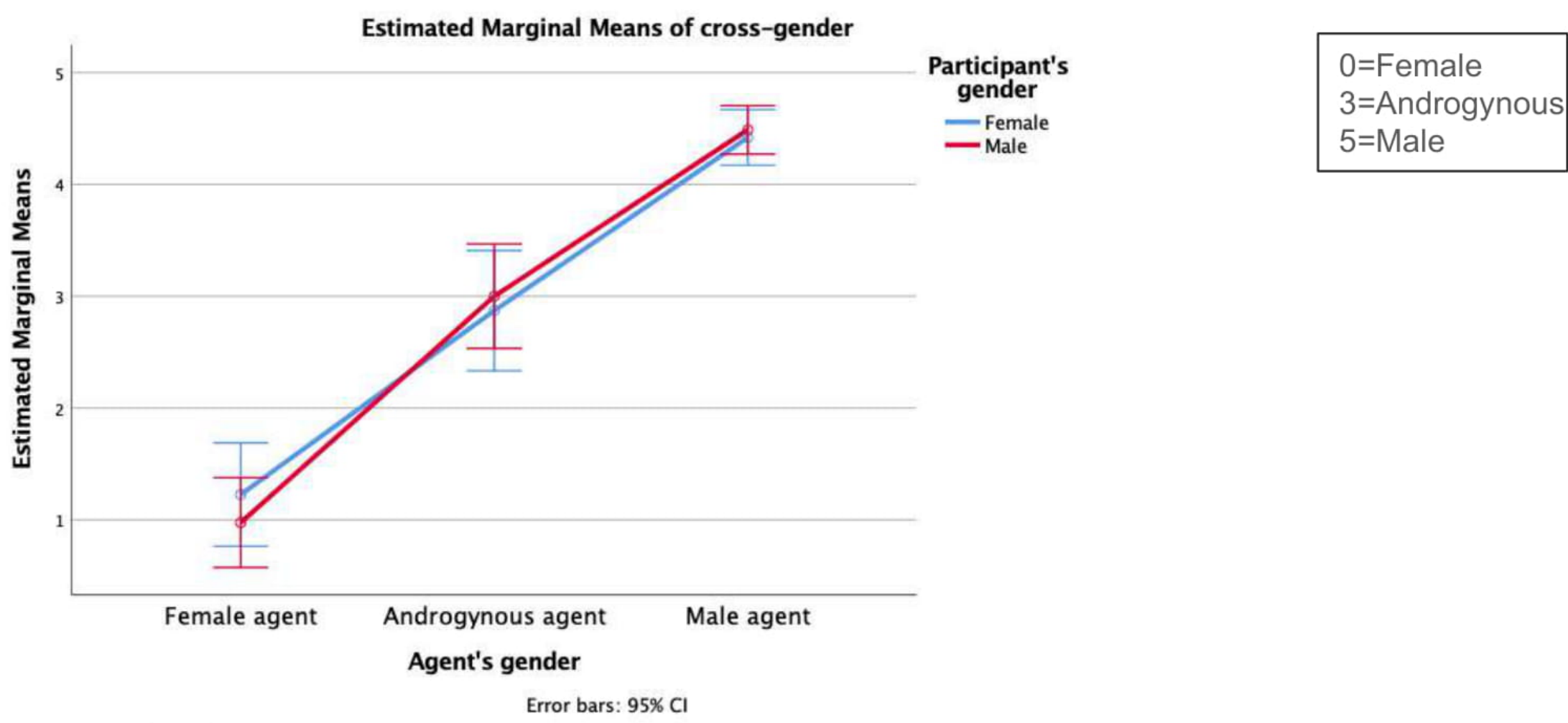1. Agency, communion and competence
2. Roles

- **72 participants**
- Amazon Mturk
- Male=41, Female=31
- Age= 25-34 (majority)

Quantitative method
(5-point Likert scale)

Results

Agents gender related appearance and its correlation with the gender score based on participant's gender.

Estimated Marginal Means of cross-gender

0=Female
3=Androgynous
5=Male

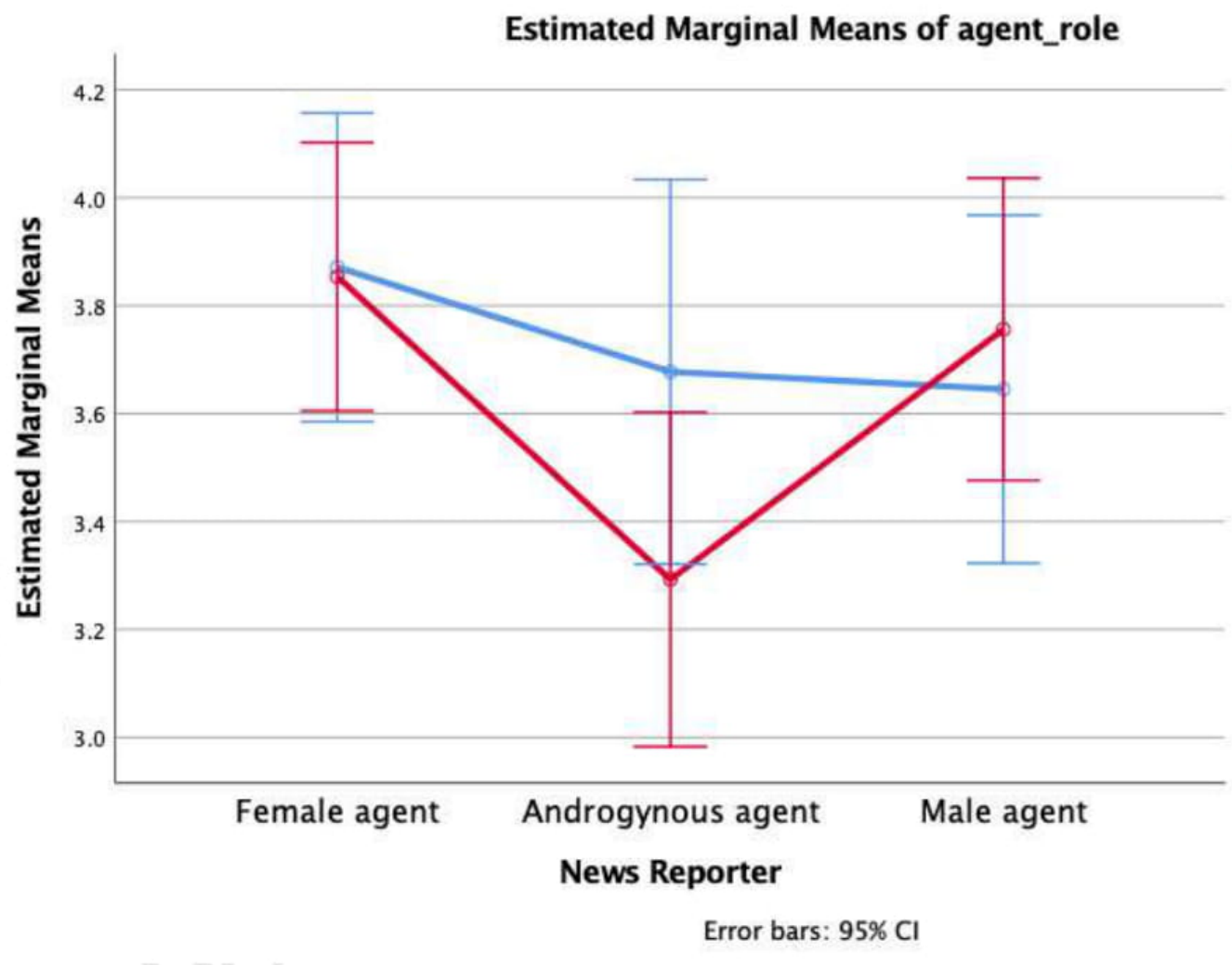✓ Significant main effect of agents' appearance on identifying the agent's gender, p<.001.

27

Results

Agents gender related appearance and its correlation with the stereotype traits score based on participant's gender.

Estimated Marginal Means of Competence
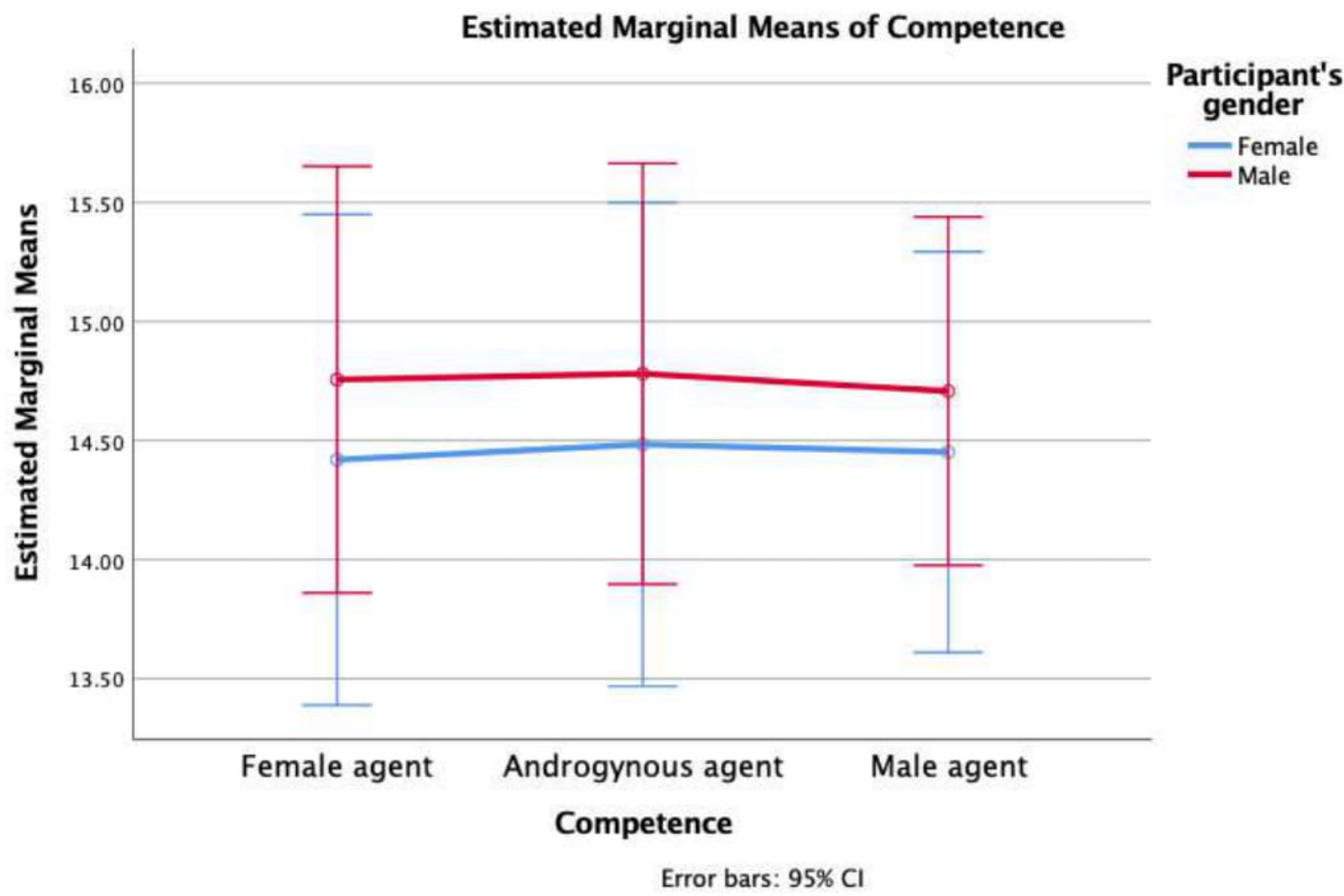
✓ No significant main effect of agent's appearance, participant's gender on **competence** scores and interaction between agent's appearance and participant's gender, p>.05 (H3 holds)
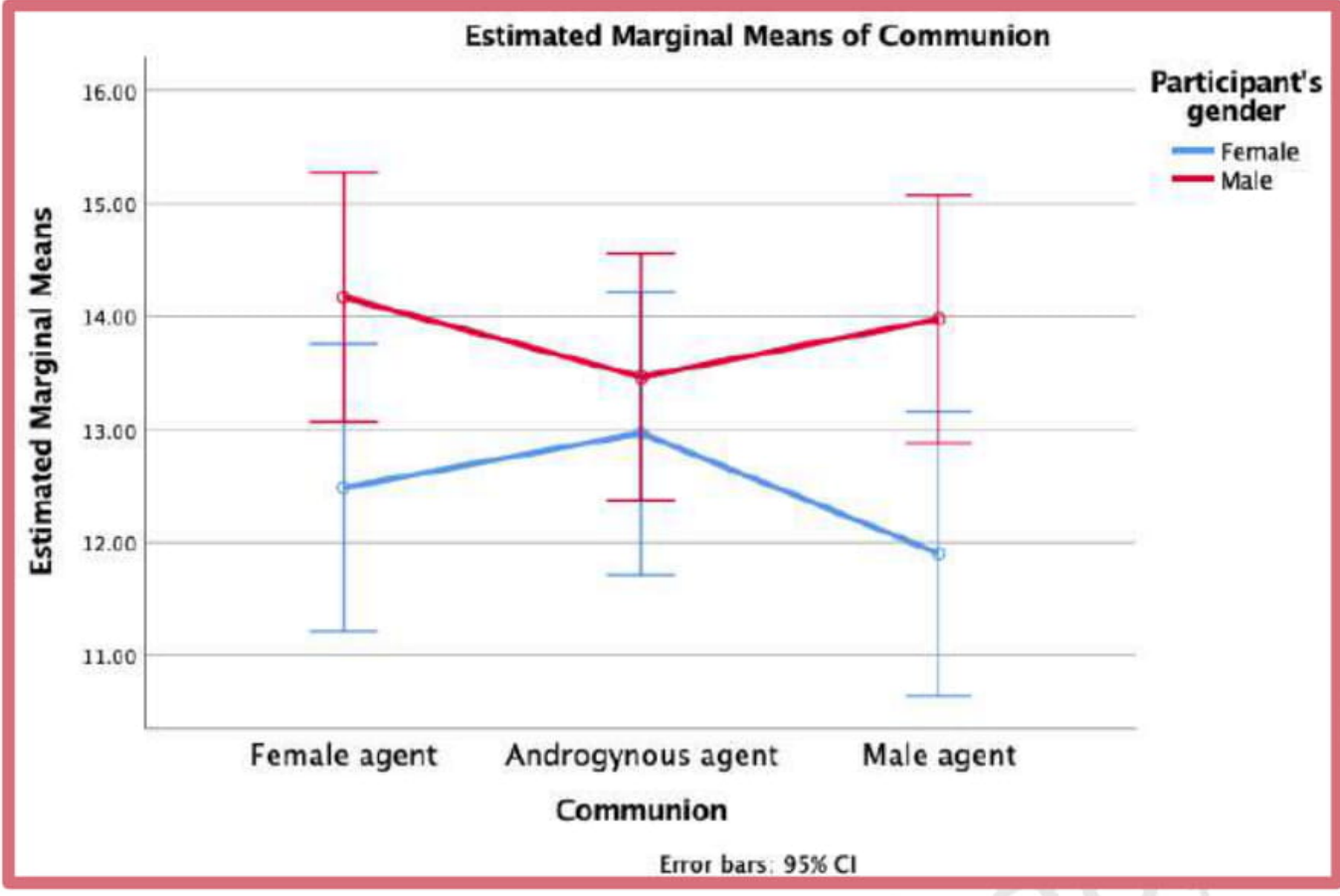
28

Results

Agents gender related appearance and its correlation with the stereotype role score based on participant's gender.
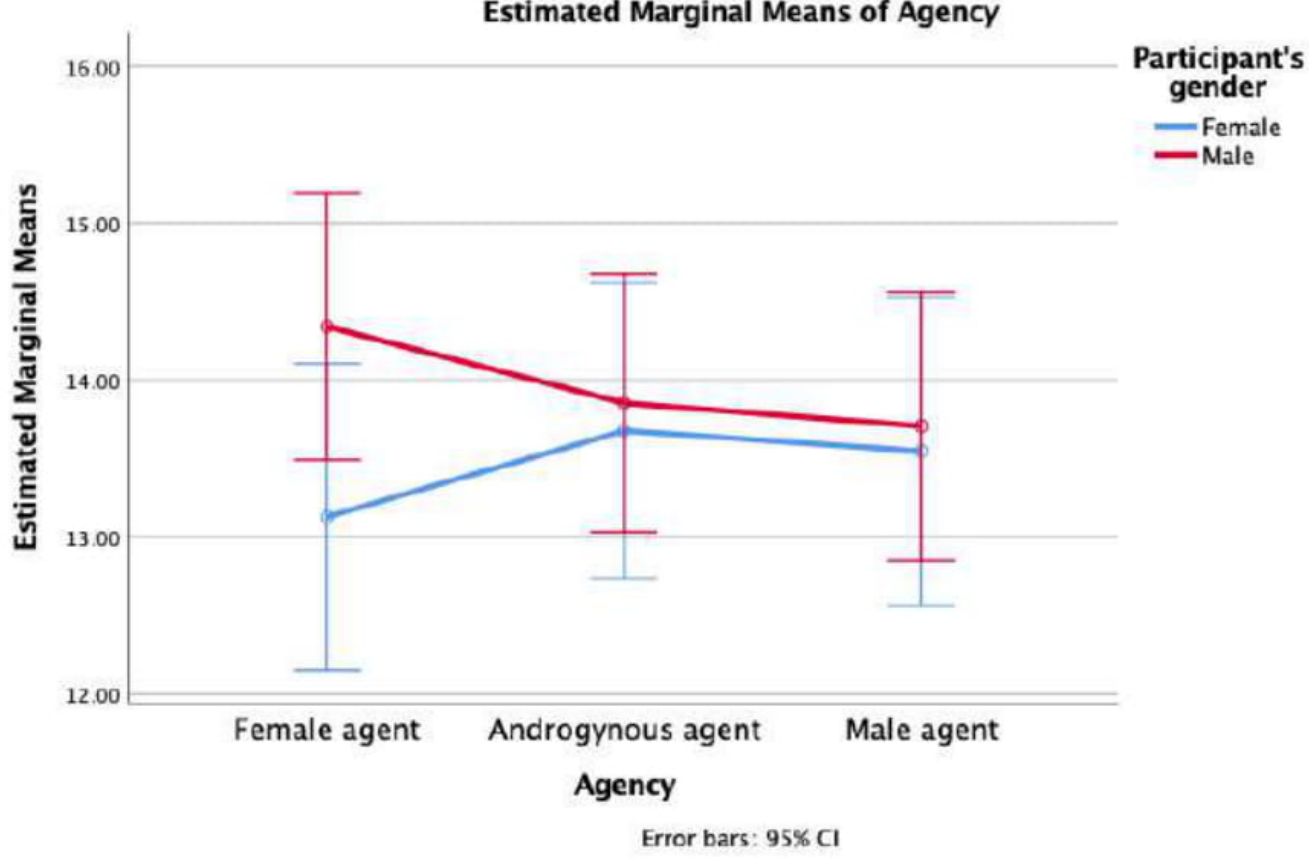

Estimated Marginal Means of agent_role

✓ Significant main effect of agents' appearance on news reporter role scores, p<.05

30

Results

Agents gender related appearance and its correlation with the stereotype traits score based on participant's gender.

Estimated Marginal Means of Communion | Estimated Marginal Means of Agency
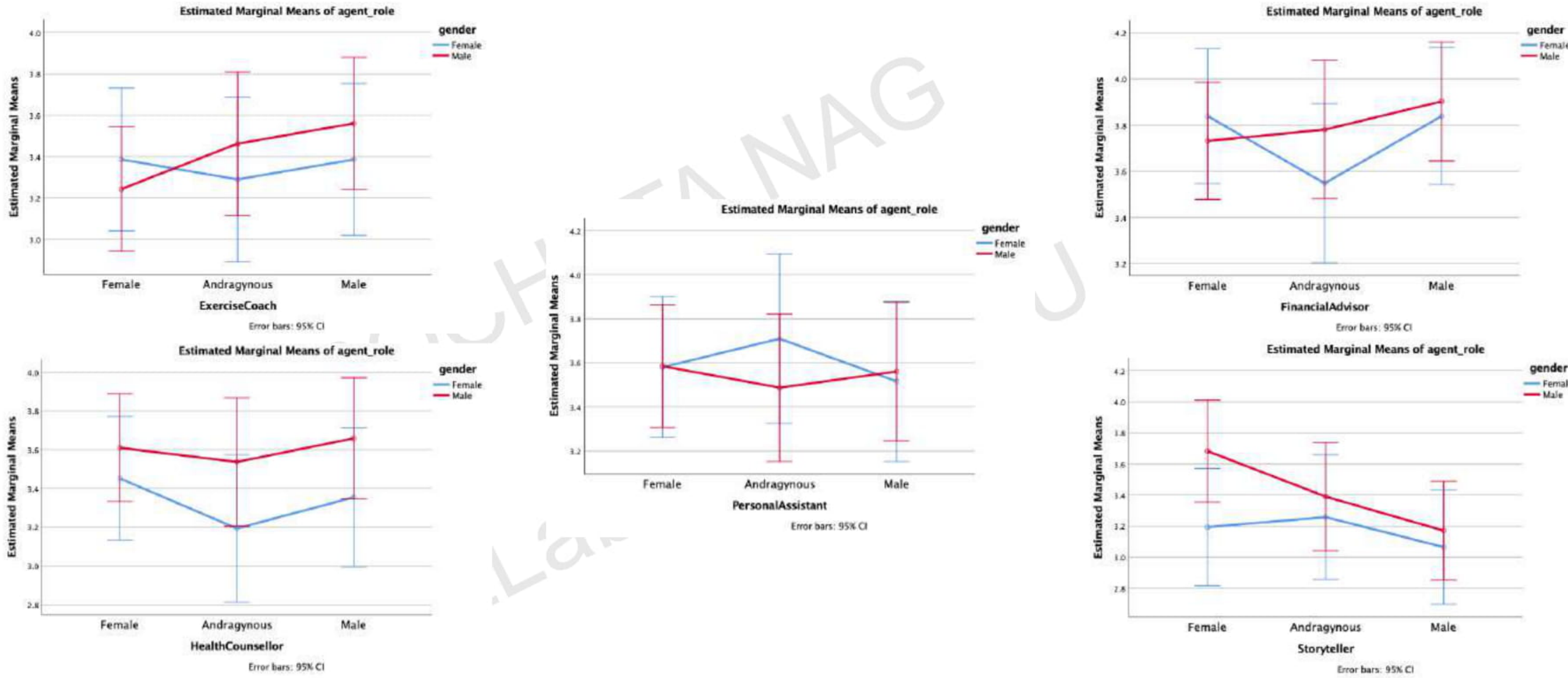
Significant interaction between agents' gender and gender of the participants for **communion** scores, p<.05

No significant main effect of agents' appearance, participant's gender on **agency** and **communion** scores, p>.05 (H1 and H2 rejects)

29

Results

Evaluated the gendered appearance of agents based of stereotype roles

Agents gender related appearance and its correlation with the gender score based on participant's gender.

31

Discussion

Findings of study 3

Discussion #1
Representative of male, female and androgynous agents with minimal differences.

Discussion #2
Androgynous agents could be used to achieve a middle ground of the male and female gender.

Discussion #3
Gender-balanced view of agency, communion, competence traits.

Discussion #4
Roles could be used interchangeably, even with androgynous agents

32